

**AN ASSESSMENT OF LIVELIHOOD DEPENDENCY AND
ANTHROPOGENIC PRESSURES ON THE TIGER HABITAT IN
KALAKAD – MUNDANTHURAI TIGER RESERVE, INDIA**

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I have great pleasure in forwarding the thesis of Shri Santanu Gupta titled "*An assessment of livelihood dependency and anthropogenic pressures on the tiger habitat in Kalakad-Mundanthurai tiger reserve, India*" for acceptance for the degree of **Doctor of Philosophy in Wildlife Science**. The thesis embodies original findings and interpretation of facts. This research was carried out by Shri Gupta under my supervision and has not been submitted in part or full to any other University/Institution for the award of any degree.

(B. K. Mishra)
Guiding Teacher

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ABSTRACT

Introduction

Kalakad – Mundanthurai Tiger Reserve (KMTR) ($8^{\circ} 20'$ - $8^{\circ} 53'$ N and $77^{\circ}10'$ - $77^{\circ} 35'$ E) located at the southern end of Western Ghats is famous worldwide for its endemic plant diversity, and the reserve is home of endangered animals like lion-tailed macaque (*Macaca Silenus*), Nilgiri tahr (*Hemitragus hylocrius*), Asian elephant (*Elephas maximus*), and tiger (*Panthera tigris*). KMTR experienced high anthropogenic pressure in past from 145 villages situated outside eastern boundary of reserve as well as from enclave settlements. According to forest department's estimate, 3215 fuel wood extractors visited park day⁻¹ and 22100 livestock freely grazed within PA from fringe villages before ecodevelopment. This had created a completely degraded habitat for wildlife in the periphery of the reserve, and gradually inner areas also started getting affected by cutting and grazing pressure. When KMTR management tried to implement the policy of 'strict protection' in past, it resulted in great hostility between them and the local population as poor people's daily living depended on PA resource extraction and selling. Due to failure in pure 'protectionist' approach, KMTR management decided to introduce ecodevelopment as the way of reducing people's livelihood dependency on Tiger Reserve, which eventually would reduce human pressure on park.

Ecodevelopment in KMTR became functional from 1997. A number of activities aimed at conservation awareness among various stakeholders, off-farm alternate employment generation opportunities for forest dependent families, promoting use of alternate fuels and energy saving devices, and biomass regeneration initiatives were taken up under this project. Implementation of these activities was through formation of local institutions called Village Forest Committees (VFCs) and capacity building programmes of various partners. The baseline information on the type, degree and extent of biotic pressure, and resource dependency of local people at the beginning of the project was quantified by Gupta and Mishra (1999) under the FREEP KMTR research project. It was required to test whether the inputs of eco-development project had actually contributed in reducing the anthropogenic pressure on KMTR, which was not much done before in similar other projects, whether in India or in other countries. Status of resource dependency and biotic pressure on KMTR was again quantified during 2004-05 after 98-99 baseline survey, and then finally repeated in 2010-11 to track changes in dependency and human pressure on KMTR during middle (04-05) and last phase (10-11) of eco-development. By this, the changes in resource dependency and human pressure on PA were measured during a decade of eco-development implementations in KMTR. Status of biotic pressure near PA boundary and enclave settlements of Kani tribes and Electricity Boards Employees housings in plateau were compared in 10-11, and the biotic pressure around interior settlements was found higher than forests near boundary of the park.

A total of 11 sample VFCs were identified to study various socio-economic parameters, resource dependency pattern at village level, and impact of ecodevelopment activities in terms of i) level of participation ii) change in non-forest based occupation, iii) annual income of beneficiaries, iv) use of alternate fuels, v) adoption of fuel saving devices, vi) conservation awareness of local people, and vii) attitude of people towards PA conservation. All the driving factors of change with respect to PA resource dependency and biotic pressure were analyzed in 11 sample VFCs. For the first time, the impact of ecodevelopment in reducing PA resource dependency and consequent reduction of anthropogenic pressure on park was thoroughly analyzed by integrating ecological and socio-economic assessment. This overall assessment of dependency and pressure on KMTR during ecodevelopment could serve as a feedback mechanism to promote better integration of conservation and development in future. Overall learnings from this study can be effectively used for necessary policy framing and process adjustments in projects dealing with similar type of conservation problems. Therefore, the present study which is a multi-disciplinary one, was undertaken with the following objectives:

Objectives

1. To quantify the change in dependency of local communities upon PA resources.
2. To assess the change in anthropogenic pressures on the PA resources.
3. To examine the drivers of change with respect to dependency and pressures.

Findings of Change in Resource Dependency and Anthropogenic Pressure

Percentage of fuel wood head loaders visiting KMTR decreased significantly between 98-99 and 10-11, the ten years period when ecodevelopment implemented in Tiger Reserve. 41% decrease ($P < 0.05$) in most forest dependent 'red group' families also took place between 98-99 and 10-11 in 11 Village Forest Committees (VFCs) sampled to track socio-economic changes during this period. 76% increase in family income was observed in sample villages between 98-99 and 10-11, and 73% of families felt that their monthly income had increased in the last decade due to support from Alternative Income Generation (AIG) program of ecodevelopment. But, the major decrease in percentage of fuel wood head loaders in PA took place in the initial phase of ecodevelopment (98-99 and 04-05), and the decrease (only 3.4%) was far too less in later stage (04-05 and 10-11) when World Bank officially withdrawn assistance.

Successful functioning of 837 women Self Help Groups (SHGs) in KMTR Ecodevelopment till 2012 with 96% rate of loan recovery helped to reduce comparatively more number of female FW head loaders (decreased from 44% in 98-99 to 23% in 10-11) than the male counterparts (increased from 56% of head loaders in 98-99 to 77% of head loaders in 10-11). Recently the demand for forest fuel wood enhanced in forests near Agasthiyar falls located in foothills of KMTR due to uncontrolled tourism.

Significant percentage decrease (31%, $p < 0.05$) in cattle entry within PA happened during initial stage (98-99 to 04-05) of ecodevelopment, but significant percentage decrease of goat entry within park happened both in initial and final stage of ecodevelopment.

There was slight decrease (6%) in cutting pressure near eastern boundary of KMTR between 98-99 and 10 – 11 when ecodevelopment was implemented in the fringe villages. But on the other hand, there was statistically significant increase (21%, Wilcoxon sig. 0.034, and paired t sig. 0.000) of unpalatable weed species within Tiger Reserve indicative of browsing pressure due to entry of free grazing cattle.

The preferable girth classes (20 – 60 cm GBH) for cut trees in KMTR both during 98-99 and 10-11 indicated community preference for fire wood. 10% preferred cut height between 1.37 m to 3.5 m in the recent transect survey of 10 – 11 indicated villagers' recent preference towards lopped fodder.

Though considerably decreased (41%) in comparison to 98-99 (67% demand met from KMTR), still 26% of fuel wood demand of fringe villages were met from KMTR during 10-11.

Interestingly, during 10-11 study, human pressure around enclave settlements within park was found slightly higher than boundary forests in terms of wood cutting, canopy opening and density of seedlings.

Findings of Driving Factors of Change

Overall interest and initial enthusiasm towards ecodevelopment decreased within male and female members after 2004-05 as most of them failed to get established in new microenterprises due to lack of technical training and marketing skills. Male members felt left out from program design as most of the skill trainings organized by VFCs were women centric, and they continued their old forest extraction activities in the later stage (04-05 to 10-11) ecodevelopment in higher proportion. It was observed that due to lack of periodical monitoring in VFCs, many members utilized loans in purposes which had no conservation linkage, or sometimes even in forest destructive acts. The PA ecosystem was suffering from cutting pressure in 10-11, because still there was high consumption of fuel wood in surrounding villages. KMTR ecodevelopment provided alternative livelihood to fuel wood extractors to refrain them from forest extraction, but done very little towards reducing daily fuel wood consumption of families, or growing fuel wood species in village surrounding outside park. Most of the forest staffs assigned special responsibilities in ecodevelopment implementations were acknowledged the importance of community participation in biodiversity conservation, but territorial staffs were unable to recognize the role of community in PA conservation due to lack of community sensitization workshops for them.

Members joined late in VFCs were not aware about the conservation linkage of community development program due to lack of awareness program in last stage of ecodevelopment. But all the members acknowledged the role of ecodevelopment in improving park-people relationships.

Important Findings and Management Recommendations

1. There was significant reduction of livelihood dependency on fuel wood extraction during ecodevelopment which was established by significant percentage decrease in fuel wood head loaders in forest trails and most dependent 'red group' families in sample VFCs. But most of the decrease took place during initial stage of ecodevelopment. Along with AIG scheme, VFCs should start planting fuel wood species in fallow land of villages, and distribute fuel wood equally among families after maturity. For the time being, villagers should be encouraged to use fuel efficient chullah and solar cooker to reduce fuel wood consumption.
2. Percentage decrease was comparatively more among female head loaders as they were trained better in alternative skills suitable for them, but male members were not trained enough in vocations suitable for them. It is required to find alternatives which are locally suitable for male members, and arrangement of training program for them.
3. The grazing pressure rose again in last phase of ecodevelopment when VFCs stopped offering members to replace their scrub cattle with milking

cow through AIG scheme from 2007 onwards due to public demand of agriculture loan. Actual requirement is creation of more milk cooperatives in Taluks around KMTR with the help of dairy development board to make milk selling a sustainable business in the area.

4. Most members failed to establish themselves in alternative livelihood due to lack of technical training, product development, packaging and marketing skills. The initial decrease of forest dependent population is unsustainable at present. The members required to train properly through experts in the field for their sustenance in new enterprises.

5. Human pressure on PA habitat was found more around enclave settlements than PA boundary during 10-11 pressure study. Free grazing cattle herds originated from Electricity Board settlements within plateau damaged forest ecosystem through continuous browsing and trampling, and halted the natural regeneration of important canopy species, thereby converted plateau area in secondary forest. The pressure found higher than boundary in terms of cutting, canopy opening, and lesser density of seedlings. Kani youths should be engaged as eco-tourism related activities through ecodevelopment, and Electricity Board Employee housings should be relocated outside the park.

1

INTRODUCTION

1.1 Background

India is blessed with one of the world's most extensive network of protected areas (PAs). The country has officially recognized PAs totaling 102 National Parks (NPs), 516 Wildlife Sanctuaries, 49 Conservation Reserves and 4 Community Reserves and covering 4.9% (1,61,613 km²) of total geographical area of the country (Wildlife Institute of India Database 2015). This has helped conserving a significant part of India's biodiversity but at the same time manifested various forms of conflicts with the local communities (Mishra *et.al.* 2009). The basic approach of managing PAs till the early 90s had been the conventional isolationist approach wherein management seeks to protect the PAs from inappropriate use of natural resources by the people so as to protect wildlife and other natural resources contained in these PAs (IIED 1995). This approach has helped to conserve a significant part of India's biodiversity including a wide variety of natural habitats, plant and animal species by putting a check on destructive development processes and industrial exploitations of resources (Bhardwaj and Badola 2007). Creation of Tiger Reserves (TR) all over the country through Project Tiger (1973) has saved the endangered tiger from extinction by fostering a path of recovery.

At the same time protected areas (PAs) has engendered conflicts between the local communities traditionally dependent on the resources of these areas, and the PA management. Out of more than one billion human population of India, 64% of the rural population and around 100 million tribal people depend on the forests for their sustenance (Lynch 1992); ninety million cattle graze inside the forests (Dwivedi 1993); 62% of the total 173412 K' tons fuel wood consumption is derived from forests (RWEDP 1997). A large number of PAs in the country were characterized by human settlements and resource use. In such a situation, attempts to protect the PAs from human intervention by coercion have often resulted in open conflicts between the communities and state forest departments. This conflict become more severe when prohibition of resource use is coupled with various man-animal conflicts such as crop raiding, cattle lifting, and loss of human lives and property. 41 clashes were reported in connection with National Parks and 66 with Wildlife Sanctuaries between 1979 and 1984 (Gadgil and Guha 1992). The persistent conflicts with fringe communities in most of the PAs in India led to a growing recognition that this 'fences and fines' approach has failed to achieve its objective of conserving biodiversity.

An emerging view among conservationists is that the successful management of protected areas (PAs) must include the cooperation and support of local people. Excluding people who live adjacent to PAs from resource use without providing any alternative is increasingly viewed as politically infeasible and ethically unjustifiable. In response, projects which link the conservation of biological diversity in PAs with local social and economic

development have been implemented. While the core objective of these projects is protected area conservation, the projects aim to achieve this by promoting socioeconomic development and providing local people with non-forest alternative income sources (Brandon and Wells 1992). Worldwide these projects are termed as *Integrated Conservation-Development Projects* (ICDPs), and popular as *Ecodevelopment* in India.

1.2 Ecodevelopment in India

In the background of above-mentioned conflicts, a Task Force was set up under the Indian Board for Wildlife (IBWL) in 1982 to propose possible strategies to reduce these conflicts for better PA management. This Task Force recommended the concept of *ecodevelopment* as a measure to gain public support for the conservation of these PAs. The government of India recognized that people living near PAs bear enormous opportunity costs while deriving little tangible benefits from conservation (Mishra *et al.* 2009). This official acceptance eventually resulted in implementation of *Ecodevelopment* projects (Panwar 1992) in 40 PAs in India through a centrally sponsored scheme in early 1990s. Later with the help of externally aided projects, *ecodevelopment* programs have been initiated in few PAs in different states. Such initiatives have also been started by NGOs in smaller pockets around few PAs (Kothari *et al.* 1998).

Ecodevelopment seek to conserve biodiversity through economic development of the local communities by offering them alternative income generating opportunities to reduce forest dependence (Badola *et al.* 1998a;

Singh 1998, Badola *et al.* 2002, Badola and Bhardwaj 2000, Karlsson B.G.1999). This is a site-specific conservation friendly package of measures for rural development and sustainable use of natural resources by local people so as to strengthen the PA conservation through community participation (Panwar 1992).

The initial inputs in ecodevelopment were sporadic and fragmented rural development activities. These were low profile, based on largely inflexible annual plans. The stress was on compensating the local communities for lost access to the resources inside the PAs, mostly through alternatives. The second generation of ecodevelopment activities in India were more organized through a focus on micro planning. However, these were also based on the assumption of a direct relationship between poverty alleviation and environmental protection (Badola 1997b, 1998). It was believed that providing people with alternatives is sufficient to guarantee the conservation of natural resources for all times to come. Although some of the ecodevelopment projects focused on the 'processes' involved in community participation, empowerment of communities as partners and collaboration with other local stakeholders, it still remains inadequate and area specific in actual implementation (Baviskar 1998). The World Bank funded two ecodevelopment projects (FREEP and IEDP) in India in late 90's covering nine PA sites in nine different states. Besides these, one tiger reserve in Madhya Pradesh has practiced notable ecodevelopment with funding support from the Government of India schemes.

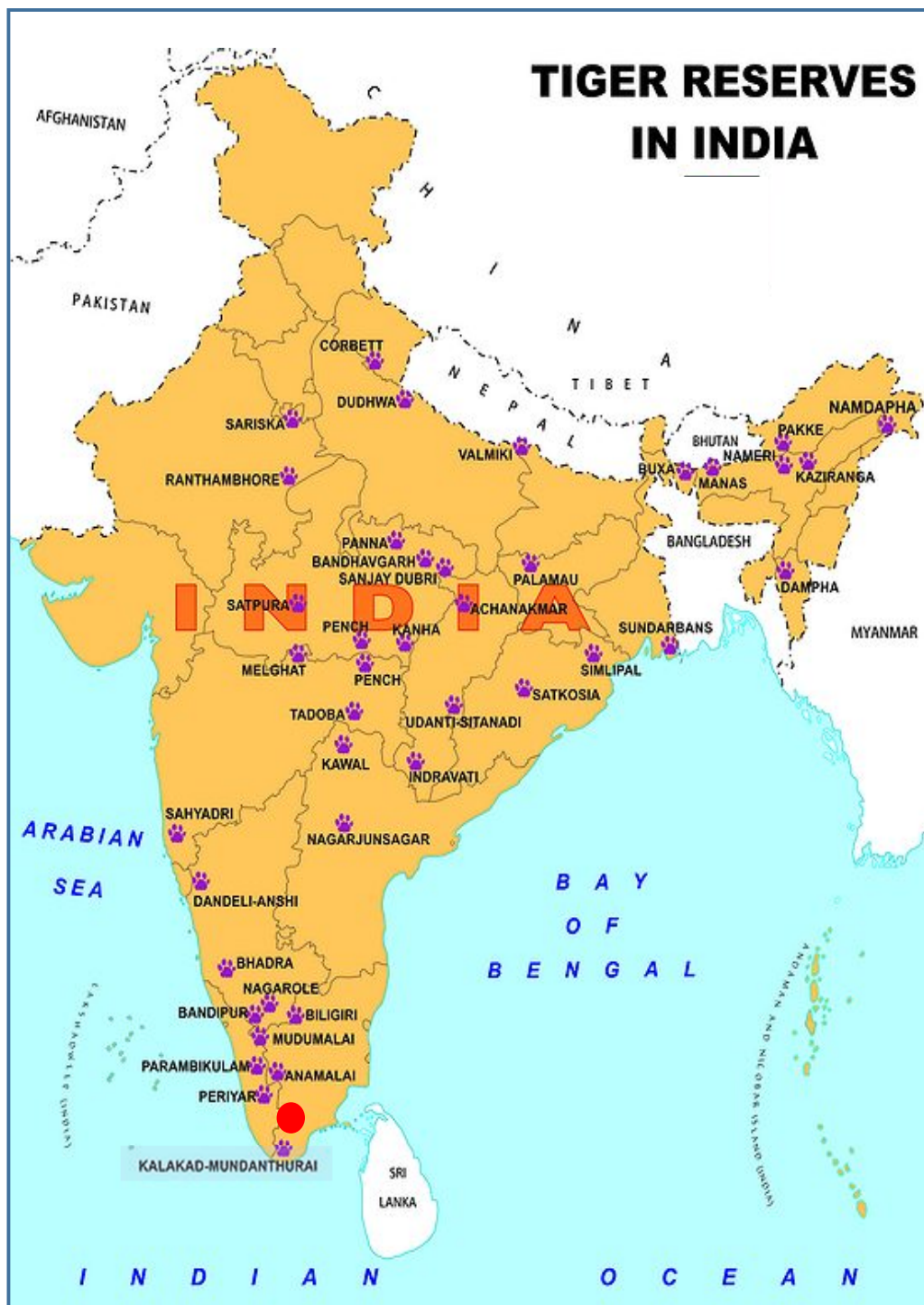
The World Bank aided Forestry Research Education and Extension Project (FREEP) was initiated in 1994 for five-year duration. In order to test participatory biodiversity conservation in India, a sub-project titled Conservation of Biodiversity (CoB) was formulated as a part of the larger FREEP project. Under the CoB, two PAs, the Great Himalayan National Park (GHNP) in north India and the Kalakad-Mundanthurai Tiger Reserve (KMTR) in south India were selected for testing the community-centered biodiversity conservation approach.

1.3 Biological and Ecological Value of Kalakad-Mundanthurai Tiger Reserve

Kalakad-Mundanthurai Tiger Reserve (KMTR) located in the southernmost tip of Tamil Nadu (Figure 1.1 and 1.2) is rich in biodiversity and known worldwide for its conservation, ecological and scenic value. Because of the occurrence of numerous streams and rivers, the reserve is called a 'River Sanctuary'. It has vegetation types ranging from thorn scrub to montane (wet) evergreen forests, all within an altitudinal range from sea level to 1866 mt. above sea level (Johnsingh 2001). As per Champion and Seth (1968) 12 major forest types could be noticed here. Of a total of 4000 species of flowering plants reported from Western Ghats, nearly 1500 species are estimated to occur in KMTR and adjacent areas (Parthasarathy 2001). Gopalan (2000) identified as many as 125 endemic species of angiosperms from this region. Part of the Agasthiarmalai hills in the upper reaches of the reserve is considered as one among the five centres of plant diversity endemism in India. The reserve is the southernmost home of Nilgiri tahr (*Hemitragus hylocrius*) and the tiger

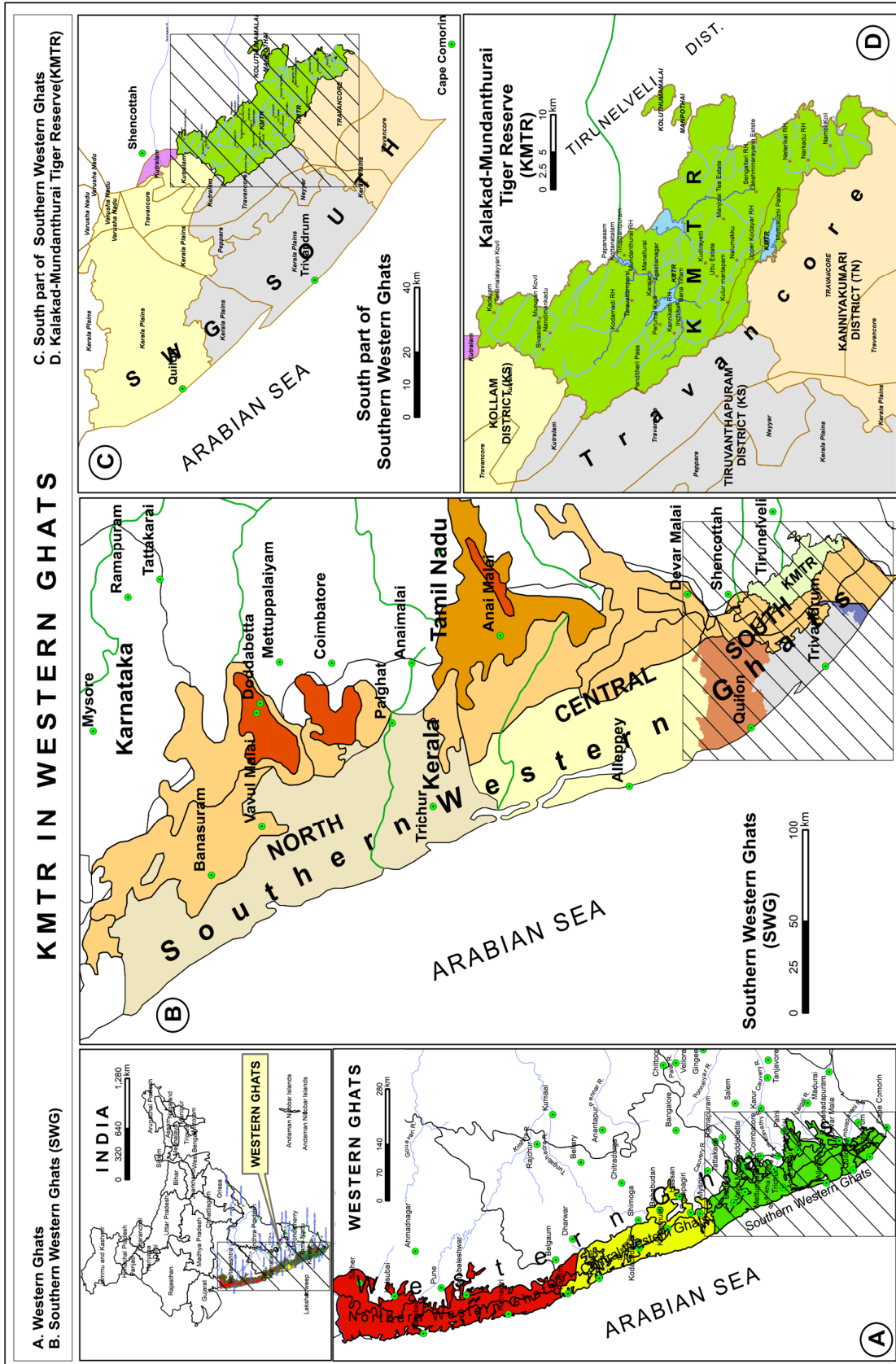
(*Panthera tigris*). It is one of the few places in South India where five primate species occur – lion-tailed macaque (*Macaca Silenus*), Nilgiri langur (*Trachypithecus johnii*), common langur (*Semnopithecus entellus*), bonnet macaque (*Macaca radiata*) and slender loris (*Loris tardigradus*). Out of these, Lion tailed macaque is an endangered species. The diverse flora of KMTR also provides habitat for Asian elephant (*Elephas maximus*), Leopard (*Panthera pardus*), dhole (*Cuon alpinus*), gaur (*Bos gaurus*), sambar (*Cervus unicolor*), cheetal (*Cervus axis*), sloth bear (*Melursus ursinus*), Indian pangolin (*Manis crassicaudata*), Indian giant squirrel (*Ratufa indica*) and Malabar grey hornbill (*Ocyceros griseus*). KMTR also has a very diverse fish (32 species, Johnsingh & Vickram 1986), butterfly and herpetofaunal assemblages. A detailed description of this area is given in Chapter 3.

Fig 1.1: Location of Kalakad-Mundanthurai Tiger Reserve in peninsular India



Source: Wildlife Protection Society of India

Fig 1.2: Kalakad-Mundanthurai Tiger Reserve in Southern Western Ghats



1.3.1 Conservation Problems in Kalakad-Mundanthurai Tiger Reserve

Conservation problems in Kalakad-Mundanthurai Tiger Reserve (KMTR) are not very different from other PAs of the country. Adjoining Mundanthurai and Kalakad Wildlife Sanctuaries were merged as a contiguous habitat for the protection of tiger and other endangered species, and declared Tiger Reserve (895 km²) in the year 1988. Biodiversity rich Mundanthurai plateau area had been subjected to licensed hunting till 1962, which resulted in decimation of tiger population. In 1962, Mundanthurai was declared as 'Tiger Sanctuary' for the protection of tiger, ten years before the launch of 'Project Tiger' by government of India. This biodiversity rich area in the southernmost part of Western Ghats had a long history of human interferences in various forms. As per the management plan record of this PA (Doraisamy 1989-90) tiger reserve was under severe threat due to inhabitation of human population, construction of hydel projects, pressure on the forests for fuel and grazing, and even movement of public buses during night hours.

Main biotic pressure exerted from the eastern side of TR where nearly 160 small and big fringe villages are situated. The village commons are either absent or in very much degraded condition. So, the poor villagers collected firewood from the tiger reserve. Their cattle grazed inside the tiger reserve. Thus the eastern sides of the reserve was mainly subjected to livestock grazing and fuel wood removal pressure. Timber-cum-fuel working coupes worked on contract basis up to 1975 in northern and central part of forest, and all the coupes were stopped after the forest division was declared as a sanctuary (Doraisamy, KMTR management plan 89-90). The pressure on PA due to fuel

wood removal increased a lot after stoppage of fuel coupes within sanctuary since 1975. According to departmental estimation nearly 3215 head loaders extracted fuel wood on a daily basis from the reserve, and another few hundred came occasionally for collection (Annamalai 2004). The practice of illegal removal of fire wood by the villagers due to livelihood dependency disturbed the wildlife habitats, and the forest was made open. Long back cattle were allowed to graze within forest on permit basis before the area was declared as Tiger Reserve. Grazing illegally without permit was also common. Before ecodevelopment nearly 22100 livestock grazed within TR from neighbouring villages (Annamalai 2004) and competed with wild herbivores for food resulting in considerable loss of wild herbivore population.

KMTR was also experiencing biotic pressure from the enclave settlements situated within it (Ali, 1998). During 1939 – 42, Upper Dam was constructed inside the forests across the main river Thambaraparani, and a vast area was submerged. For the construction of lower dam and settlements of Electricity Board Colony, labourers and contractors for the dam work were brought from outside and allowed to stay inside the forest. After completion of dam construction, some of them settled within PA by encroaching lands. Again Servalar hydel dam was constructed on river Servalar within KMTR in 1988, and extensive destruction of natural evergreen shola forest and consequent loss of wildlife took place at that time. Electricity Board settlers and illegal encroachers within KMTR have large number of cattle holding. Most of these families used fuel wood for cooking and this requirement was met from the forests of the Mundanthurai plateau. The practice of illegal removal of fire wood

by the public had disturbed the animal habitats particularly in Mundanthurai. The forests were made open and damaged. From 1914 onwards four Kani hill tribes had settled in the forests. They were brought from Kalakad region by British people to carry out plantation works and felling coupes (Doraisamy management plan 89-90). They settled within KMTR in four colonies, namely, Agasthiar Kani Kudiyiruppu, Servalar Kani Kudiyiruppu, Mylar Kani Kudiyiruppu and Injikuli Kani Kudiyiruppu. Inside the core zone, high in the mountains of rain forest at Kakachi, there are several tea estates. In past Singampatti ex-landlord leased out over 8000 hectares of forest land, situated within tiger reserve at present, to Bombay Burma Trading Corporation for raising plantation crops, tea, coffee and cardamom. The clear felling of natural forests to raise these plantations resulted in extensive damage of critical forest ecosystem in the past. About 5000 people resided within KMTR to maintain these plantations, and these labourers collected fuelwood from the surrounding forests.

Inside the tiger reserve there are religious places like Sorimuthu Ayanar temple in Mundanthurai plateau, and Nambi Koil in southern end of park boundary near Kalakad, and also tourist places namely Agasthiyar and Manimuthar waterfalls. Pilgrims and tourists visit these places throughout the year, and the quantum of local tourists visiting tiger reserve had increased manifold from 2004-05 onwards. Sorimuthu Ayanar temple is situated right in the center of the Mundanthurai plateau and attracts thousands of pilgrims during the Adi Amabassai festival. This festival is celebrated for 3 to 4 days in the last week of July, and the pilgrims cut the fuelwood for cooking purpose thereby causing lot of damage to the nearby forest.

KMTR was subjected to biotic interferences both from inside enclave settlements, as well as outside fringe villages surrounding eastern boundary. This high biotic pressure on tiger and other large carnivores' habitat, notably cutting and grazing pressure in Mundanthurai forest, which is considered as ideal habitat for tiger and leopard within TR, needs to be minimized for the survival of large carnivores in this part of Western Ghats. Destruction of forest habitat gradually pervaded deep inside the tiger reserve, as anthropogenic pressures were evident in the surrounding forests of settlements as well as in the periphery of the park. Baseline estimation during 98-99 suggested average depth of human extraction trails were 5 km interior of tiger reserve. There was urgent need to halt the habitat destruction in dry deciduous and mixed deciduous forests in periphery and plateau in order to maintain a pristine habitat for endangered lion-tailed macaque in the wet evergreen forests of KMTR in upper reaches. Any gap created due to felling within arboreal path of lion-tailed macaque may lead to rapid decline in the species population, which happened in past. There was a need to reduce livelihood dependency on park resources and subsequent human pressures in order to protect the habitat of endangered tiger and Lion-tailed macaque along with several other rare and endangered flora and fauna found in KMTR.

1.3.2 Ecodevelopment in KMTR

While poaching and timber smuggling incidents can be controlled by enforcing strict protection measures, the biotic pressure arising chiefly due to the resource dependency of the local people cannot be stopped until and unless alternatives are provided to them. Realizing this, the IDA funded FREEP KMTR Ecodevelopment Project was initiated by the KMTR management in the year 1995 to reduce the resource dependency of the local communities living inside and in the close surroundings of the reserve. A number of conservation awareness activities, off-farm alternate employment generation opportunities for forest dependent families, promoting use of alternate fuels and energy saving devices, and biomass regeneration initiatives were taken up under this project. Implementation of these activities was through formation of local institutions called Village Forest Committees (VFCs) and capacity building programmes of various partners. Initially the project was launched in three Kani settlements as well as in 113 fringe villages situated within five kilometers radial distance from the eastern boundary of the tiger reserve. World Bank funded the project from 1995-96 to 2001-02 (seven years). Thereafter KMTR eco-development activities continued due to funding support from Project Tiger, and maintenance of healthy funds in 80% of VFCs because of high repayment of alternative livelihood loans distributed mostly through Self-Help Groups (SHGs). A total of 132 VFCs were functioning by 2001 – 02. Many resource dependent villages falling outside the 5 km impact zone were incorporated as eco-development villages in the post project period, and a total of 96 VFCs were added by 2012, thus 95% (228 VFCs out of total 241) of fringe villages were covered under ongoing eco-development program in KMTR.

1.4 The Present Study

The baseline information on the type, degree and extent of biotic pressure, and resource dependency of local people at the beginning of the project was quantified by me (Gupta & Mishra 1999) under the FREEP KMTR research project, where the task to conduct ecological and socio-economic studies in KMTR was given to Wildlife Institute of India, Dehradun. In the first few years of implementation of the project, it was not possible to determine whether the inputs of ecodevelopment project have actually contributed in reducing the anthropogenic pressure on KMTR. Also, there were other possible driving forces (like change in local demography due to migration of unskilled laborers, etc.) behind change in pressure status over the years which needed to be enquired scientifically. Keeping all the options open for a scientific enquiry, data were collected during the year 2004-05 and again in 2010-11 to compare and contrast the status of resource dependency of local people and human pressure on KMTR.

1.4.1 Objectives of the Study

Thus, the broad objectives of the proposed study are:

1. To quantify the change in dependency of local communities upon PA resources.
2. To assess the change in anthropogenic pressures on the PA resources.
3. To examine the drivers of change with respect to dependency and pressures.

1.4.2 Hypothesis and Key Questions

The hypotheses likely to be tested by the proposed study are:

- *H₀: Provision of alternate income generation packages for forest dependent families, supply of alternate fuel and energy saving devices for all, and biomass regeneration effort in selected villages through the ecodevelopment project, is going to reduce resource dependency of local people upon the PA*
- *H₀: As dependency of local communities upon PA resources is going to decrease over time, people will refrain from going to the forest resulting most likely in reduction of anthropogenic pressure*
- *H₀: Intensive conservation awareness programmes in the fringe villages through ecodevelopment project is going to develop positive attitude of local folk towards PA conservation, and build up better relationship with PA staff resulting in reducing the park-people interface conflicts.*

In order to test these hypotheses, attempts have been made in the proposed study to answer the following key questions:

1. What were the livelihood dependencies (type and quantum) of local communities on KMTR resources in 98-99, then in 04-05, and what is the status in 10-11?
2. What were the type, degree and extent of anthropogenic pressure on KMTR in the year 98-99, then in 04-05, and what is the status in 10-11?
3. Is there any significant change in the anthropogenic pressures and livelihood dependency of the local communities after the implementation of ecodevelopment program?

4. What are the critical driving factors of change with respect to dependency and anthropogenic pressures?

1.4.3 Relevance of the Study

Several studies have been carried out both at national (CEE 1997, Pandey and Wells 1997, Baviskar 1998, Annamalai 2004, Melkani 2001, PEACE 2004, Mishra *et al.* 2009) and international levels (Wells *et al.* 1992, Larson *et al.* 1998, Ferraro 2001, Ferraro and Kiss 2002, Muller and Albears 2004, Skonhoft and Johannesen 2004, Bajracharya 2007, Baral *et al.* 2006) on evaluation and assessment of community based biodiversity conservation projects, but there is no comprehensive study except that of Bhardwaj and Badola (2007) that has analyzed the impacts of project inputs and the desired conservation outputs. There has not been any serious attempt to investigate whether the inputs of such projects have actually resulted in reducing the dependency and hence benefited the PAs by reducing anthropogenic pressures upon them. Hence, the present study is an attempt to fulfill this gap by understanding the linkages between conservation oriented community development programs and their desired conservation benefits.

1.5 Organization of Thesis

The whole thesis is organized in eight chapters. The introductory chapter deals with the background of the study, conservation problems in KMTR, research questions, objectives and approach of the study, and its relevance or contribution in the biodiversity conservation in protected areas of India, as well as similar tropical and sub-tropical zones of the world. Second chapter consist

of review of literatures relevant to the current study. A general description of KMTR and fringe communities, their land use pattern, livelihood, resource use, impacts on tiger reserve, man-animal conflict, and recent implementation of ecodevelopment is made in chapter three. Change in livelihood dependency of local communities on KMTR's resources over time after implementations of ecodevelopment is discussed in chapter four. Similarly, change in anthropogenic pressures on KMTR over time as a consequence of change in dependency during ecodevelopment is discussed in chapter five. An overall assessment of the impact of KMTR's ecodevelopment program in terms of institution and capacity building, financial stability, social capitals, skill development, and conservation awareness among communities are discussed in chapter six. Driving factors of change with respect to livelihood dependency and biotic pressure are thoroughly analyzed and discussed in chapter seven. At last, concluding remarks are made in chapter eight regarding change in resource dependency and human pressure on KMTR, with a scientific assessment of possible reasons of change.

2

REVIEW OF LITERATURE

2.1 Current Status of Knowledge

The negative impact of biotic pressures on forest ecosystems is extensively studied and well documented (Berkmullar *et al.* 1990, Silori 1998, Silori and Mishra 2001). While poaching and timber smuggling incidents can be controlled by enforcing strict protection measures, the biotic pressures arising chiefly due to resource dependency of the local people cannot be stopped until and unless alternatives are provided to them (IBWL 1983). This assumption resulted in pushing the concept of ecodevelopment (Panwar 1992, World Bank 1996, Singh 1997, Mishra 1999, Badola *et al.* 2002) as a viable practical solution to reduce resource dependency of local people on PAs, and thus the interface conflicts. The Government of India implemented the first set of ecodevelopment projects in 40 PAs in early 90s through a centrally sponsored scheme, and later on the second generation of ecodevelopment projects in late 90s through externally aided projects (WII 1999 a & b, World Bank 2000, World Bank 2004).

Understanding the ecology of human and livestock living adjacent to the PAs, and their interaction with wildlife and their habitat begun in India since early 80s. Berkmuller (1988) studied the dependence of local people on the resources of Rajaji National Park. In another study, Berkmuller *et al.* (1990)

assessed the distribution of human pressure within the Ranthambhore National Park and suggested simple methods of assessment of biotic pressures that can be used by the forest department. Rodgers (1990) studied feeding behavior and ecology of free ranging livestock in reserve forests on the north bank of the Narmada River, Madhya Pradesh. The problems of overgrazing, weed proliferation, and lack of tree regeneration in the Chila – Motichur corridor forest for elephant movement in Rajaji-Corbett National Parks in Northern India were discussed by Johnsingh *et.al.* (1989). Rajvanshi and Gautam (1990) studied the pole cutting pressures and their ecological impacts in Bastar forests in central India as an effort towards conducting an EIA study. The issue of illegal livestock grazing and fodder cutting in Royal Chitwan NP by local people has been examined by Sharma and Shaw (1993). Studies on evaluation of habitat status for the elephants in the corridor forests linking Rajaji and Corbett National Parks, and local people's dependency and resource use pattern on this forest was done by Badola and Mishra (1995, 1996) with a view to design compatible management strategies. Sundriyal and Sharma (1995) did a detail ecological study regarding effects of anthropogenic pressures for fodder, fuel and timber collection from a temperate forest of the Mamlay watershed in Sikkim Himalaya, mainly on forest structure, biomass and tree regeneration. Species richness, turnover, cut height classes and disappearance of certain species due to high level of extraction were reported during ecological status comparison between low and highly disturbed sites in the evergreen forest tract of the district of Uttara Kannada in South India by Daniels and Gadgil (1995). Silori (2000) studied the status and distribution of anthropogenic pressure in the buffer zone of Nanda Devi Biosphere Reserve in western Himalaya. In another study, Silori

and Mishra (2001) studied pressure and dependency of local people on the natural resources of Mudumalai Wildlife Sanctuary and suggested compatible ecodevelopment activities in fringe villages of the crucial elephant corridor. This study analyzed the fodder requirement of village cattle and availability in the surrounding forests, and recommended to replace two-third of the scrub cattle with few high milk yielding good breeds of cattle through ecodevelopment programs which was later followed by the Tamil Nadu Forest Department in partnerships with the local NGOs.

Several other studies regarding impact of fuel wood, fodder, non-timber forest product extraction and livestock grazing on Indian forests were done in late 90's onwards. Dixit and Rajvanshi (1998) studied patterns of wood removal from dry deciduous reserve forests in Narmada Basin in Central India, and the impact of extraction on future growth of forests, specially Teak (*Tectona grandis*). A quantitative estimation of selected non-timber forest products gathered by the indigenous people in the Biligiri Rangaswamy Temple (BRT) sanctuary in Karnataka, and the effect of extraction on forest structure and composition were analyzed by Shankar *et al.* (1998). In the same paper, Shankar *et al.* (1998) showed the difference in demand and supply of fuel wood in and around the same Biligiri Rangaswamy Temple (BRT) Sanctuary, and discussed management options to meet energy requirement. Samant and Dhar (2000) quantified the species-wise extraction of fuel wood from a site (Gori Ganga Valley) in Askot Wildlife Sanctuary in the Kumaun Himalaya. Chhettri and Sharma (2002) studied impact of firewood extraction on tree structure, regeneration and woody biomass productivity in a trekking corridor of the

Sikkim Himalaya. Kumar and Shahabuddin (2005) investigated the effects of biomass extraction on forest vegetation composition, diversity and structure in Sariska Tiger Reserve in northern India. The impact of resource extraction on dry deciduous forests adjoining the eastern boundary of Kalakad-Mundanthurai Tiger Reserve (KMTR) were analyzed, and compared with the vegetation structure, diversity, basal area and regeneration status of undisturbed sites by Arjunan, M. (2005). Though as per field experience in the same PA, it can be mentioned that there is no such undisturbed site existing near eastern boundary of KMTR, if not artificially fenced and protected from cutting, lopping and grazing for a definite period. Samant *et al.* (2006) used a new approach to examine extraction trends of fodder species in a botanical hot spot (Gori Valley) of Askot Wildlife Sanctuary in Kumaun Himalaya. Davidar and Arjunan (2007) assessed collection intensity of forest products in three different regions of Western Ghats placed under different levels of protections, and the impact of collections on forest. In another paper, Davidar and Sahoo (2010) tested the association of extraction pressure on Indian forests with proportion of agricultural households, wage labour and population density of the area.

Some of the above mentioned studies quantified natural resource extraction from the park, and many looked into the ecological impacts of anthropogenic pressures, like on species diversity, biomass, pattern of species regeneration, community compositions etc. Other than the study of Berkmullar *et al.* (1990) and Silori and Mishra (2001), rest of them actually developed valuable baseline data in the mentioned aspects which are useful for further ecological monitoring to track changes in forest communities. In most of the

cases researchers did not make any specific management recommendations to reduce existing human pressure on PA. Only Berkmuller *et al.* (1990) designed simple methods to assess biotic pressure on park surrounded by fringe villages which can be performed by the forest staff, and Silori & Mishra (2001) suggested ecodevelopment to reduce number of scrub cattle in the villages located on crucial elephant corridors of Mudumalai Wildlife Sanctuary in Tamil Nadu.

Integrated Conservation and Development Project or Program (ICDP) have been defined as “ an approach to the management and conservation of natural resources in areas of significant biodiversity value that aims to reconcile the biodiversity conservation and socio-economic development interests of multiple stakeholders at local, regional, national and international levels. McNeely (1988) talked about developing and using economic incentives to promote conservation of biological resources at the community level in late 80's. Brandon and Wells (1992) first used the term 'Integrated conservation-development projects' (ICDPs) for such initiatives that aim to reconcile the management of protected areas (PAs) with the social and economic needs of the local people. Based on experiences of 23 such projects in Africa, Asia and Latin America, vital elements in the design of ICDPs were identified, and the effectiveness of field experience was assessed by them. Brandon and Wells (1992) in their seminal paper discussed about the common critical factors for a successful ICDP performance. They also discussed issues like identification of real threat factor for the PA before implementations of project, appropriate incentives for the resource dependents and conservation linkages of the same,

meaningful involvement of local communities in design and implementations of the project, merging of biodiversity conservation objective with the ecological benefit local communities receive due to the existence of park, and determining scale of implementations based on project need and resources available for the project functioning. Wells (1995) briefly reviewed the performance and prospects of ICDPs trying to translate concepts of biodiversity conservation and sustainable economic development into effective on-the-ground activities in developing countries. Possible shortcomings of the benefits sharing components of Integrated Conservation and Development Projects (ICDPs) have also been discussed by Barrett and Arcese (1995). In reference to the protection of large African mammals, Barrett and Arcese considered ICDPs better than total bio centric conservation projects or only anthropocentric rural development projects, but at the same time they were critical about the conceptual flaws of such projects which might limit their future sustainability. In another paper, Wells and McShane (2004) tried to find out the best possible ways of involving local stakeholders in the PA conservation and sustainable use of biodiversity resources. Spiteri and Nepal (2006) provided an overview of the problems associated with incentive based conservation approaches in developing countries. They suggested improvements in accurate identification of 'target' beneficiaries, greater inclusion of marginal communities, and efforts to enhance community aptitudes. Spiteri and Nepal (2008) pointed out the inability of incentive-based programme (IBP) in Chitwan National Park (CNB) to distribute the benefits equally among villages located in the buffer zone of the park. Baral and Stern (2006) assessed the performance of five Conservation Area Management Committees (CAMCs) in the Annapurna

Conservation Area (ACA) in Nepal. They found that the ICDP was associated more with conservation activities than development activities with passage of time, and gradually building-up interests in conservation amongst local communities. But it took nearly a decade for the change to happen, suggesting that sufficient time is required to influence behavioral changes in target population. Bajracharya *et al.* (2007) assessed and analyzed the same project in Nepal, and discussed about its social, economic and conservation benefit to PA management, along with the observation that the program was unable to meet the expectation of poor and marginalized, and maximum economic benefits including eco-tourism went to local elites. Spiteri and Nepal (2008) also had similar view that project benefits of Annapurna Conservation Area (ACA) were not effectively targeted to resource dependent communities. Baral *et al.* (2006) analyzed the structural and process changes that took place in conservation institutions in ACA over time.

As such ICDPs have managed to attract the lion's share of the funding for biodiversity worldwide. But so far the results have not been very encouraging. Analysis of ICDPs revealed that these projects were experiencing many difficulties in meeting either their conservation or development objectives (Brandon and Wells, 1992). After more than one decade of implementations worldwide in various names and forms, the performances of ICDPs are not so positive. For example, just five out of 36 ICDPs reviewed by Kremen *et al.* (1995) were able to show a positive relationship between development efforts and conservation of endangered biological resources. The researches were mainly restricted to discussions on ICDP concepts, economic strategies,

institutional policies, target group of beneficiaries, equity, community empowerment and attitudes when analyzing ICDPs in various parts of the world; no attempt was made to analyze whether on-field local community development initiatives had actually reduced human pressure on forest or not.

Few biologists and conservationists are critical about the ICDP concept and feel that “win-win solutions” like ICDPs do not exist (Redford 1991, 92, 2003 Redford and Sanderson; Terborgh 1999). They believe the sole objective of PAs created all over the world is conservation, and in any situation cannot be expected to satisfy the economic development goals. Ecologists like John Terborgh (1999) had the opinion that protecting biodiversity is fundamentally incompatible with economic development of any kind. Recently Redford advocated simple reformulation of ICDP formula, labelling some as “conservation projects with development” and others as “development projects with conservation” based on priorities and necessary tradeoffs.

ICDP or ecodevelopment, as it is known in India, is considered successful and sustainable if it is ultimately able to develop positive attitude towards PA conservation among local folk. The basic assumption is such that the overall economic development through ecodevelopment in the fringe villages will reduce forest resource dependency of poor families which eventually compensate their losses due to lack of access to PA resources. This will improve relationship between local communities and forest department. Higher economic return from adopted non-forest based alternatives, environmental awareness programmes for the communities, and development of mutual trust

gradually will create conservation-friendly attitude within local communities. A good number of studies dealt with fringe community conservation attitudes in last two decades to test the above hypothesis. Some of them are discussed below.

Badola (1998) found that local people supported the idea of conservation of corridors linking Rajaji and Corbett National Park in north India. Simultaneously, it was revealed that the dependency on forest was due to lack of alternatives, inability to produce alternatives from market, and in some cases 'habitual' or 'traditional'. Some people opposed the idea of conservation as they were dejected by damage from wildlife and forest department's inaction towards it. Mehta and Heinen (2001) explored whether local people attitude towards conservation improved in Annapurna and Makalu – Barun Conservation Areas in Nepal, which have largely adapted a community Biodiversity Conservation approach in management. They found that majority of local people held favourable attitude towards conservation and concluded that participation in training, benefit from tourism, wildlife depredation issues, ethnicity, gender, and level of education were the significant predictors of local attitudes. Arjunan *et al.* (2006) concluded that providing benefits through on-going ecodevelopment in Kalakad-Mundanthurai Tiger Reserve (KMTR), Tamil Nadu, did not have any impact on underlying attitudes of the surrounding village communities. Gubbi *et.al.* (2008) assessed Periyar Tiger Reserve ecodevelopment project, and had the opinion that benefits through ED did not influence villagers' attitudes towards PA conservation. Instead, previous experience of human-wildlife conflict, respondents' age and their participation

in ecotourism influenced conservation attitude. On the other hand, Mariki (2013) analyzed participatory approach in a national park in Tanzania, Africa, and concluded that meaningful local participation and equitable sharing of park's benefits with the people would create positive attitude towards conservation. Baral and Heinen (2007) studied two PAs in the western Nepal which were part of a major landscape-level conservation programme, and concluded that the liberalization of PA management has enabled the use of resources, improved livelihoods and solicited more favourable conservation attitudes.

Results of the above representative studies revealed that in some cases community attitude towards conservation became positive after receiving some incentives designed to compensate the 'cost' of conservation borne by the local communities. But many ICDPs failed to distribute the benefits equally among communities. In some cases critical factors influencing community attitudes towards conservation were age, education, livelihood dependency and experience of wildlife damage in the locality.

Integrated Conservation-Development Projects (ICDPs) are termed as 'Ecodevelopment' in India. It seeks to conserve biodiversity through economic development of the local communities and by offering alternative income generating opportunities to them to reduce forest dependence (Badola *et.al.* 1998a; Singh 1998). Ecodevelopment is a site-specific conservation friendly package of measures for rural development and sustainable use of natural resources by local people so as to strengthen the PA conservation through

community participation (Panwar 1992). From the inception, there have been several difficulties in implementing ecodevelopment projects, and studies conducted in this field of new science have drawn mixed responses. While many of the problems have been linked to the specific design or flaws in implementation (CEE 1997; Singh 1997), work by Kothari *et al.* (1989, 1997 and 2000) raised more fundamental and conceptual issues.

Rodgers (1992), Pabla *et al.* (1995) and Badola *et al.* (2002) have formulated guidelines for ecodevelopment planning around PAs. During ecodevelopment planning for Great Himalayan National Park (GHNP), Pandey and Wells (1997) suggested measures like settlement of forest rights, alternative income generations for resource dependents, benefit sharing in terms of forest products, coordinated actions with other local rural development agencies, wildlife research, and regulated ecotourism in the area under the ambit of project. Full scale pilot projects started in India from 1995-96 onwards initially for five years in nine protected areas having wide range of biological and ecological attributes. Many of these projects went through mid-term evaluation and published status report (KMTR Ecodevelopment Status Report by Annamalai 2004) which provided valuable data and information for further socio-economic monitoring.

Simultaneously action research projects were undertaken and as experiences got piled up, the understanding of the concept of ecodevelopment became clearer leading to further refinements. In Rajaji National Park, an attempt was made to bring all the stakeholders to a common platform along

with capacity building of primary stakeholders for integrated conservation and development (Bhardwaj *et al.* 2002). Likewise, the collaborative project of GOI-UNDP and West Bengal Forest Department at Jaldapara Wildlife Sanctuary was committed to conservation of biodiversity by integrating wildlife management and ecodevelopment, and remained focused on the processes and building partnership with various stakeholders (Mishra *et al.* 2003). Bhardwaj *et al.* 1999 attempted to identify the mutual impact zone of Panna National Park with the help of forest staff and local communities. Mahanty (2002) explored the role of relationships and networks between actors in conservation and development intervention, which was based on her study of India Ecodevelopment Project at Nagarhole National Park in Karnataka. She suggested to focus on negotiation and network building as a central part of the intervention process. Bajracharya *et al.* (2006) examined the socio-economic impacts of community based conservation in Annapurna Conservation Area of Nepal, and concluded that the socio-economic benefits outweigh the costs. Recently, Bhardwaj and Badola (2007) analyzed the impacts of the India Ecodevelopment Project in Periyar Tiger Reserve and critically examined the factors responsible for success and failure ecocodevelopment initiatives.

2.2 Justification of Undertaking the Work

Research in the field of ecocodevelopment is a recent phenomenon in India as well as elsewhere in the developing world, and thus, there is scarcity of information. Moreover, the hypothesis that rural development can promote conservation of biodiversity remains virtually untested. Often the linkages between development and conservation in many “integrated” programs are far

too diffuse to ensure success. Despite many unanswered questions and grey areas regarding ecodevelopment, it still considered as strongest strategy for maintaining biodiversity (Kremen *et.al.* 1995). Therefore biologists should invest substantial effort in improving the model of integrated conservation and development. A review of available literature in this new field of science suggests that except the work of Bhardwaj and Badola (2007) in Periyar Tiger Reserve, there is no research that has studied the project inputs and processes involved in this relatively new approach of conservation, and analyzed impacts of such inputs on the socio-economic and cultural well beings of the local communities thought to be having direct or indirect link with the conservation benefits of the PAs. No study has yet tried to investigate whether the inputs of such projects have actually resulted in reducing the dependency and hence anthropogenic pressure upon PAs. Hence, the present research is very significant from the point of view of filling this gap. There is an urgent need of integrated study which covers both the socioeconomic and ecological aspects for evaluation of ecodevelopment inputs, and their assumed conservation benefits. Status of resource dependency and pressure on KMTR were thus evaluated periodically in the current study at the beginning, end and post-project phase, and simultaneously socio-economic driving factors behind changes in anthropogenic pressure were thoroughly investigated. Such an evaluation will serve as a feedback mechanism to promote better integration of development inputs and desired conservation benefits. Therefore, this study will provide required scientific evidences needed to find out whether project inputs and field-applications by PA managers are in tune with the conservation of the PA.

3

STUDY AREA DESCRIPTION

3.1 Geographical Location and Boundaries

Kalakad-Mundanthurai Tiger Reserve (KMTR) is situated in Tirunelveli and Kanyakumari districts of Tamil Nadu and lies between 8° 20' and 8° 53' N latitude and 77°10' and 77 ° 35' E longitudes. The Reserve is located at the southern end of Western Ghats, and occupies the eastern slope of it. The northwest boundary of the reserve is contiguous with the forests of Peppara, Neyyar, and Sendurni Wildlife Sanctuaries, and Kulathupuzho Reserve Forest of Kerala, which is a 287.61 km long interstate boundary. The reserve is bounded by Ambasamudram and Tenkasi taluks of Tirunelveli district in the north, Ambasamudram and Nanguneri taluks of Tirunelveli district in the east, and Kanyakumari district in the south. There are 241 small and big forest dependent villages all along the 110-km long eastern boundary of KMTR, which extends from Kadaiyam to Thirukurangudi range. The Reserve comprises two adjacent Protected Areas (PAs) – the Kalakad Wildlife Sanctuary and the Mundanthurai Wildlife Sanctuary, both in Tirunelveli district, as well as part of Veerapulli and Kilamalai reserve forests in Kanyakumari district which was added to the Reserve during 1996. The total area of the Reserve is 895 km², of which 537 km² is in the core zone (Melkani 2001). Trivandrum and Madurai are the nearest airports. The nearest railway station is at Ambasamudram which is 17 km away from Mundanthurai. The Tiger Reserve is well connected with rest

of the country through Tirunelveli railway station which is 48 km away from KMTR.

3.2 Zonation

The Tiger Reserve covers most of the part of Tirunelveli hills, Agasthiarmalai proper, and Mahendragiri to the South except a small portion from Courtalam to Shenkottah pass in the North which comes under Tirunelveli Forest Division and small portion of Kanyakumari District in Tamil Nadu and part of Thiruvananthapuram District of Kerala in the South. The base map of the study area is shown in Figure 3.1.

KMTR covers seven territorial ranges- Kalakad and Thirukurangudi Ranges form part of Kalakad Sanctuary; Upper Kodaiyar Range forms part of Kanyakumari Sanctuary; Kadaiyam, Papanasam, Mundanthurai and Ambasamudram Ranges form part of Mundanthurai Sanctuary. KMTR includes four ecodevelopment ranges namely Thirukurangudi, Ambasamudram, Papanasam and Kalakad. Kadaiyam territorial range also implements ecodevelopment programmes.

Figure 3.1: Base Map of KMTR



Source: Sarkar (2005)

3.3 Topography, Geology and Soil

The area has a varying altitude from sea level to 1867 m above sea level. The topography is quite variable with steep rocky slopes in the northern and the southern part of eastern boundary of park i.e., Kadaiyam and Thirukurangudi to gentle undulating areas and plateaus near Papanasam hills. The study area comprises 3 distinct physiographic units, namely steep hilly terrain, low altitude Mundanthurai plateau and high altitude upper Kodaiyar plateau.

The geological formations in KMTR are chiefly of metamorphic origin and archaic in age represented by quartz, gneisses, granite and limestone. The area, being a part of southern Western Ghats, represents the continental block of peninsular India. Most of the exposed gneisses of this area are 2500 million years old (Wadia 1967).

The soil is yellow to reddish yellow, ferruginous sandy loam on the hill slopes and elevated grounds. The ground is rocky and the soil is hard due to excessive leaching at many areas. Small alluvial deposits are found along most of the riverbanks. The soil depth is up to 5 m along the gentle slopes and broad valley. Humus content is high in the evergreen forests, moderate in the deciduous forests with deeper soil where sporadic clay and semi-swampy conditions can be met with and low amount in the outer fringes. Soil pH ranges from 5.8 to 7 in the evergreen forests and from 5.1 to 6.8 in the semi-evergreen forests. Moisture content varies from 56.1% to 84.6% in the scrub jungles, low altitude grasslands, semi-evergreen and evergreen forests.

3.4 Climate

3.4.1 Temperature

Hot and dry climate prevail at foothills up to 350 m. above sea level during summer months reaching over 38°C. March to May is the hottest part of the year. Again it usually remains dry and hot during September. There is no winter in true sense, but climate remain pleasant in December and January. Mean daily temperature ranges between 24°C to 38°C, and 44°C as maximum (Papanasam hydel project data).

3.4.2 Wind

Strong winds prevail from March to May in the upper reaches of KMTR. South-West monsoon blows with high velocity between June and August.

3.4.3 Rainfall

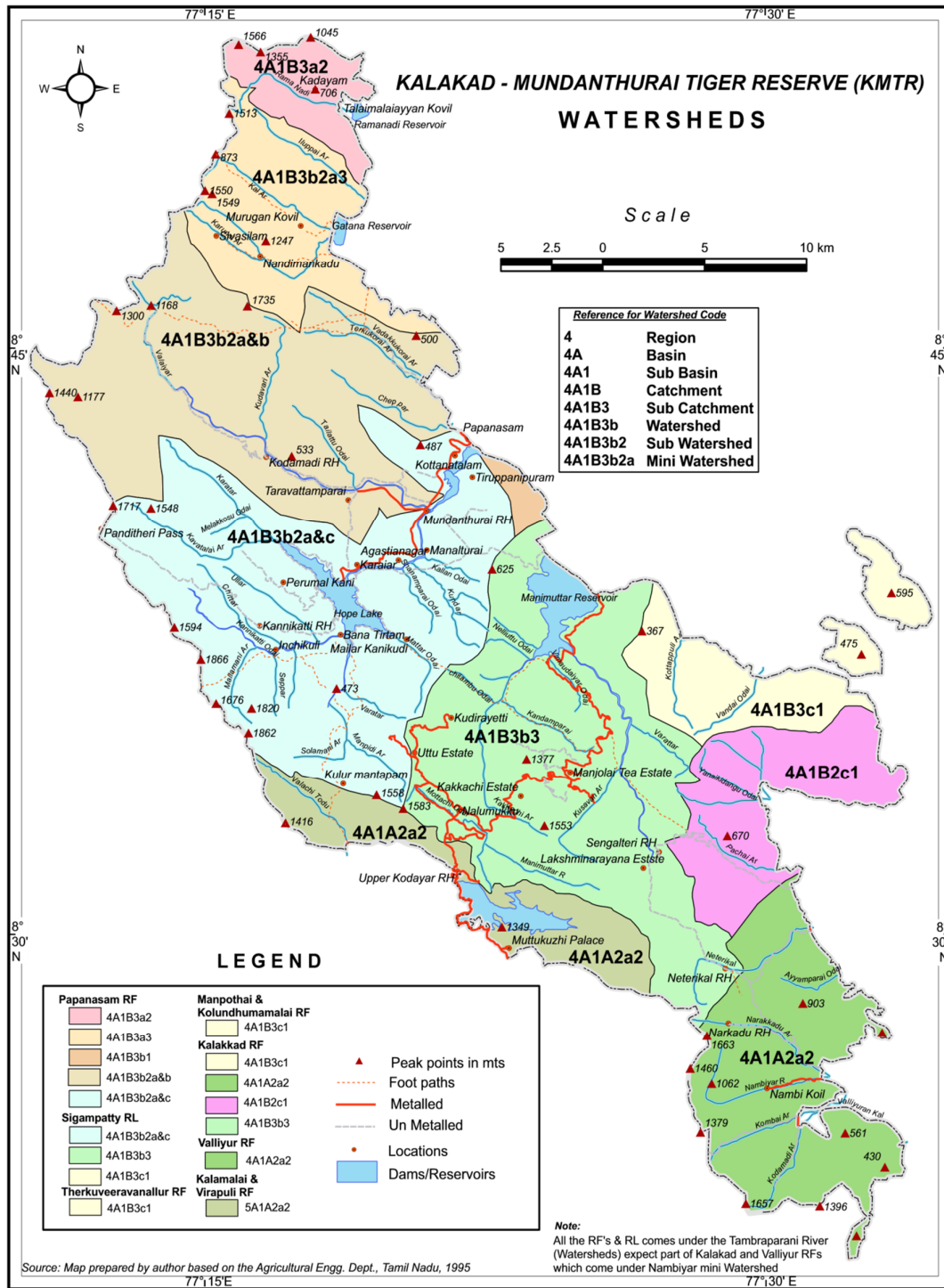
Being at the southernmost tip of the Western Ghats, some of the areas within park receive rain for almost ten months in a year. The south-west monsoon usually breaks in the first week of June in the interior Ghats and continues till August. The early break of monsoon in the catchment area of Tamiraparani accounts for the flow during July and August. The north-east monsoon has its effect from October to December. The maximum rainfall is experienced in the months of June and July. There is a drastic decline in rainfall from the Ghats to eastern foothills. Due to this buffer zones of KMTR on the eastern slope always remain relatively dry and hot. Pronounced variation in rainfall is found between Mundanthurai plateau of the park and adjacent Kodamadi forest located in higher elevation. Amount of rainfall varies drastically

from merely 750 mm in the eastern slopes to more than 3500 mm in the high ranges of western slopes.

3.5 Hydrology

Because of occurrence of numerous rivers and streams, KMTR is also known as 'river sanctuary' (Johnsingh 2001).The reserve has 3 major watershed (Figure 3.2); upper Kodaiyar, Manimuthar and Tamiraparani. The tiger reserve has 14 major rivers and several small streams coming out of it. The major among them are Tamirabarani, Servalar, Karaiyar, Ramanadi, Manimuthar, Pachayar, Kodaiyar, Kadnar and Kallar. Dams and reservoirs like Karayar, Servalar, Manimuthar, Kodaiyar, Ramanadi, and Kadanandi forms major irrigation and drinking water network of Tirunelveli, Tuticorin and parts of Kanyakumari district. Hydro-electric power stations at Servalar lower dam and Kodaiyar supplies electricity to the adjoining regions. Needless to say that the very life and survival of the people of Tirunelveli, Tuticorin and Kanyakumari districts depend on the upkeep and health of the pristine forests of the reserve which give rise to these streams and rivers (Johnsingh 2001).

Figure 3.2: Watersheds of KMTR



Source: Sarkar (2005)

3.6 Flora

KMTR has wide variety of habitats, ranging from low-elevation scrub and deciduous forests to tropical evergreen forests, *Ochlandra* forests and high elevation grasslands (Pascal 1968). As per Champion and Seth (1968) 12 major forest types could be noticed here. A total of 35% area of the park is occupied by wet evergreen forest, 32% dry deciduous, 10% scrub jungle, 8% dry evergreen, 6% plantations, and 9% mixed forest.

3.6.1 Tropical Wet Evergreen Forest

These forests occupy nearly 350 km² area in KMTR and are generally located between 850 – 1600 m above sea level. The characteristic tree species in these forests include *Aglaia elaeagniodea*, *Bischofia javanica*, *Callophyllum austroindicum*, *Canarium strictum*, *Cullenia exarillata*, *Dipterocarpus indicus*, *Elaeocarpus serratus*, *Mesua ferrea*, *Strombosia ceylanica* all attaining a height of 30-40 m. Canopy gaps and forest edges are heavily laden with woody as well as herbaceous climbers such as *Aristolochia tagala*, *Ancistrocladus heyneanus*, *Erythralium populofolium*, *Stephania wightii*, *Strychnos colubrina*, and others.

3.6.2 Tropical Semi Evergreen Forest

As described by Champion and Seth (1968) this is known as Tirunelveli dry evergreen forest. Like wet evergreen, this type also shows closed canopy but the canopy height rarely exceeds 30 m. It is restricted to few patches and occurs as transition zone between wet evergreen and dry deciduous forests. Endemic species such as *Hopea utilis*, *Hopea parviflora* occur in this vegetation

type along with other common species such as *Alstonia scholaris*, *Chukrasia tabularis*, *Dalbergia latifolia*, *Mangifera indica* etc.

3.6.3 Tropical Dry Evergreen Forest

This category forms a narrow zone between tropical wet evergreen and tropical dry deciduous but it has very distinct forest composition. It is generally found between altitudes 300 – 500 m above sea level. The canopy height of the trees ranges from 10 – 15 m and canopy cover ranges from 70 – 75%. Characteristic tree species in this type include *Albizzia amara*, *Albizzia lebbek*, *Aglaia roxburghiana*, *Terminalia bellirica* etc. *Hopea utilis* is also seen in this type of forest in pockets. This type is rich in climbers and shrubs.

3.6.4 Tropical Dry Deciduous Forest

The tropical dry deciduous forests are restricted to some parts of Mundanthurai plateau and lower parts of eastern slopes covering nearly an area of 250 km². The average canopy cover is 30 – 50%. The structure of the woody vegetation is relatively simple with only two layers i.e., the trees (approximately 8 -12 m) and shrubs (< 5 m). Tree species in this forest are *Tectona grandis*, *Anogeissus latifolia*, *Chloroxylon swietenia*, *Diospyros melanoxylon* etc. *Erythroxylon monogynum*, *Zizyphus xylopyrus* etc. are the large shrubs which at times attain tree form (up to 5 m). The open areas as well as roadside show lush growth of herbs and grasses. Weeds such as *Eupatorium odoratum*, *Lantana camara*, *Ageratum conyzoides*, *Parthenium hysterophorus*, and *Cassia tora* infest areas under heavy livestock grazing near the human settlements.

3.6.5 Riverine Forests

The riverine forests have their own significance in the reserve which exhibit characteristic species composition. *Callophyllum polyanthum*, *Syzygium cumini*, *Terminalia arjuna* are common tree species in these regions, whereas at higher altitudes species like *Garcinia gummi-gutta*, *Mesua ferrea* etc. are present.

3.6.6 Savanah – Woodlands

Pure grasslands, as seen in high ranges of Nilgiri, are not found in KMTR. However, frequently burnt slopes and hilltops are characterized by scattered woodlands and stunted shrubby vegetation dominated by grasses. At lower elevation (< 700 m), frequently burnt slopes dominated by common grasses like *Cymbopogon flexuosus*, *Imperata cylindrica*, *Themeda cymbaria* etc.

3.6.7 Plantations

KMTR has plantation areas within it like teak, *Eucalyptus*, *Bombax* and *Ailanthus* at lower elevations and tea, coffee and cardamom at higher elevation (>1000 m). Nearly 10% of the total area of KMTR falls under the plantation of timber trees while up to 5% area is under the plantation of economic species.

3.7 Fauna

The diverse habitat types of the reserve described in the preceding paragraphs provides the best grounds for an equally diverse fauna. The tiger reserve supports a large number of mammalian fauna. The threatened species

include the lion tailed macaque (*Macaca silenus*), Nilgiri langur (*Presbytis johnii*), Brown palm civet (*Paradoxurus jerdoni*), and Nilgiri tahr (*Hemitragus hylocrius*). Fifteen bird species that are endemic to Western Ghats are reported from KMTR *i.e.*, Nilgiri pipit (*Anthus nilghiriensis*), Travancore white breasted laughing thrush (*Garrulax jerdoni*), Grey headed bulbul (*Pycnonotus priocephalus*), Blue winged parakeet (*Psittacula columboides*), Nilgiri wood pigeon (*Columba elphinstonii*) and Malabar grey hornbill (*Tockus griseus*). The reserve has a very diverse fish fauna and butterfly fauna with rare species such as Spot Puffin (*Appias lalage*). Herpetofaunal assemblages is high with many endemic and rare species such as *Dasia haliana*, *Calotes andamanensis* and the black microhylid frog (*Melanobatrachus indicus*) reported by Vasudevan (1997).

3.8 The Local People and Land Use Pattern in General

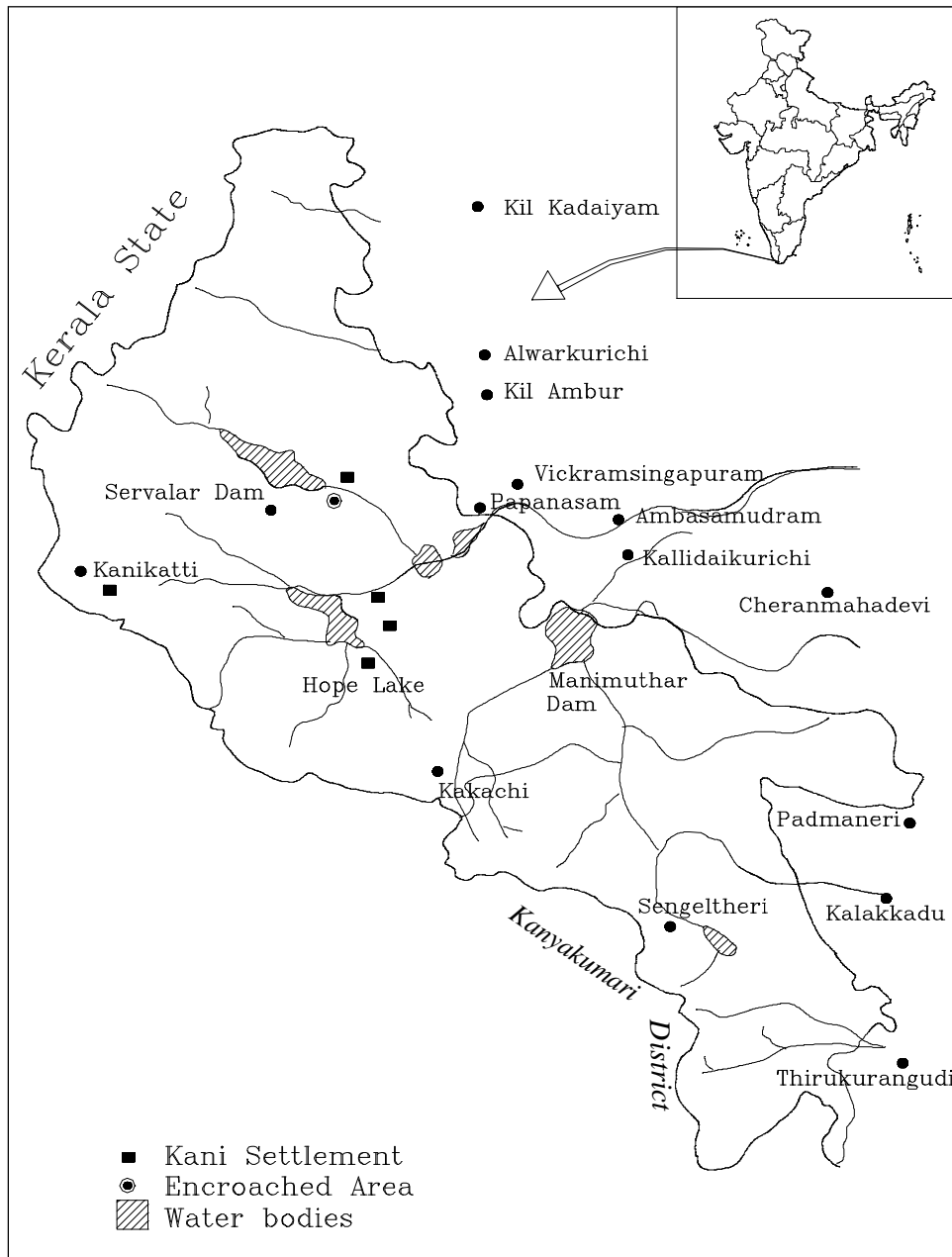
Kalakad-Mundanthurai Tiger Reserve (KMTR) experiencing biotic pressures from the villages situated outside the eastern boundary of the reserve, as well as inside settlements located in Mundanthurai plateau and upper reach tea / coffee plantations (Figure 3.3). There are 241 small and big villages all along the 110-km long eastern boundary, which extends from Kadaiyam to Thirukurangudi range. Villagers in these villages are agriculturist and are relatively poor. Most of the families belong to marginal communities like scheduled caste and other backward castes, and a high percentage among them are landless labourers. The village commons are either absent or in very much degraded condition. So, the poor villagers collect firewood from the forests of the tiger reserve for their own use or for selling in the market for a

livelihood. Their cattle graze inside the forest of the tiger reserve. Thus the eastern sides of the reserve are mainly subjected to livestock grazing and fuel wood removal pressure. According to Tamil Nadu Forest Department, an estimated 3215 head loaders felled fuel wood on a daily basis from the reserve foothills before ecodevelopment, and hundreds of others used to come occasionally for the same. Similarly, 22100 livestock from neighbouring villages used to graze within park during that time (Annamalai, R. 2004). This had created a degraded habitat for wildlife with poor cover of low quality forage.

Scattered within the 895 square kilometer area of the park, there are a number of enclave settlements of which the important one are those of the Tamil Nadu State Electricity Board establishments near the lower dam and Servalar dam on the Mundanthurai plateau. The settlements near Servalar have a large number of cattle holding. Throughout the year, these cattle graze freely in the entire Mundanthurai plateau. Majorities of the residents of these settlements are the employees of the State Electricity Board who mostly use fuelwood for cooking. Thus, their fuelwood requirement is met from the forests of the Mundanthurai plateau. Inside the core zone, high in the mountains of rain forest at Kakachi, there are several tea estates. A tea estate of Bombay Burma Trading Corporation (BBTC) occupies 3391 hectares of land on lease in Manjolai. Nearly 10,000 – 15,000 people are said to be employed in these estates. Labourer of the tea garden collects fuelwood from the surrounding forests.

In addition, a tribal community known as *Kani(s)*, numbering about 400 in 102 families and 5 different hamlets reside within tiger reserve. Kanis are from Kerala, and well known for their knowledge on wild flora and fauna. During British period they were brought to Tamil Nadu to work as labourers in tea and cardamom estates. The five settlements of Kanis inside KMTR are Injikuzhi and Periamailar in upper reaches of Ghats, and Chinnamailar, Servalar and Agasthiyar Kani Kudiyiruppu in the plateau. Kanis collect resources like wood, climbers, medicinal plants, and other NTFPs from the forest. Recently many of them were employed by KMTR management as guards and watchers.

Figure 3.3: An outline map of KMTR showing fringe villages



3.9 Positive and Negative Impacts of PA on Fringe Communities

3.9.1 Water Value of KMTR

From ecological point of view, KMTR is basically the catchment forest or watershed of the rain fed and perennial Tamiraparani river. Tamiraparani and its tributaries constantly bringing mineral rich sediments to the foothills, which forming highly fertile soil for agriculture in the fringes of PA. This river irrigates an estimated 1.5 lakhs hectares and brings drinking water to a vast hinterland including Tirunelveli and Tuticorin cities. It also generates several megawatts of hydroelectricity for southernmost districts of Tamil Nadu (Annamalai, R. 2004).

3.9.2 Wind Value of KMTR

When the monsoon breaks, strong west and south-west gales set that brings moist winds to cool the air in the reserve. South-west monsoon between June and August is accompanied with blows of high velocity winds. Indirectly forest slopes on the eastern side keep the surface temperature of the locality under control after dry summer months.

3.9.3 Man-animal Conflict in Boundary Villages

A large number of villages located very close (within 500 m) to the eastern boundary of tiger reserve, so as the farming lands of such villages. Eastern boundary forests of KMTR are highly fragmented and disturbed due to various anthropogenic activities, which have eventually led most wildlife species to become ecological dislocates over period of time and consequently stray out of PA and cause crop damage of varying degree. Many wild animals such as wild pig, elephant, sloth bear and sambar stray out to the adjoining villages' cultivation areas. Crop damage by wild pigs has become a problem of

severe nature. Incidentally problems of crop damage by wild pig and sambar in the fringe villages has increased after ecodevelopment when sign of habitat improvement near boundary is noticed. Forest department erected electric fencing on boundary to ward off wildlife from entering crop fields and orchards in selected locations during ecodevelopment, but ultimately proved ineffective in keeping animals within PA. The quantum of crop damage in the fringe villages of KMTR is very high, and spreads over all along the eastern boundary. A total of 235 crop damage incidences were recorded between 1997 -99 in 39 sample villages situated near boundary (FREEP-KMTR Project Report WII 1999). Crop damage and associated loss to poor farmers who were denied legal access to KMTR's resources after the establishment of reserve is the main reason of conflict between community and department. It ultimately resulted in a negative attitude towards conservation of wildlife among fringe communities. It was found that only 33% of the recorded crop depredation cases between 1994 and 97 were compensated by forest department, which ultimately lead to mistrust towards department (FREEP-KMTR Project Report WII 1999).

3.10 Forest Offences

A total of 2603 forest offences were booked by KMTR forest department over last ten years from 1998 to 2008, among which 91% (n = 2376) were miscellaneous with maximum fuel wood extraction offences. Besides fuel wood extraction, illegal livestock grazing was also recorded by forest department from eastern side of the park.

3.11 Implementation of Ecodevelopment

KMTR ecodevelopment was officially launched in December 1994 with World Bank assistance with an objective to reduce human pressure on park

arising from fringe villages' located near eastern boundary (Figure 3.4). To reduce the resource dependency of local people on KMTR, a three-prong programme was launched with the following components: (a) creation of alternative income generation packages which were non KMTR-biomass-dependent for the resource dependent communities, (b) introduction and propagation of the use of non-wood based fuel efficient cooking stoves, and (c) enhancement of availability of fuel and fodder in villages situated around KMTR. This project was launched in three Kani settlements as well as in 113 fringe villages situated within five kilometers radial distance from the eastern boundary of the tiger reserve. Due to satisfactory progress of the project, World Bank extended support to KMTR ecodevelopment for another two years, and the project ended in the year 2001. Later on, KMTR ecodevelopment received fund flow from Project Tiger office to continue community development activities in the fringe areas. The various initiatives implemented so far under this project till year 2012 were: a) formation of Village Forest Committees (VFCs) in 228 villages, that means 95% of buffer area villages b) preparation of micro plans in all these villages, c) creation of 940 Self-Help Groups (SHG) for alternative income generation activities, d) disbursement of loans for alternative livelihood to 30603 VFC families, e) organization of awareness campaigns, training programs (total 2281 members trained), workshops and seminars for local communities, frontline staff and local NGOs for generating awareness and motivation about the project, and f) introduction of energy conservation (to 4400 families) and biomass regeneration (10749 families benefitted) initiatives in VFCs.

Figure 3.4: Ecodevelopment villages surrounding eastern boundary of KMTR



Source: Sarkar (2005)

3.12 Intensive Study Area and Approach of Study

The present study began as a research component part of World Bank funded Ecodevelopment project in Kalakad-Mundanthurai Tiger Reserve in 1998-99. Initially the aim was to generate baseline information with respect to the type and extent of biotic pressure that was operating in the eastern side of park. KMTR suffered from anthropogenic pressure mainly from the buffer zone located near eastern boundary of the reserve where a total of 241 small and big villages were situated, with a large number of families depend on KMTR's resource for livelihood. All the human foot trails for resource extraction within 110 km stretch eastern boundary of KMTR were marked on 1: 50000 topo sheet, and 22 sample trails were monitored for resource dependency for one year (1998-99). The base camp for the study was set up in Dana village near Papanasam hills where the main entrance for Mundanthurai plateau is located. The camping place was located centrally to the park, besides having other infra-structural facilities, the village is very close to V K Puram, the nearest urban hub from KMTR. Besides resource dependency study, belt transects were laid simultaneously in six sample forest beats to quantify human pressures.

The second phase of study was conducted on resource dependency during 2004-05 to find any significant change in forest dependency of poor families after official completion of ecodevelopment project. Meanwhile KMTR ecodevelopment programme continued after formal withdrawal of World Bank, and even expanded to almost 95% fringe villages situated outside the park. During the year 2010-11 that is after about ten years of successful implementation of ecodevelopment activities in KMTR it was considered an

ideal time to take stock of the human pressure and resource dependency of local communities upon the PA. Therefore, the third phase of study was initiated in the same area and same spots to assess pressure and dependency, and to ascertain ecodevelopment input has any bearing with the changes. In this phase transects were also laid in the forest trails radiating out from enclave settlements located within tiger reserve to compare human pressure from fringe villages located outside with that of inner settlements. Species regeneration and recruitment status were also studied in selected locations within park.

The detailed study on socio-economic driving factors behind changes in dependency and pressure on park was done in last phase during 2010-11. For this eleven sample Village Forest Committees (VFCs) were selected statistically. Detailed socio-economic studies of VFC families in those villages were performed based on secondary data and information, and through personal interviews and group discussions. Studies were done on various levels of VFC organizational structure and even within forest staff. Attitudinal changes among villagers regarding tiger reserve and biodiversity were also studied. Other than the sample VFCs, overall socio-economic changes in other VFCs were also analyzed by studying secondary data like micro plan, PRA data, minutes of VFC meetings etc. Overall the study touched both ecological and socio-economic monitoring aspect to track changes. The main objective was to investigate whether ecodevelopment measures had any impact on resource dependency of local villagers, and thereby able to reduce human pressure or not.

All the ecological and socio-economic data analysis was done in MS OFFICE EXCEL 2013. Most of the statistical analyses comprising various parametric and non-parametric tests (Das, D. 2010, Mishra, B.N.1983 and Rangaswamy, R. 2010) were done in IBM SPSS STATISTICS 20 software. Detailed study methods have been dealt in the concerned chapters.

4

CHANGE IN RESOURCE DEPENDENCY

4.1 INTRODUCTION

Kalakad-Mundanthurai Tiger Reserve (KMTR) experienced severe anthropogenic pressure in the past due to resource dependency of fringe villages' located near eastern boundary of park, with 145 villages comprising of about 30,000 households and a population of about 1,80,000. The major source of livelihood for the local population depends on the cultivation of crops such as rice, bananas, sugarcane and groundnuts. About 67% of the households of the fringe villages are daily wage labourers, many of whom depend on the collection and sale of forest products for their livelihood. Villagers used to collect fuel wood, broom grasses, green leaf manure, honey, edible fruits, medicinal plants, fodder, tendu leaves, timber and woody climbers from plateau and boundary forest of KMTR. Most of them used to sell forest products in the local market for a daily living. These villages maintain about 50,000 cattle that often graze within PA territory, and cause the degradation of foothill forest in the buffer zone of KMTR (Dutt 2001). Still most of the households regardless of socio-economic status, use fuel wood as a primary source of energy for domestic needs, and maximum demand are met from the tiger reserve. According to Forest Department's own estimate, nearly 3215 head loaders extracted fuel wood from the eastern side of the park on a daily basis, and

22100 livestock grazed within park coming from neighbouring villages before initiation of ecodevelopment.

There are large numbers of resource dependent families also located within KMTR's enclave settlements. There are 5 tribal hamlets, 2 TN Electricity Board enclaves, Bombay Burma Trading Corporation, and 5 Tea Estate employee's colonies located within tiger reserve. Even some areas within PA are encroached upon by outsiders came in the area as labourers during construction of dams, and ultimately settled here. There are 5 major settlements in the tea gardens located in upper reaches of eastern slope, namely Manjolai, Kakachi, Nalamukhu, Oothu and Kudiraivetti. In these settlements there are a total of 1,107 housing units with an approximate population of 6,600 of which 1,586 are permanent workers. Most of the settlers use fuel wood for cooking which they collect from forest. Tamil Nadu Electricity Board employees keeping cattle within park, and most of the herds graze freely in Mundanthurai plateau. Around 1500 – 2000 cattle owned by Electricity Board employees used to graze in the forest. On the other hand, Kani tribals settled inside PA almost entirely have forest based life style, and they used to collect fuel wood, NTFPs, woody climbers, medicinal plants etc. almost on daily basis.

The resource dependency of large number of fringe village communities and inside settlements had resulted severe conflict between communities and KMTR management in the past when management tried to prevent the forest extraction by strict protection measures. Like many other PAs of India, the persistent conflicts of forest department with local communities over the issue

of forest dependency in KMTR has led to the understanding that this 'fences and fines' approach has failed to reduce human pressure on the forest ecosystem when the survival of local people is at stake. Therefore, to reduce anthropogenic pressure mainly arising from villages situated adjacent to eastern boundary of KMTR, and thereby improve the forest habitat, ecodevelopment project was introduced in 1994-95 with financial assistance from World Bank. One of the main objectives of the programme was to provide alternative non-forest based income to the poorest of the poor families to reduce their livelihood dependency on KMTR.

4.2 METHODOLOGY

4.2.1 Reconnaissance Survey for Biomass Extraction

In the first phase of study (98-99), a reconnaissance survey was carried out along 110 km long eastern boundary of KMTR in first four months of the study to record human foot trails, and the type and degree of anthropogenic pressure around these foot trails based on direct and indirect evidences. Direct evidences included presence of head loaders, cattle, and people engaged in hunting. Indirect evidences included weapon sharpening signs on rocks, cutting signs on trees, cattle dung, precious stone mining evidences, and presence of foot trails. The foot trails seen along the PA boundary were marked on 1: 50,000 scale topo sheet, digitized and trail density (number of trail km⁻¹ of boundary line) was determined for each forest beat on the boundary. Similarly, Kani tribal settlements, Tamil Nadu State Electricity Board Settlements, and the

encroached locality near Servalar Electricity Board Employees quarters were visited to get acquainted with the problems of anthropogenic pressure.

A rapid habitat assessment around each trail was done based on observing the forest canopy and soil erosion pattern up to a depth of 300-500 meters of forest from the boundary. Ocular observations were made to find out what percentage of forest canopy was damaged because of cutting and what type of soil erosion was prevailing in the area.

After that beat wise pressure score was calculated as an integrated measure of pressure due to canopy and forest floor damage, occurrence of number of trails, and pressure types (Sale and Berkmuller 1988). Pressure scores for canopy and forest floor damage were given in a scale of 1 to 3. The score of 1, 2 and 3 were ranked as low, medium and high pressure respectively. Canopy damage up to 10%, 11-30% and more than 30% was considered low, medium and high respectively. Prevalence of rill, sheet and gully erosion were considered as low, medium and high pressure on the forest floor respectively. Trail density was considered as an indirect measure of biotic pressure upon forest. Thus, up to 1 trail km^{-1} , 1.1 to 2 trail km^{-1} , and more than 2 trail km^{-1} was rated as high, medium and low pressure respectively. Likewise, if a forested area experienced only 1 type, 2 to 3 type, and more than 3 type of biotic pressure, it was considered experiencing low, medium, and high pressure.

The names of user villages utilizing a trail or group of trails were recorded by 'on the spot' interview of villagers and also were cross checked by

interviewing local field staff (Berkmullar *et al.* 1990). The purpose of biomass collection (own use/selling) was noted from the head loaders. The depth of affected area of the PA forest in each beat was calculated by averaging length of trails in that beat. Based on reconnaissance data, a total of 22 sample trails (Table 4.1) were identified for resource dependency study at the PA level. Identification of sample trails were done on the basis of the following criteria: (a) trail experiencing heavy influx of head loaders and cattle herds, (b) trail used by multiple villages for resource extraction, (c) trail goes deep into the tiger reserve, (d) trail experiencing extensive habitat damage on either of it's side. Likewise, 74 fringe villages were identified as villages using the resources of the KMTR forest (Gupta and Mishra 1999). Henceforth, these villages will be termed as user villages. Similar rapid assessment of resource extraction and cattle grazing were also done before initiation of intensive study in 2004-05 and 2010-11 to track visible changes in extraction pattern.

Table 4.1: Beat wise location of sample trails

| Forest Beat | Trails | Locations |
|--------------------|---------------|-----------------------------------|
| Govindaperi | 1 | Ramanadi Dam pathway |
| Shivaselam | 2 | Kadananadi pathway |
| Amboor | 3 | Muduliyarpetti pathway |
| Amboor | 4 | Alkatiparavi-Chekadimalai pathway |
| Koraiyar | 5 | Panniyar garden pathway |
| Koraiyar | 6 | Dana-Alkatiparai pathway |
| Aladiyur | 7 | Channel pathway |

| Forest Beat | Trails | Locations |
|--------------------|---------------|--|
| Aladiyur | 8 | Chettimedu pathway |
| Singampetti III | 9 | Manimuthar dam to S.M. Koil pathway |
| Singampetti II | 10 | Mathupadai |
| Singampetti I | 11 | Pottal village pathway |
| Vadagarai | 12 | Eshaki Amman Koil pathway |
| Vadagarai | 13 | Behind Padmaneri village |
| Padmaneri | 14 | Manjovilai village pathway |
| Kalakad | 15 | Shivapuram-Mungiledi village pathway |
| Malaiyadipudur | 16 | Mavadi Koil pathway (near Sathan Koil) |
| Malaiyadipudur | 17 | Chidamburapuram village pathway |
| Nambi Koil | 18 | Pallivasal pathway (near Sathan Koil) |
| Nambikovil | 19 | Nambikovil pathway |
| Valliyur | 20 | Mathaius garden pathway |
| Valliyur | 21 | Rajapudur pathway |
| Perivirisuriyan | 22 | Rosmalpuram village pathway |

4.2.2 Intensive Trail Monitoring for Biomass Extraction

4.2.2.1 Fuel Wood and NTFP Collection

All the 22 sample trails were monitored from 6 a.m. in the morning till 5 p.m. in the evening for three consecutive days in three main seasons for a period of one year. At Kalakad-Mundanthurai area rainy, winter and summer season extend from June to November, December to February, and March to May respectively. Therefore, monitoring was conducted during the mid-period

of the respective season *i.e.* August, January and April months for rainy, winter and summer seasons respectively. The same exercise was repeated in 2004-05 and continued in 2010-11 to detect the change. The monitoring team consisted of four persons which got divided into two groups of two each. While one group sat on the entry/exit point of the trail on the boundary to record various observations, the other group randomly followed the head loaders to informally interact with them for another set of observations. Care was taken by the monitoring team so that the extractors would not know that their movements and activities were being monitored.

For quantification of biomass extraction, parameters like number of male, female and children head loaders, type and number of head loads brought by them, distance traveled, name of area visited and their village etc., were recorded. While counting the number of head loads, care was also taken to record the following: (a) whether the biomass was fresh or dry, and (b) if the head load was fuel wood, the diameter class of majority of the cut wood in that bundle. The average weight of male, female and children head load for firewood, lopped fodder, thatch and broom grass were calculated based on weighing 30 samples of each type and measuring the average moisture content.

4.2.2.2 Quantification of Annual Extraction of Fuel Wood

The total annual fuel wood extracted from the entire park was calculated based on the average number of male, female and children head loads

removed trail¹ day⁻¹ in different seasons, their respective standard weight, and the total number of days in the respective season.

4.2.2.3 Livestock Grazing Pattern

For quantification of grazing pressure, number and composition of livestock herd entering the PA through each of the 22 sample trail was recorded systematically besides recording the duration of time spent by each herd, distance travelled, and area of the protected area visited as per the methods suggested by Rodgers (1990). Care was also taken to find out the herd origin (name of the village).

4.2.3 Level of Forest Protection

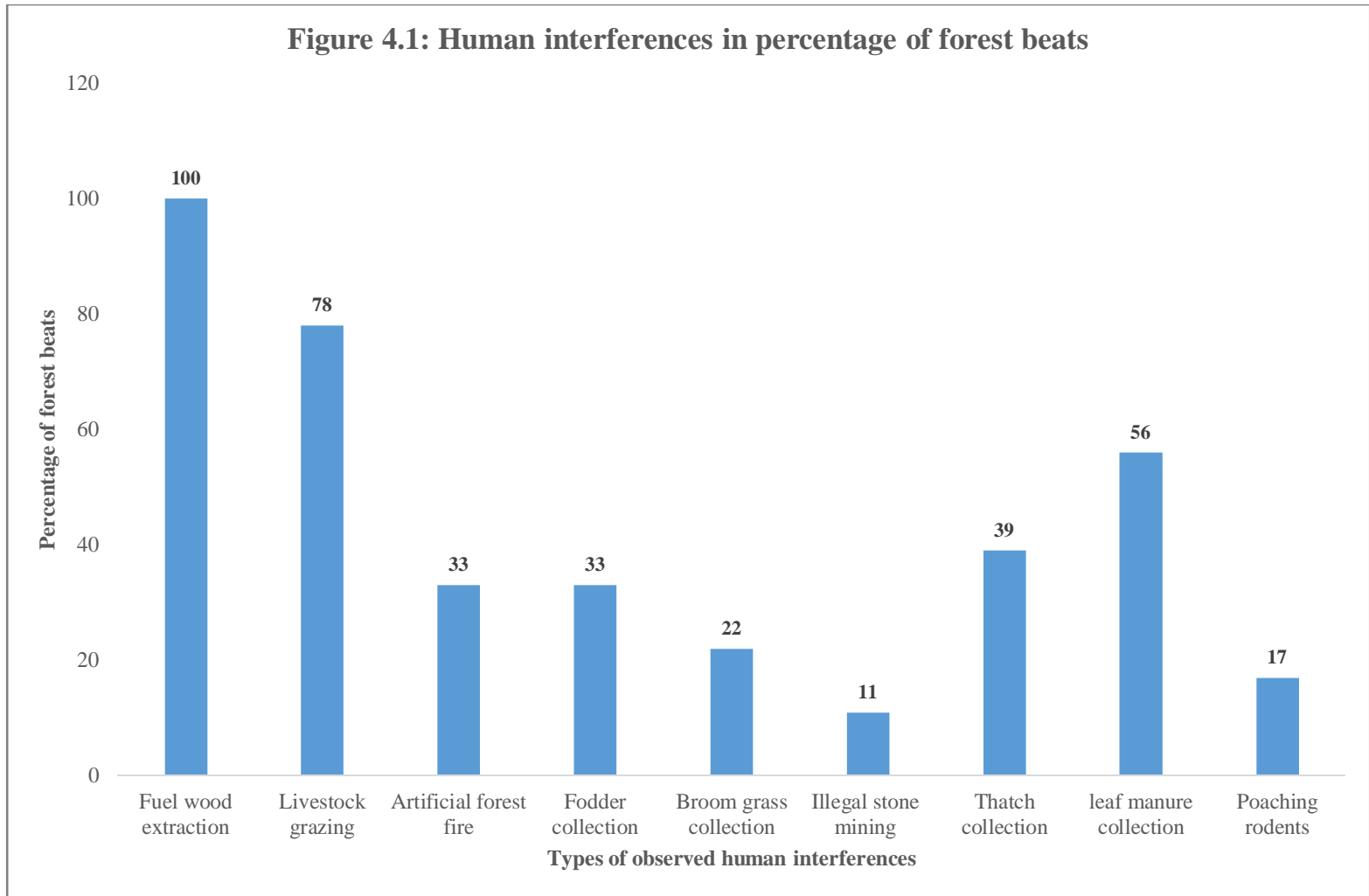
Changes in level of forest protection between 1998-99, 2004-05 and 2010-11 were measured by on field observation of forest guards and watchers activities, group discussion with villagers and forest staff, and analyzing forest offence records. Eastern boundary of park was subdivided into north, central and south zones, and then separately scored to compare level of protection. Frequency of encounters with forest guards / watchers during survey, their level of willingness to prevent illegal extraction, frequency of sighting free cattle grazing within park, Village Forest Committee (VFC) members opinion regarding forest protection, and level of forest offences during above mentioned periods were systematically recorded and then scored in a 0 to 5 scale. A score between 0.1 – 0.9 considered as 'very low', 1 – 1.9 as 'low', 2 – 2.9 as 'medium', 3 – 3.9 as 'high medium', and 4 – 4.9 as 'high' respectively.

4.3 RESULTS

4.3.1 Reconnaissance Survey

4.3.1.1 Change in Biomass Extraction Pattern

At the beginning of baseline survey during 1998-99 it was found that fuel wood extraction and livestock grazing were the most common types of interferences in 78 to 100 % of the forest beats (Figure 4.1). Biotic pressures like artificial forest fire by pilgrims, gems stone mining by blasting, hunting of rodents by trained dogs were mainly restricted in the northern side of PA boundary, among which forest fire was prevented by forest guards by strict vigilance over pilgrims' illegal activities in later years. *Dodonea viscosa*, a foothill shrub dried and applied as leaf manure, was mostly extracted from the forest beats located in the southern side of boundary, and the practice was still observed in 2010-11. Collection of *Phoenix pusilla* for making broom mainly went on in northern and central side of the park boundary in 1998-99, and found concentrated in beats located centrally during 2010-11 survey. Some old forest trails identified in 1998-99 survey as heavy influx route for cattle and goats as well as head loaders, like trail near Chettimedu village or near Madura Coats factory, were abandoned by extractors during 2010-11 survey, and new trails adjacent to it developed. In northern side of park boundary, cycle loads (8-10 cycle loads day⁻¹) of fuel wood were seen in 2010-11 in place of head loads during 1998-99, though lesser in number than per day head loads counted earlier for the region.



4.3.1.2 Change in Level of Forest Protection

Changes in level of forest protection between 1998-99, 2004-05 and 2010-11 were measured by on field observation of forest guards and watchers activities, group discussion with villagers and forest staff, and analyzing forest offence records of last decade (Table 4.2). Overall score for the level of protection is estimated as low (score 1.4) during 1998-99, and then increased to medium (score 2.03) in 2004-05, and high medium (score 2.67) in 2010-11. It was observed that level of protection increased significantly in central (from low to medium) and southern (from medium to high medium) part of eastern boundary of KMTR between 2004-05 and 2010-11, whereas protection level increased from low to medium between 1998-99 and 2004-05 in northern part of the PA boundary. Increase in forest protection in the central zone of eastern boundary was a significant measure, as major chunk of fuel wood collectors and sellers originate from the villages located in this area, and markets are nearby.

4.3.1.3 Change in Pressure Profile

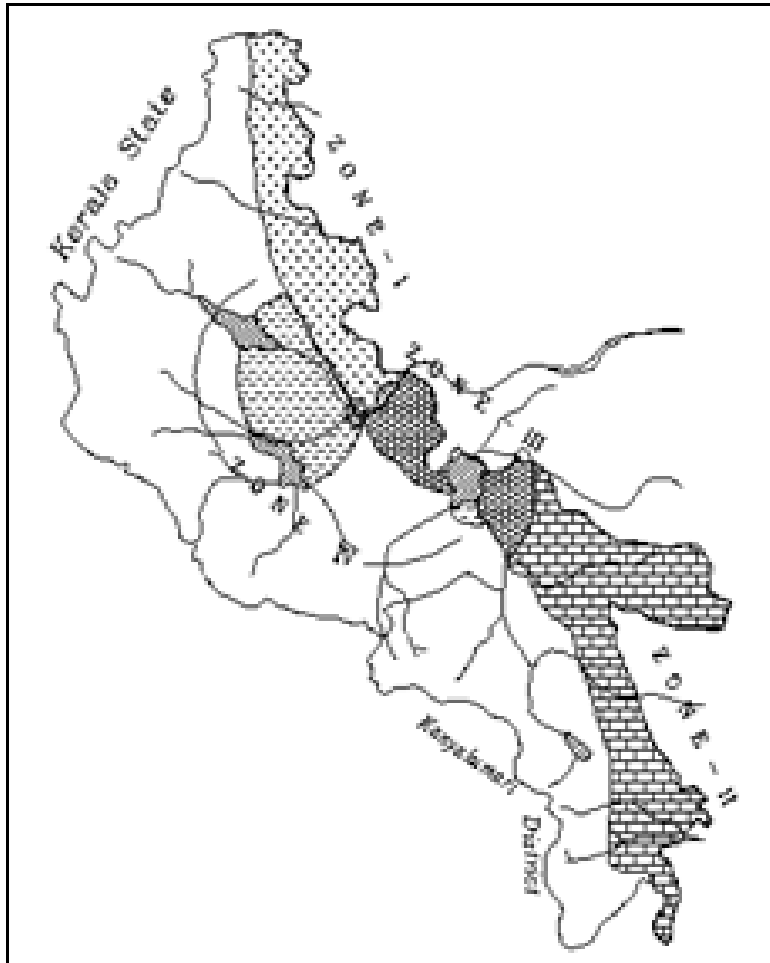
Based on ocular observations of fuel wood head loaders, cattle herds, tourism and pilgrim activities inside KMTR during reconnaissance, a reconnaissance based pressure profile of KMTR eastern boundary was constructed in 1998-99, and again the notable changes identified in 2010-11(Figure 4.2). North-central boundary of the park was designated as Zone I of pressure profile, where fuel wood head loading, gems stone mining, hunting of rodents were observed in 98-99. Lesser number of cycle loads in comparison to 98-99 head loads, and marginal increase of grazing were observed in 2010-11. South-central boundary of the park was designated as Zone II, where comparatively more numbers of herds were found grazing within TR than Zone I in 98-99, along with leaf manure collection. Less number of cattle and goat herds

were found grazing within park in 2010-11 survey. Central part of KMTR's eastern boundary was designated as Zone III where major chunk of head loaders used to operate (98-99) due to its' proximity to big villages, townships, and commercial activities. Fuel wood head loading through forest trails was comparatively less in 2010-11 as level of forest protection enhanced during ecodevelopment. Instead, fuel wood sellers were noticed near water-falls and temples located within park during 2010-11 survey, which might be due to increased number of local tourists. Mundanthurai plateau within park was designated as Zone IV during 98-99 survey as it was subjected to biotic pressure from free grazing cattle, either from Electricity Board (EB) settlements within plateau, or from fringe villages located in foothills. Free grazing herds in plateau from fringe villages decreased during 10-11.

Table 4.2: Change in level of forest protection

| Eastern boundary of KMTR | Level of forest protection | | |
|-----------------------------|----------------------------|-------------|-------------|
| | 1998-99 | 2004-05 | 2010-11 |
| North | 1.6 | 2.1 | 2.6 |
| Central | 1 | 1.7 | 2.4 |
| South | 1.6 | 2.3 | 3 |
| Overall score | 1.4 | 2.03 | 2.67 |

Figure 4.2: Notable changes in pressure profile constructed during the year 1998-99 and 2010-11



Zone – I: Kadaiyam and Papanasam Range. Notable biotic pressures(98-99) – Fuel wood collection, gems stone mining and hunting rodents

Notable biotic pressures (10-11) - Livestock grazing and cycle load of fuel wood **Changes:** Lesser no of cycle load observed than head loads in past, with marginal increase in grazing

Zone – II: Ambasamudram, Kalakad and Thirukurangudi Range. Notable biotic pressures (98-99) – Livestock grazing and leaf manure collection.

Notable biotic pressures (10-11) - Livestock grazing and leaf manure collection. **Changes:** lesser no of cattle and goat herds within PA

Zone – III: Papanasam and Ambasamudram Range. Notable biotic pressures (98-99) – Fuel wood collection, livestock grazing and tourism.

Notable biotic pressures (10-11) – Fuel wood extraction in tourist and pilgrimage spots in interior with plastic littering.

Changes: Purchase of forest fuel wood had increased near Agasthiyar waterfalls due to heavy influx of local tourists. Grazing decreased.

Zone –IV: Papanasam, Ambasamudram and Mundanthurai Range. Notable biotic pressure (98-99): Tourists and pilgrims. High free buffalo & cattle grazing in plateau.

Notable biotic pressure (10-11): Tourists and pilgrims. Free grazing rarely observed **Change:** Decrease in free grazing observed

4.3.1.4 Change in Ecodevelopment Impact Zone

Among 74 user villages enlisted (Annexure I) during 98-99 survey, 52 (70% of total) were found extracting fuel wood from the protected forest. 85% extractors sold fuel wood in market and rest 15% collected for household use. Other than fuel wood, villagers used to collect plant biomasses like lopped fodder, green leaf manure, broom grass, thatch etc., and sent livestock for grazing within PA. People of 14 villages (19% of total) were engaged in all the three activities namely fuel wood collection, grazing and collection of one or other type of biomass. In addition, fuel wood extractors came from 19 villages where ecodevelopment was not initiated till 98-99 as they fell outside 5 km radial distance from PA boundary designated by KMTR management as Ecodevelopment (ED) Impact Zone. It was also observed during the same time that a total of 6 settlements which even if fall under 5 km radial distance zone, no ecodevelopment work initiated till then. In 2010-11, forest department included the above mentioned 19 villages and the other 6 settlements situated within 5km from KMTR, as ecodevelopment villages. In fact, at present there was no arbitrary impact zone for ED, as the management realized that people living more than 5 km distance from KMTR also visit the park for resource extraction.

4.3.2 Intensive Trail Monitoring for Biomass Extraction

4.3.2.1 Change in Fuel wood Extraction

The fuel wood collection took place round the year in the entire eastern boundary of the PA, and the local people walked on an average 3-5 km into the forest from the boundary line and spent about 5-6 hrs. for collection of one head load of fire wood. It was observed during baseline survey in 1998 – 99 that people came from villages situated as far as 8 – 10 km distance from the PA boundary, and in some

cases even from nearest townships like Kallidaikuricchi and Ambasamudram to collect fuel wood from tiger reserve. The economic dependency on fuel wood was so high at that time that sometimes a single head loader was seen collecting fire wood even twice in the same day from the reserve. Such things were not noticed later on during 2004-05 and 2010 – 11 survey. Though cycle loads of fuel wood collection from PA were recorded specially from sample trails located in northern side of PA boundary during final stage of monitoring (10-11). It was a new trend developed in pockets which might be to reduce the physical exhaustion as well as to save the time for collection.

Number of fuel wood head loads per trail per day reduced from 14 head loads (rainy 26 ± 7.4 , winter 9 ± 1.7 , and summer 11 ± 1.7) in 98-99 to 9 head loads (rainy 10 ± 0.6 , winter 8 ± 0.2 , summer 8 ± 0.5) in 2004-05, and then to 8.5 head loads (rainy 10 ± 2.49 , winter 8 ± 2.08 , summer 7 ± 2.34) in 2010-11 (Table 4.3). The bulk percentage decrease (37.14%) in number of head loads trail⁻¹ day⁻¹ took place between 98-99 and 04-05, and the major reduction took place during rainy season (June to October-November). Landless labourers became frequent fuel wood extractors as they had lesser job opportunities from agricultural activities in the locality from June to November. The percentage decrease (39.29%) in number of fuel wood head loads trail⁻¹ day⁻¹ between 98-99 and 10-11 was statistically significant (Wilcoxon signed rank test sig. 0.008). The percentage reduction in fuel wood extraction was comparatively far less (only 3.4%) between 04-05 and 10-11 than between 98-99 and 04-05 (37%, Wilcoxon sig. 0.093). It was evident that the major decrease in percentage of fuel wood head loaders in PA took place in the initial phase of ecodevelopment (98-99 to 04-05).

Baring 3 statistical outliers in 98-99 rain data, there was significant seasonal difference (repeated measure ANOVA) in average fuel wood extractors trail⁻¹ day⁻¹ between three seasons. There was significant difference (repeated measure ANOVA sig. =0.050) in number of FW head loaders between rain (9.8±0.6) and summer (8.2±0.5) in 04-05. It is to be mentioned here that North-East Monsoon (between October to December) has it's spell of rain during winter in southern state like Tamil Nadu, which in some year creates similar wet condition in winter like July and August. In such cold and wet condition, the demand for fuel wood during winter months remained same like rainy season. In 10-11, significantly higher number of head loaders visited park during rain (10.4±2.49) than winter (7.7±2.08, repeated measure ANOVA sig. =0.010) and summer (7.4±2.34, repeated measure ANOVA sig. =0.034).

According to Tamil Nadu Forest Department status report 2004 (Annamalai 2004), there were 3215 FW head loaders day⁻¹ collecting KMTR resource prior to ecodevelopment in 1995. According to baseline research findings in 98-99, 2282 FW head loaders day⁻¹ visited park after the initiation of KMTR ecodevelopment. Between 04-05 and 10-11, the number of FW head loaders visiting park further reduced to 1467 day⁻¹. Percentage of FW head loaders in KMTR decreased significantly between 98-99 and 10-11, the ten years period when ecodevelopment implemented in Tiger Reserve. When proportion of male and female fuel wood head loaders over the years were analyzed, it was found that relative percentage of male head loaders increased from 56% in 98-99 to 77% during 10 -11, whereas, in the same period, female head loaders decreased from 44% to 23% of total head loaders.

4.3.2.2 Quantification of Annual Extraction of Fuel Wood

The total amount of fuel wood extracted from the entire park had been calculated by multiplying the average weight of fuel wood removed trail⁻¹ year⁻¹ and the total 163 trails of the entire park area. It had been assumed that all the trails were equal and the amount of fuel wood removed through each of the trail was equal.

The annual fuel wood requirement of the total human population of 75,382 living in fringe villages during 98-99 estimated to be 33,018 mt. taking the average requirement of 1.2 kg person⁻¹ day⁻¹ (Mishra and Ramakrishnan 1982). Considering 30% of this collected from non-forest areas, and 220 mt. purchased from wood depot, rest 22892 mt. (67% of the total fuel wood requirement) must had been collected by people from KMTR. When the fuel wood demand of fringe villages was again estimated in 10-11 for 207088 village population, nearly 12,000 people were found to become non-fuel wood user as they got alternative energy like LPG and hot-point stove through ecodevelopment. Again considering recent trend of non-forest wood collection from orchards and agricultural land, and another quantum from wood depots, 26% of total fuel wood demand of fringe villages was found to be met from KMTR in 10-11(41% decrease from 98-99).It needs to be mentioned that people were forced to collect low quality woods and sticks from gardens, orchards, bushes and fencing meant to protect crops as they were debarred from entering PA due to stricter forest protection by management in the last phase of monitoring (10-11). It can be assumed that the demand of quality wood for household purposes is still there, and require to be compensated by more biomass generation outside PA.

Table 4.3: Fuel wood removed (head load trail⁻¹ day⁻¹) during the year 98-99, 04-05 and 10-11

| Season | Head load trail ⁻¹ day ⁻¹ | | |
|-----------------|---|-----------|-------------|
| | 98-99 | 04-05 | 10-11 |
| Rain ± SE | 26.25 ± 7.4 | 9.8 ± 0.6 | 10.4 ± 2.49 |
| Winter ± SE | 9.13 ± 1.7 | 8.4 ± 0.2 | 7.7 ± 2.08 |
| Summer ± SE | 11 ± 1.7 | 8.2 ± 0.5 | 7.4 ± 2.34 |
| Total Mean ± SE | 14 ± 2.4 | 8.8 ± 1.3 | 8.5 ± 0.95 |

4.3.2.3 Change in Livestock Grazing

4.3.2.3.1 Cattle Grazing Pattern

About 9 to 10 herd of livestock used to enter into the PA forest for grazing through each of the sample trail day⁻¹ during baseline survey. Free grazing of livestock within KMTR, owned both by fringe villages and Electricity Board Employees settlements within park, were common features during 98 – 99. It got reduced during 04-05 and 10 – 11.

During 98-99, average 96 cattle and 181 goats entered PA (Table 4.4) for free grazing trail⁻¹ day⁻¹. There was 31.38% decrease (Wilcoxon sig. 0.014, paired t sig. 0.011) in number of cattle (66 cattle) entered trail⁻¹ day⁻¹ during 04-05 in comparison to 98-99. Though percentage decrease in average number of cattle entry trail⁻¹ day⁻¹ found to be 31.33% between 04-05 and 10-11(42 cattle), the difference was not statistically significant (Wilcoxon sig. 0.338) due to high variance. Percentage decrease in cattle entry trail⁻¹ day⁻¹ through eastern boundary amounted to 55.62% (Wilcoxon sig. 0.021, paired t sig. 0.011) between 98-99 and 10-11.

Significant seasonal difference in cattle grazing within park was observed during all the three phases of monitoring. Significantly higher number of cattle (108±15.6) grazed within park during summer (35% more) than rain (80.3±17.3, repeated measure ANOVA sig. 0.049), and during winter (98.7±18, 24% more) than rain (repeated measure ANOVA sig. 0.036) in 98-99. In 04-05, significantly higher number of cattle (73±2.4) grazed during summer (33%

more) than rain (55 ± 4.3 , repeated measure ANOVA sig. 0.020), while difference in cattle grazing within PA between summer and winter (68.2 ± 3.3) was insignificant (repeated measure ANOVA sig. 0.058), and the difference between rain and winter grazing pattern was statistically insignificant due to high variance. Similarly in 10-11, significantly higher number of cattle (53 ± 7.26) grazed within KMTR during summer (47% more) than rain (36 ± 4.95 , repeated measure ANOVA sig. 0.011), while both the difference in cattle grazing between rain and winter, and winter and summer found to be statistically insignificant.

4.3.2.3.2 Goat Grazing Pattern

During 98-99 survey free grazing goat herds were found grazing in large number ($181 \text{ trail}^{-1} \text{ day}^{-1}$) within PA (Table 4.3). There was 41% decrease (Wilcoxon sig. 0.004, paired t sig. 0.003) in free grazing goats inside KMTR between 98-99 and 04-05 ($117 \text{ trail}^{-1} \text{ day}^{-1}$). Further it decreased to 61% (Wilcoxon sig. 0.007) between 04-05 and 10-11 ($46 \text{ trail}^{-1} \text{ day}^{-1}$). Unlike fuel wood head loads from PA and free grazing of cattle within park, there was significant reduction of free goat grazing within KMTR in all the three phases of monitoring during ecodevelopment.

The seasonal free grazing of goat and sheep herds within Tiger Reserve in 98-99 showed relatively higher during rain and winter than summer, but the findings were statistically insignificant due to high variance. The trend reversed in 10-11 when relatively more number of goats grazed within park in summer

months. There was significant seasonal difference (repeated measure ANOVA sig. 0.015) in goat grazing between winter (183 goats trail⁻¹ day⁻¹) and summer (68 goats trail⁻¹ day⁻¹) in 98-99. During 04-05 survey, significant seasonal difference was found between summer (54 goats trail⁻¹ day⁻¹) and rain (152 goats trail⁻¹ day⁻¹, repeated measure ANOVA sig. 0.056), and summer and winter (144 goats trail⁻¹ day⁻¹, repeated measure ANOVA sig. 0.018). Average number of goat grazing within PA in summer (65 goats' trail⁻¹ day⁻¹) was found relatively higher than rain (36 goats) and winter (39 goats) in 10-11 survey, but the difference was not statistically significant.

Table 4.4: Cattle and goat grazed (No. trail⁻¹ day⁻¹) during the year 98-99, 04-05 and 10-11

| Season | No of cattle and goat trail ⁻¹ day ⁻¹ | | |
|-----------------|---|----------------------------|-----------------------------|
| | 98 -99 | 04-05 | 10-11 |
| Rain ± SE | 80.3±17.3 (293 ± 94.5) | 55.4 ±4.3 (152 ± 6.2) | 35.6±4.95 (35.68±4.8) |
| Winter ± SE | 98.7±18 (183 ±29.4) | 68.2±3.3 (144 ± 4.7) | 39.3±7.8 (38.43±9. 6) |
| Summer ± SE | 108±15.6 (67.8± 13) | 73.2 ± 2.4 (54± 5.4) | 52.7±7.26 (64.73±15.1) |
| Total Mean ± SE | 95.6±6.56 (181±53) | 65.6 ±3.8 (116.7 ± 5.6) | 42.42±5.03 (45.66 ±8.63) |

Note: Average number of goats grazed (No. trail⁻¹ day⁻¹) and percentage decreased is given in parenthesis

4.4 DISCUSSION

4.4.1 Decrease in Fuel Wood Extraction from Park during Ecodevelopment

The goal of ecodevelopment is to promote conservation of biodiversity by improving human living standards. The mechanism is to provide local people with environmentally sound, economically sustainable alternatives to destructive land use (Kremen, Merenlender and Murphy 1994). The main issue of conservation in KMTR was large number of poor, landless families where members were engaged in fuel wood extraction and livestock grazing within PA on a regular basis. The basic objective of implementation of ecodevelopment in KMTR was to reduce forest dependency of local people by providing them non-forest based alternatives, and thereby reducing human pressure on park.

Fuel wood extraction was a common feature all along the eastern side of KMTR which is surrounded by villages. In India, fuel wood is mainstay of rural population for cooking and other household and non-agricultural works (Chakravarti, 1985, Anon 1988) as it is the cheapest and most easily accessible source of fuel for the majority of the rural population, and so was the case in the present study. As a result, forest habitat near eastern boundary of the park was in a complete state of degradation, and an average depth of 5km from the boundary found almost degraded during initial survey conducted in 98-99. At that time, ecodevelopment initiatives in and around KMTR had just began, and was too early to judge any impact of ecodevelopment in reducing biotic pressure. The survey was repeated during 04-05 and then in 10-11 to measure

the impact of ecodevelopment in reduction of human pressure on park. Percentage of fuel wood head loaders visiting KMTR decreased significantly between 98-99 and 10-11, the ten years period when ecodevelopment implemented in Tiger Reserve. This decrease can be attributed to increase in the socio-economic status of the poorest forest depended households due to ecodevelopment input such as alternate non-forest based income generation activities. 41% decrease ($P < 0.05$) in most forest dependent families also took place between 98-99 and 10-11 in 11 Village Forest Committees (VFCs) sampled to track socio-economic changes during ecodevelopment (chapter 7).

The KMTR ecodevelopment project managers succeeded in combining forest protection with economic empowerment of village women in the locality. Individual loans were given for alternative non-forest based livelihood to forest resource dependents for initial 2-3 years, and the status of loan recovery was not satisfactory at any eco-ranges specially created for implementation of ecodevelopment in fringe villages. Management soon learnt the lesson, and later on started providing ecodevelopment loans through formation of men and women Self-Help Groups (SHGs) in each VFCs. The response from women members were overwhelming, and with no time a large number of women Self-Help Groups were formed under the banner of ecodevelopment which was the first of its kind in this area. Successful functioning of 837 women Self Help Groups (SHGs) in KMTR ED till 2012 with 96% rate of loan recovery helped to reduce comparatively more number of female FW head loaders (decreased from 44% in 98-99 to 23% in 10-11) than the male counterparts (increased from 56% of head loaders in 98-99 to 77% of head loaders in 10-11). It means,

comparatively more number of female fuel wood head loaders abandoned old forest extractive profession as they found economic alternatives through SHG loans, but male counterparts were not been benefited to that extent by alternative livelihood program, and still going to forest for extraction. Now, the PA management has to offer some economic opportunity to male head loaders as well through training / skill development to reduce pressure on the reserve.

Other than that, many women (21% of surveyed household) chose bidi rolling on contract basis as profession especially in villages near central part of park boundary as they were preferred over male in this profession by local bidi makers. Many of them reportedly left going forest for fuel wood cutting and selling after getting the contract of bidi rolling on a daily basis. Most of them considered it less strenuous than head loading, and an opportunity to work at home also attracted them. Though many women mentioned about sufferings from respiratory and bronchial diseases due to tobacco during questionnaire survey in sampled villages.

The main entrance of KMTR located on the foothills of Papanasam hills named after Papanasam temple, a famous temple in southern Tamil Nadu. Many small and big villages, Madura Coats spinning mill, and Vickramsingapuram, the nearest municipal town and commercial complex, located in this region. Maximum number of forest dependent landless poor families used to live in this region and earn their daily living by selling bundle of fuel wood which they have collected from the park. It was found that number of

fuel wood head loaders reduced in this region after implementation of ecodevelopment. At the same time, the level of forest protection improved during ecodevelopment, which helped in reduction of illegal fuel wood cutting from the reserve. In addition to that, migration of daily waged labourers of Madura Coats spinning mill to nearby industrial cities in the same period (5.25% decrease in population of V K Puram between 2001 and 2011, the municipal township adjacent to KMTR) in search of jobs might also had contributed in decrease of fuel wood head loaders in the central part of eastern boundary. The daily waged labourers of Madura Coats used to collect fuel wood from park in their 'off days'. A major percentage of this work force migrated to nearby industrial towns and cities in the last decade after Madura Coats slashed their labour force. So, ecodevelopment was not the only reason behind decrease in number of fuel wood head loaders, especially in areas like this where multiple socio-economic factors were simultaneously operating.

At the same time, there was a quantum jump in local tourists in Papanasam temple and temple adjacent Agasthiar falls in the last decade. Local tourists were seen coming from all parts of Tamil Nadu in weekends, and many new lodges and hotels established to serve them. Many tourists used to cook foods near temple premises as part of local culture, and require wood for cooking. During 10-11 survey and forest trail monitoring exercise, fuel wood head loaders were seen collecting wood for selling near Agasthiar falls area, which is located within PA. It is a new demand of fuel wood created in the last ten years due to uncontrolled tourism around Agasthiar falls, which the park management should control.

4.4.2 Decrease in Cattle and Goat Grazing inside Park during Ecodevelopment

There were nearly 40,000 cattle holding and approximately 30000 – 35000 goat and sheep population in 160 villages located just on the periphery of park boundary on the eastern side during 1998-99. Majority of this livestock population of fringe villages then used to graze freely within KMTR, and in some cases buffalo and goat herds were supervised by paid herdsman. Villagers used to keep dung of such scrub cattle within a shallow trench dug in the backyards of house, which eventually sold as truckloads of natural fertilizer in surrounding districts of Tamil Nadu, and in neighbouring state Kerala. It was observed during 04-05, and especially during 10-11 survey that quantum jump in application of inorganic fertilizer in surrounding agricultural fields gradually reduced the common practice of keeping scrub cattle for dung, as there was far less demand of cattle dung. On the other hand the Alternative Income Generation (AIG) scheme encouraged village communities to take eco loan for buying milking cow. VFC records of eleven sample VFCs revealed that 13% of families took eco loan to buy milking cow, which was the third most sought after alternative enterprise after loan for agriculture and small business. In recent years, Tirunelveli district was among the highest milk producing district in Tamil Nadu (Tamil Nadu State Agricultural Plan 2009), so evidently milk selling was profitable. The above two factors leading to gradual reduction of free grazing cattle within PA along with strict protection by forest guards during ecodevelopment. Similar like the trend of fuel wood head loading from park, there was significant decrease in number of free grazing scrub cattle herds within KMTR in the last decade when ecodevelopment implemented in fringe

villages to reduce grazing pressure. At the same time, significant percentage decrease in cattle entry in PA only happened within 98-99 and 04-05, which means in the initial stage of ecodevelopment.

Large number of goat and sheep herds used to visit KMTR every day in every season during 98-99. Goats were naturally free grazing animals, and were sent to the PA whenever there was an opportunity, sometimes with paid herdsmen. Number of goat herds inside tiger reserve reduced drastically in later years (04-05 and 10-11) of ecodevelopment. During socio-economic survey in sample villages, VFC member respondents talked about recent high economic return associated with selling goats in meat market. Villagers started getting high economic return by selling a six months old well nourishes goat with an average weight ranged from 8 – 12 kg according to the breed of the animal. There was 28% increase in goat population between 1997 and 2004 (TN State Agriculture Plan 2009), and must had been higher than this in Tirunelveli district as it has one of the largest livestock holding in the state. Incidences of domestic animal lifting by wild carnivores in fringe villages happened in the recent past from 2008 onwards due to habitat improvement near boundary, which prompted families not to send goat and sheep herds within PA for free grazing. Higher level of forest protection by staff and imposition of fines also acted as a deterrent during this period. Instead herds were sent for free grazing in nearby farmlands after harvests, and to the fallow land available within village premises. Previously (98-99 and 04-05) large herds of goats were sent to the PA during rain to avail the tender green leaves of plants, but decreased from 2005 onwards after market demand for goat meat enhanced in neighbouring

areas. Unlike fuel wood extraction and cattle grazing, free grazing of goats significantly reduced in all the three stages of monitoring, and the percentage decrease was very high.

5

CHANGE IN ANTHROPOGENIC PRESURE

5.1 INTRODUCTION

Human pressure on PAs appears in a variety of forms. However, for this study, biotic pressure has been defined as cutting of fuel wood, grazing and browsing by domestic livestock, harvesting of timber, lopping of fodder species, and collection of leaf manure and broom grass to the extent of creating negative impacts on wildlife and their habitat (Berkmuller, 1988). From the study of resource dependency of fringe villages, it became evident that fuel wood extraction and livestock grazing pressure was distributed throughout the eastern boundary of park, and pressures due to lopping of fodder, broom grass or leaf manure collection etc. were restricted in some locations based on demand of the product, and availability within PA.

Harvesting of fuel wood and timber has profound effects on the biodiversity of the forest ecosystem (Sayer and Whitmore 1991), often leading to the change in species composition and vegetation structure (Bormann *et.al.* 1977; Berkmuller 1988; Berkmuller *et. al.* 1990; Kouki 1994). The uncontrolled grazing by domestic livestock is another aspect of removal of biomass from natural ecosystems, which has direct impact on the regeneration process of forest by removing the young saplings and soil loss due to trampling (Kelt and Valone 1995; Saberwal 1995). The anthropogenic pressure status on the

eastern boundary forest of KMTR was in the range of medium to high from north to south end of PA in terms of cut species, proliferation of weed and bare ground due to fuel wood extraction and cattle grazing within park. During the initial transect study for anthropogenic pressure in 98-99, nowhere the status of human pressure was low near eastern boundary of the Tiger Reserve. KMTR ecodevelopment was then just introduced in fringe villages to reduce human pressure on park by improving the non-forest based income of local communities. Theoretically, if it is considered that the human pressure on park became zero after the implementation of ecodevelopment in KMTR, even then the forest ecosystem need some time to recover, at least five to ten years to show signs of regeneration. In fact, forest regeneration after disturbance is not expected to happen in the same pace like socio-economic changes within communities. It is a slow process. So, the same belt transects were again laid in 10-11, approximately 10 years after the initial survey in 98-99, to find any reduction of human pressure on KMTR ecosystem after implementation of ecodevelopment.

5.2 METHODOLOGY

Based on the reconnaissance and rapid habitat assessment study described earlier, six forest beats were selected along the PA boundary for pressure study (Gupta and Mishra 1999). A total of 12 belt transect of size 500m x 8m were laid in these forest beats (2 transect in each beat) to quantify the anthropogenic pressure of different kinds. Belt transects were laid at 1km interval on either side of 6 imaginary lines of varying lengths, ranging from 4-8 km, going inside the forest from the boundary. Care was taken to keep the

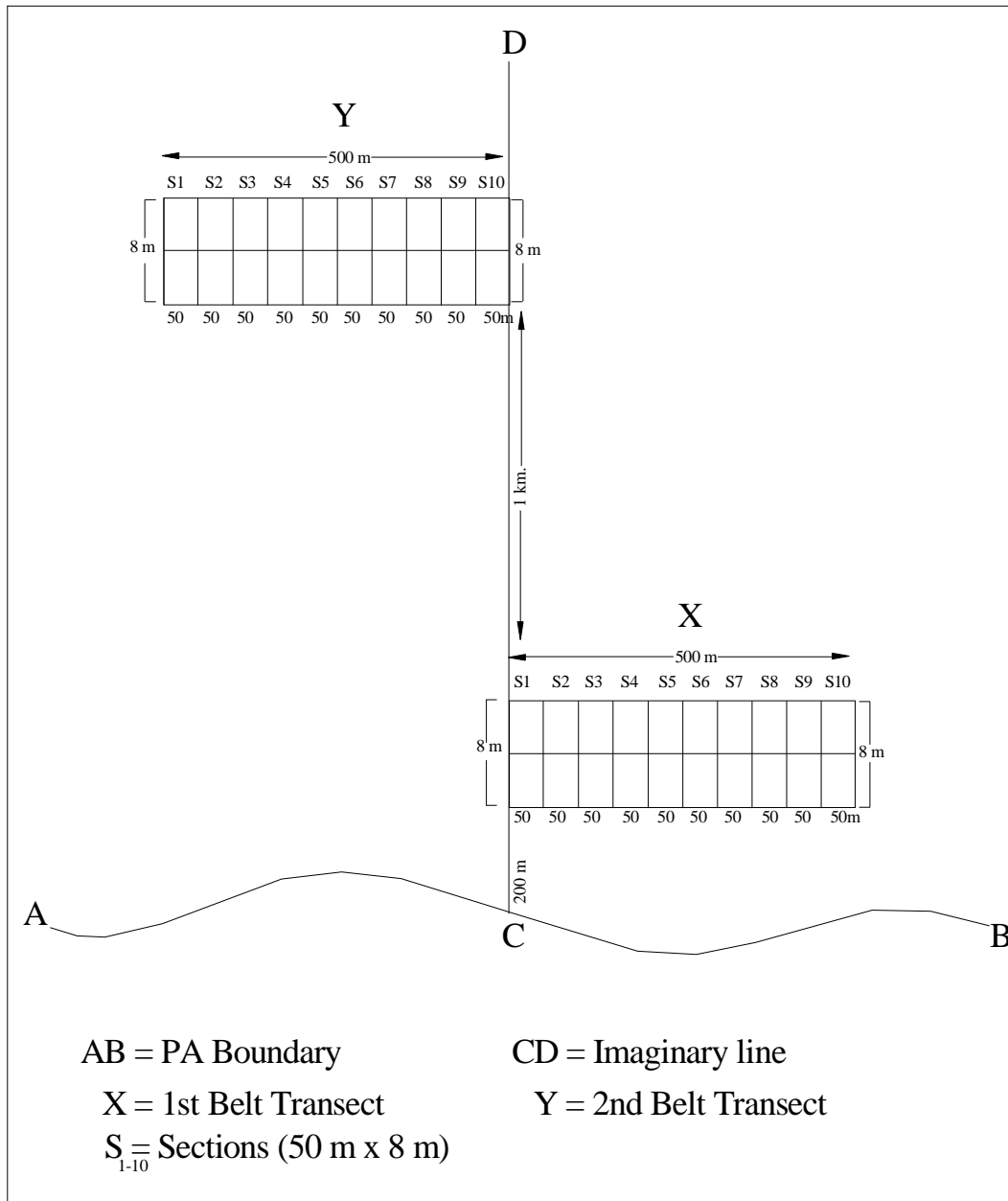
imaginary lines parallel to each other and at least 2 km apart. Hence, two belt transects were laid at 1 km interval on either side of each of the 6 imaginary lines situated in 6 sample beats of the eastern boundary. The lay out design of this has been given in figure 5.1. Pressure parameters were recorded in 10 sections of 50m length of each 500 m x 4m belt transects. By adopting such a transect layout it was ensured that the entire area along the eastern boundary was thoroughly covered for various types of measurements pertaining to anthropogenic pressure study. Two of the sample forest beats for transect study were located in the northern side of forest boundary, three were located in middle, and one in southern side of the park boundary. Belt transects were laid again exactly in the same locations of sample forest beats in 10 -11 to detect any change in the status of human pressure on forest ecosystem. In addition to this, another 16 transects were laid during 10-11, eight of which were located on either side of imaginary lines radiating from the human settlements located within Tiger Reserve in order to compare biotic pressure originating from inner settlements and in eastern boundary forests (20 belt transects altogether) which is surrounded by villages. Thus, a total of 28 belt transects were laid on either sides of 14 imaginary lines within KMTR to complete the study during 10-11.

5.2.1 Wood Cutting Pressure

Along the entire length and breadth of the belt transect, species wise enumeration of total standing, and cut trees was done in order to quantify the proportion of cut /uncut trees (Sale and Berkmuller, 1986). The diameter of cut stems were recorded in 8 classes ranging from 2-4 cm to > 16 cm with an

interval of 2 cm in order to find out the proportion of timber wood and fuel wood cut in this area. It may be noted that people in this area used tree / wood ranging from 4 – 10 cm diameter (breast height) as fire wood and > 10 cm diameter is used as timber wood. Cut height of individual trees in each section of belt transect were also recorded along with measurement of cut diameter. Wood cutting pressure in the boundary forest of KMTR was first measured in 98-99, and then again repeated in 10 -11 to detect any decrease in cutting pressure after ecodevelopment.

Figure 5.1 Transect Layout Design



5.2.2 Lopping Pressure and Status of Regeneration

Lopping pressure and status of regeneration in boundary forest was compared with forests surrounding interior settlements of KMTR during 10-11. Based on the ocular estimation of the intact crown cover of a lopped tree, the percentage of lopping was estimated and thus the lopped trees were categorized under either of the four categories: (i) 1 – 25% crown cover – very high lopping, (ii) 26 – 50% crown cover – high lopping, (iii) 51 – 75% crown cover – medium lopping, and (iv) > 75% crown cover – low lopping. However, before taking the ocular estimation of intact cover of the lopped trees, 100 observations were made using the gridded mirror (Mishra 1968) to verify the corrections of the ocular observations.

The status of regeneration was studied following Mishra (1968) and Muller – Dombois and Ellenberg (1974). Within each 50 m x 4 m sections of belt transect, the ecological assessment of regeneration was made. All the individuals >10 cm diameter at breast height i.e. 1.37 m or 4.5 ft. as trees, individuals between 6 – 10 cm diameter with height > 1 ft. as saplings, individuals with 4 – 6 cm diameter (> 1 ft. height) as recruitment, and individuals up to 4 cm diameter and height < 1 ft. considered as seedlings. Average density of trees, saplings and seedlings ha⁻¹ of PA area were calculated from the data.

5.2.3 Livestock Grazing Pressure

Quantification of the livestock grazing pressure was based on direct evidences such as livestock density in the forest and relative frequency of occurrence of livestock dung piles and wildlife dung pallets / scats, and indirect

evidences such as proportion of weed and non-weed species and bare and covered ground.

The relative frequency of occurrence of livestock dung piles and wildlife dung pallets / scats was estimated based on the observation in each section of 50 m length of the belt transect and finally averaged for different study sites.

In each of the belt transect, at every 25 m interval, the presence and absence of weed and non-weed species as well as bare and covered ground were recorded to find out the proportion of weed and non-weed species and bare and covered ground. Frequency of occurrence of 0 – 10%, 11 – 31%, 31 – 60%, and 61 – 100% were given a score of 1, 2, 3 and 4 respectively. Score of 1, 2, 3 and 4 were ranked as low, medium, high medium and high pressure. The whole exercise was done in 98-99 and then again repeated in 10 – 11 to detect changes.

5.3 RESULTS

5.3.1 Change in Wood Cutting Pressure

After baseline survey in 98-99, same transects were laid again in six sample forest beats on boundary in 2010-11 to detect changes (Table 5.1). Biotic pressure due to wood cutting was considerably high (37% trees found cut in boundary forest) during baseline survey in 98-99. There was an overall 6% decrease (31% trees found cut) of fuel wood cutting pressure (10-11 survey) in roughly ten years, though the difference was statistically insignificant (Wilcoxon sig. 0.347, paired t sig. 0.355).

Percentage of cut trees decreased in 50% of sample forest beats, and increased in other 50% beats. Beat wise, fuel wood cutting reduced in Singampetti II forest beat (from 56% cut stems in 98-99 to 23% cut stems in 10-11), Padmaneri (from 40% to 28%) and Govindaperi beat (from 45% to 21%). Cutting pressure reduced in the beats located in northern and southern corner of PA boundary. Cutting pressure increased in centrally located beats like Koraiyar (22% in 98-99 to 42% cut stems in 10-11) and Aladiyur (29% in 98-99 to 42% in 10-11), both recently exposed to high tourist influx and subsequent fuel wood demand.

Cut diameter classes were analyzed during baseline survey (98-99) in order to find out proportion of timber wood and fuel wood cut in the area. About 50% of cut stems fell in 2-4 cm diameter class while majority (85%) were within 2-8 cm diameter class, only 15% were more than 8 cm diameter. Interestingly in a similar study in Mudumalai WL Sanctuary, Silori (1998) found 80% cut trees in > 8 cm diameter which indicated people's demand for timber in contrast to people's demand for fuel wood in KMTR. In 10-11 (Figure 5.2), 90% of cut trees were found within 2-8 cm diameter, indicating even more preference towards wood as fuel than in 98-99. 40% cut trees were found at ground level and another 50% at the level of breast height (1.37m / 4.5ft) in 98-99 transect study. During 10-11 (Figure 5.3), 50% stems were cut at ground level, while the rest 50% at 1.3-3.5 m height. Within this, 90% were cut at breast height, and the rest extended from breast height (4.5 ft.) to 3.5 m (12 ft.) indicating increase in lopping within PA.

Major tree species (Gamble 1928) cut by the villagers for fuel wood were *Bauhinia racemosa*, *Zizyphus rugosa*, *Amoora rohituka*, *Albizzia odoratissima*, *Plectronia didyma*, *Lannea coromandelica*, *Flacourtia indica*, *Hopea parviflora*, *Cassia fistula*, *Zizyphus xylopyrus*, *Morinda citrifolia*, *Acronychia laurifolia*, *Canthium parviflorum*, *Dolichos biflorus*, *Elaeocarpus serratus*, *Garcinia echinocarpa*, *Pavetta indica*, *Averrhoa carambola*, *Streblus asper*, *Schleichera trijuga*, *Tectona grandis*, *Dalbergia latifolia*, *Grewia tiliaefolia*, *Albizzia amara*, *Dichrostachys cinerea*, *Albizzia lebbeck*, *Chloroxylon swietenia*, *Isonaudra canudolleana*, *Acorus calamus*, *Albizzia procera*, *Givotia rottleriformis*, *Lagerstroemia lanceolata* etc.

During 2010-11, a comparison was made between anthropogenic pressures in Mundanthurai plateau, the zone up to which roads are built within KMTR to reach the dam sites, and boundary forest of KMTR. It is to be mentioned that Kani tribal settlements and Tamil Nadu State Electricity Board (TNEB) staff quarters are located right inside the park in Mundanthurai plateau. There was no such difference in terms of wood extracted from PA between boundary and plateau. In fact, percentage of trees cut in plateau (33.75%) was 2% higher than boundary (31.45%, Mann-Whitney U and independent t sig. > 0.05), and proportionately higher presence of wild herbivores and carnivores recorded in transacts laid near boundary (69%) than plateau (63%, Mann-Whitney U and independent t sig. > 0.05).

Among total 68 species (Appendix III) found cut and lopped or parts extracted, 54 were trees, 9 shrubs, 4 herbs and 1 liana / climber. 43 species were used for fuel wood, 17 for timber, 6 for fodder, 3 for green manure, and 23 species for making various wooden implements. Following 13 species were cut most often among the total 68 cut species in KMTR eastern boundary forest: *Amoora rohituka*, *Zizyphus xylopyrus*, *Amarantus spinosus*, *Zizyphus rugosa*, *Albizzia lebbeck*, *Albizzia procera*, *Dichrostachys cinerea*, *Averrhoa carambola*, *Albizia amara*, *Cassia fistula*, *Lagerstroemia lanceolata*, *Phoenix humilis* and *Garcinia echinocarpa*.

Table 5.1: Comparison of cutting and grazing pressure between 98-99 and 10-11

| Forest Beat | Cut (%) | | | Weed (%) | | | Bare Ground (%) | | |
|----------------|-----------|-----------|------------------------------|------------|-----------|------------------------------|-----------------|-----------|-------------------------------|
| | 98-99 | 10-11 | Decrease | 98-99 | 10-11 | Increase | 98-99 | 10-11 | Increase |
| Govindaperi | 45 | 21 | 6 % decrease (P > .05) | 41 | 58 | 21% increase (P < .05) | 12 | 32 | 10 % increase (P > .05) |
| Shivaselam | 27 | 29 | | 6 | 52 | | 31 | 36 | |
| Koraiyar | 22 | 42 | | 55 | 63 | | 0 | 32 | |
| Aladiyur | 29 | 42 | | 19 | 62 | | 63 | 44 | |
| Singampetti II | 56 | 42 | | 9 | 50 | | 0 | 54 | |
| Padmaneri | 40 | 28 | | 67 | 39 | | 62 | 32 | |
| Mean± SE | 37 ± 5.72 | 31 ± 4.09 | | 33 ± 11.31 | 54 ± 4.02 | | 28 ± 13 | 38 ± 4.01 | |

Figure 5.2: Cumulative frequencies of different cut diameter classes in 1998-99 and 2010-11

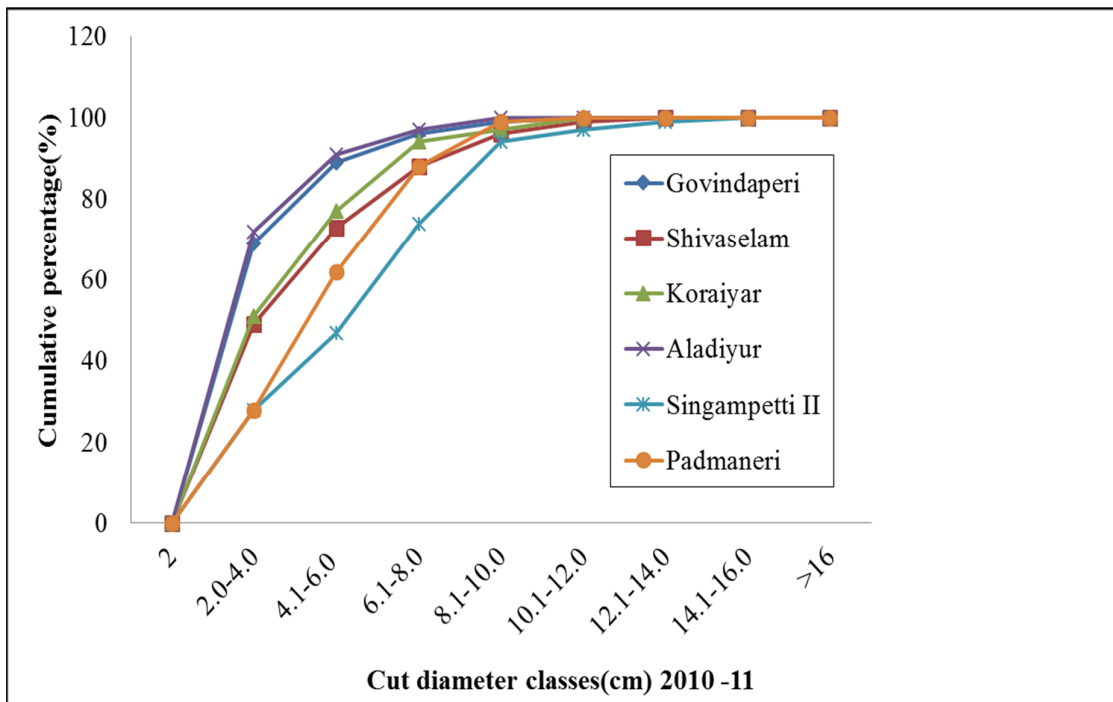
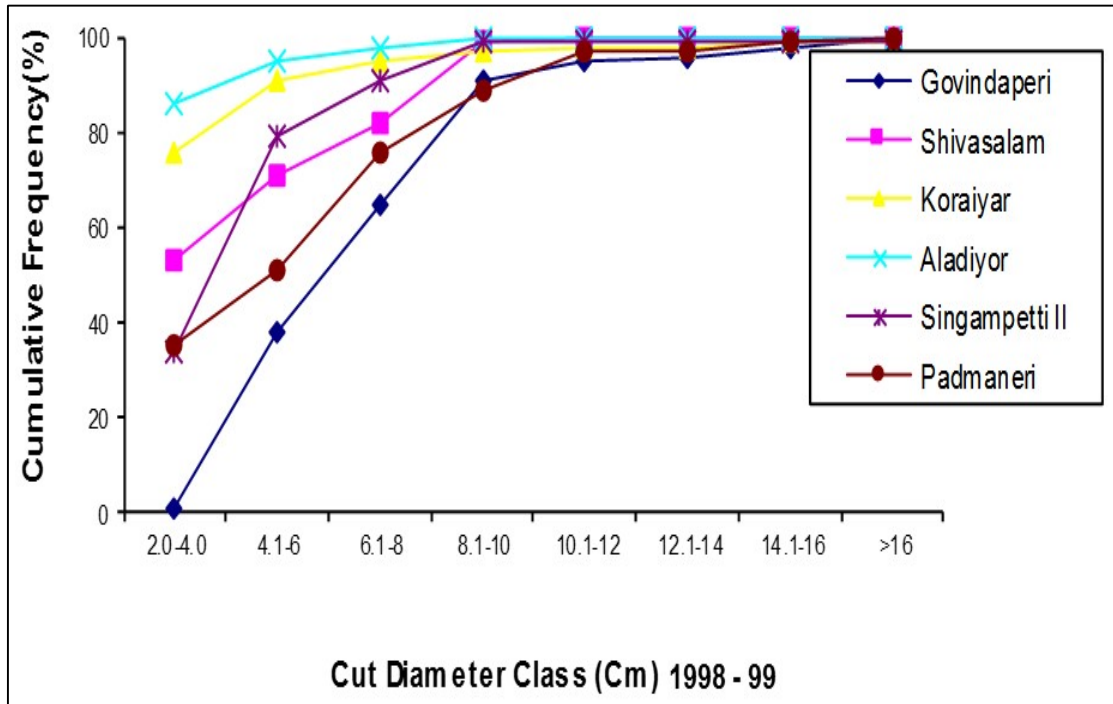
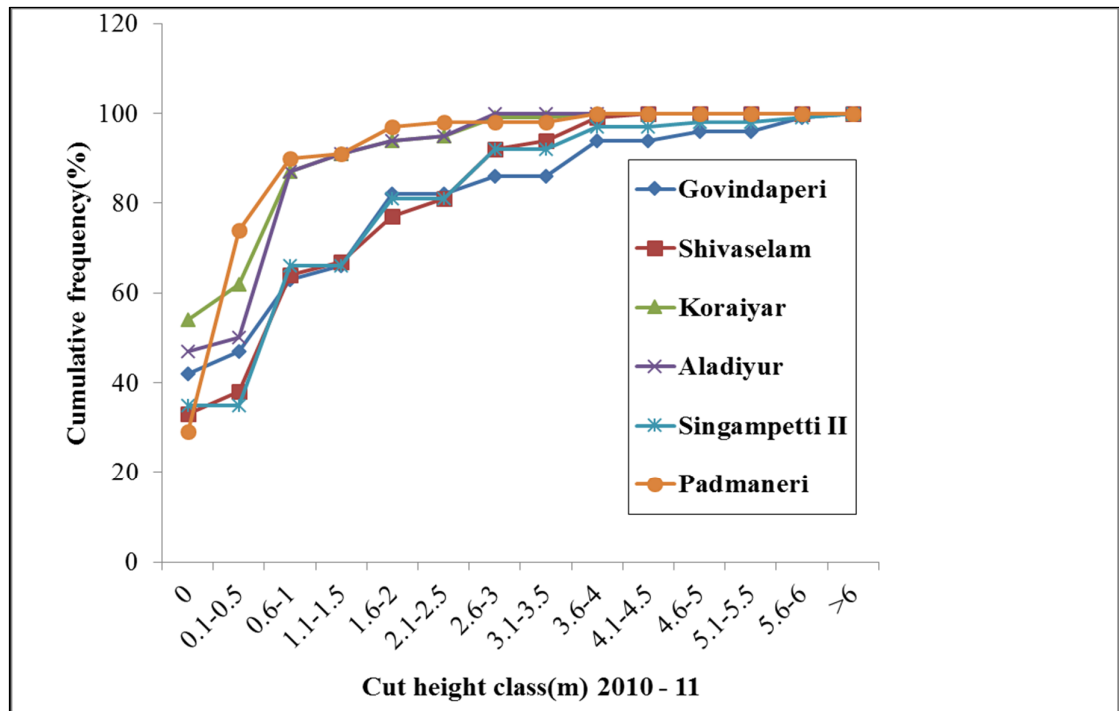
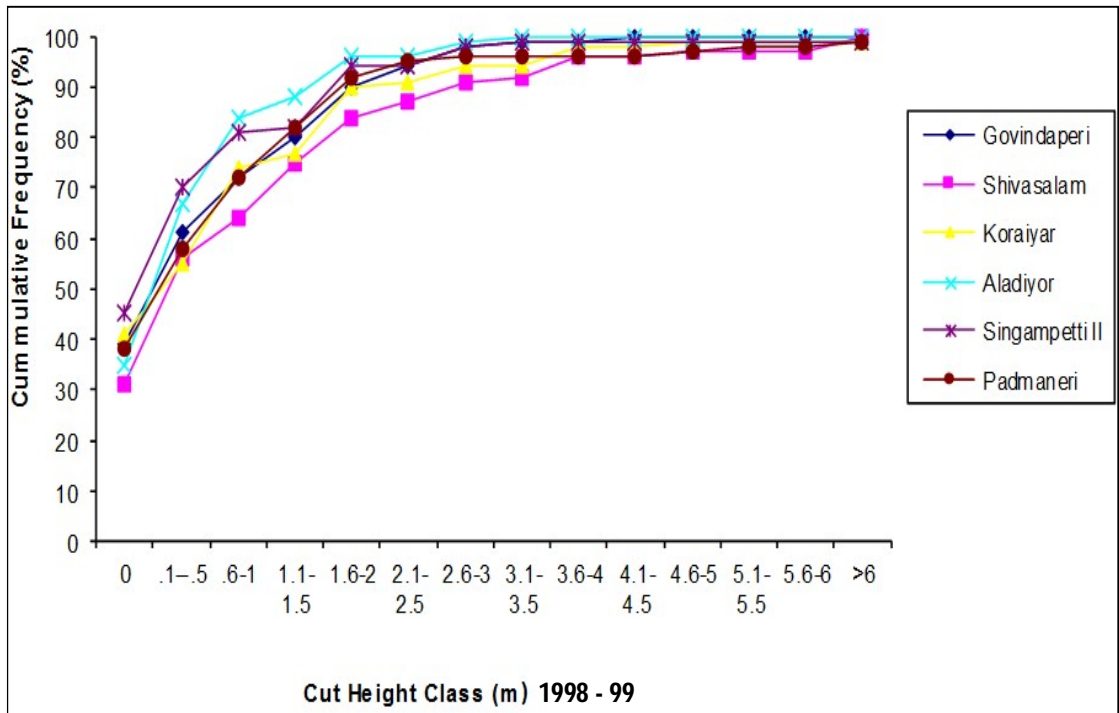


Figure 5.3: Cumulative frequencies of different cut height classes in 1998-99 and 2010-11



5.3.2 Lopping Pressure and Status of Regeneration

Transect data (2010 – 11) regarding percentage of canopy cover and status of regeneration in boundary forest and forests surrounding interior settlements did not differ much. Average 38% canopy cover was observed in forests near eastern boundary, whereas 32% canopy cover was found (Mann-Whitney U test sig. 0.751, independent t test sig. 0.658) in forests surrounding settlements within KMTR. Signs of lopping damage were evident in trees everywhere. Lopping ranged from medium to very high category in beats situated on eastern boundary. Except Agasthiyar fall tourist zone, (65% crown cover) lopping ranged from high to very high in relatively deeper inner settlements. Preference towards lopping was also evident from nearly 10% of preferred cutting height in the range of 1.37 m to 3.5 m in the forests near to eastern boundary of KMTR.

Average density of trees, saplings and seedlings in the boundary as well as settlements within KMTR were compared to found difference in regeneration status. There was no significant difference between boundary and inner settlements regarding forest regeneration. Average density of seedlings was even far less in interior settlements (690 ha^{-1}) than forests near boundary (1416 ha^{-1}), indicating depressed regeneration status of various woody species in plateau due to high intensity wood cutting, grazing, trampling and browsing in the past as well as present. Extremely low sapling and seedling density of some canopy species around interior settlements might be due to the fact that the season (rain) when such species cut maximum by tribals and other settlers coincided with their seed propagation (Sundriyal and Sharma, 1995). The forest ecosystem had still not recovered near PA boundary from the past human pressure as is evident from low sapling and seedling density than the density

of mature trees in some of the forest beats that experienced heavy cutting and grazing pressure, which indicated an inverse trend in forest structure. Moreover, cutting pressure was not decreased significantly between 98-99 and 10-11 near PA boundary. The marginal decrease which took place was not sufficient enough for the recovery.

5.3.3 Change in Livestock Grazing Pressure

Change in forest habitat in terms of livestock grazing pressure was quantified by percentage of weed species and exposed forest floor in above mentioned six sample beats. There was significant increase (Table 5.1) in weed percentage (Wilcoxon sig. 0.034, paired t sig. 0.000) between 98-99 (33%) and 10-11 (54%). Percentage of weed increased in all sample beats except Padmaneri located in the southern end of PA boundary. Both cutting pressure and weed percentage increased (43% increase in weed) in Aladiyur forest beat, located near central portion of forest boundary. Interestingly, ecodevelopment could not be implemented properly in villages surrounding this beat due to various internal problems and conflicts. Similarly, overall 10% increase in bare ground was found during 10-11 in comparison to 98-99 survey, but the increase was not statistically significant (Wilcoxon sig. 0.347, paired t sig. 0.293) due to high variance. Forest habitat adjacent to eastern boundary has not completely recovered from the damage done in past before and during ecodevelopment, although there was statistically significant percentage decrease in number of fuel wood head loaders and livestock entering park for extraction between 98-99 and 10-11. Regarding cutting and grazing pressure assessment in ten years of interval, there was marginal decrease in percentage of cut trees, but significant increase in percentage of weed indicating browsing pressure in forests near boundary.

The weed species spreading at fast pace in buffer zone of KMTR were *Lantana camara*, *Casia tora*, *C. occidentalis*, *Opuntia dillenii*, and *Ageratum conyzoides*

5.3.4 Overall Status of Human Pressure on KMTR

Beat wise pressure ranking of six sample beats on eastern boundary of KMTR was done in 1998 -99 as integrated measure of pressure on PA in terms of percentage of cut trees, weed species and exposed ground within belt transects laid on either side of imaginary line going inside PA from the boundary. It was found that beats located in northern (Govindaperi) and southern (Padmaneri) end of eastern boundary as well as middle zone (Aladiyur forest beat) experienced high pressure from human resource extraction, but the rest of the area along eastern boundary were considered as medium pressure zones. According to the pressure scores of 2010 -11, all the sample beats spread across north to south of eastern boundary still experienced high medium pressure (frequency of occurrence 31 – 60%) after ecodevelopment. In straight terms, human pressure on PA slightly decreased in southern end of eastern boundary and remain same in northern side, but on the other hand slightly increased in the forest areas falling in between north and south corners of the park boundary. Greater proportion of wildlife presence than domestic livestock was observed in northern (79%) and southern (61%) end of eastern boundary during 2010-11 belt transect study indicated habitat improvement in that part of PA due to less biotic interference.

5.4 DISCUSSION

5.4.1 Change in Biotic Pressure after Ecodevelopment

There was slight decrease (6%) in cutting pressure near eastern boundary of KMTR between 98-99 and 10 – 11 when ecodevelopment was implemented in the fringe villages. But on the other hand, there was statistically significant increase (21%) of unpalatable weed species within Tiger Reserve indicative of browsing pressure due to entry of free grazing cattle. It was estimated that nearly 60% of free grazing scrub cattle in fringe villages were replaced by stall fed milking cow through ecodevelopment loans, but remaining 40% were yet to be replaced. In the first five years of ecodevelopment, KMTR management successfully replaced scrub cattle of fringe villages by offering loan for milking cow. Analysis of Village Forest Committee (VFC) records revealed that from 2007 onwards, comparatively less percentage of families asked for ecodevelopment loan to buy milking cow. Most probably, the local milk market got saturated by that time which made families uninterested towards milking cow loan. On the other hand, poor villagers didn't have the money to purchase fodder for the stall fed animal, and most of them were landless. As a result, they lopped branches from the PA which became evident by 10% preferred cut height between 1.37 m to 3.5 m in the recent transect study of 10 – 11. It can be reiterated here that the percentage decrease in cattle entry through PA boundary between 98-99 and 04–05 was statistically significant, but the decrease which took place between 04-05 and 10-11 was not significant.

The preferable girth classes (20 – 60 cm GBH) for cut trees in KMTR both during 98-99 and 10-11 indicated community preference for fire wood. Dixit and

Rajvanshi (1998) recorded 20 -50 cm as preferred girth class for Central Indian forests, and Silori (1998) recorded 25 – 60 cm girth class as preferred for fuel wood and construction purpose in Mudumalai Wildlife Sanctuary in South India. The preference of cut towards lower girth classes would have serious ecological implications regarding forest structure of Tiger Reserve by reducing the recruitment of trees into subsequent maturity classes (Pickett *et.al.*1989). A large number of individuals of small diameter sizes are of secondary species that contribute little to wood biomass (Sundriyal and Sharma 1995). If biotic pressure cannot be curbed beyond an ecosystem threshold, many more canopy species will be devoid of regeneration and the forest will be dominated by secondary species in due course. In due course, the adverse effects of secondary species would be the lowering of diversity as well as biomass in the buffer zone of KMTR. For example *Albizzia amara*, a large leguminous tree found in the dry southern regions of Tamil Nadu, was cut extensively for fuel, timber, green manure and gum in KMTR. We found less abundance of *Albizzia amara* during 10-11 survey as compared to that observed during 98-99. Such highly preferred species became rare due to high cutting pressure.

Similarly, most of the decrease (37%) in fuel wood head loading through boundary forest took place in the initial five years (98-99 to 04-05) of ecodevelopment, and there was comparatively far less decrease (3.4%) in fuel wood head loading in the later period of ecodevelopment (04-05 and 10-11) though the fund flow for the programme remain almost same in that stage.

Though considerably decreased (41%) in comparison to 98-99 (67% demand met from KMTR), still 26% of fuel wood demand of fringe villages were met from KMTR

during 10-11. There was negligible decrease in monthly fuel wood consumption (from 4 kg month⁻¹ in 98-99 to 3.5 kg month⁻¹ in 10-11) in village house hold level over the years. So, demand of fuel wood still persisted in the fringe villages surrounding KMTR. Demand for forest fuel wood was reflected by slight decrease (6%) in cutting pressure in forests near eastern boundary of PA between 98-99 and 10-11, and the difference was not statistically significant. The percentage decrease in number of fuel wood head loaders and cattle entry / exit through KMTR boundary during first phase of ecodevelopment (98-99 to 04-05) caused initial decrease in human pressure on park. This decrease allowed the highly damaged habitat near eastern boundary to recover. The higher presence of wild herbivores and carnivores near eastern boundary areas of KMTR in recent time was due to less human interference and corresponding habitat improvement. This happened due to reduction in number of resource dependent families in the fringe villages. But the increase in proportion of unpalatable weed species within transects definitely suggesting that grazing pressure was on the rise again between 04-05 and 10-11.

5.4.2 Biotic Pressure around Interior Settlements of KMTR

Interestingly, during 10-11 study, human pressure around enclave settlements within park was found slightly higher than boundary forests in terms of wood cutting, canopy opening and density of seedlings. The far lesser seedling density (ha⁻¹) in the interior forest around inside settlements than boundary areas indicated high grazing pressure due to free cattle herds originated from Electricity Board employees settlements. Excessive grazing followed by trampling, accelerates the process of soil erosion and thereby deplete the nutrient pool (Mashalla, 1988). Forests around inner settlements denuded in many places and soil characterized by 'gully erosion' indicated

cutting, trampling and browsing pressure. Similar concerns were echoed on settlement pressures within KMTR in the evaluation report on Tiger Reserves of India, published by Ministry of Environment and Forest, Government of India (2006). Though ecodevelopment was implemented in three 'Kani' tribe settlements from the beginning, it remained almost non-functional, and there was no ecodevelopment initiative in Electricity Board settlements within park.

6

Implementations of Ecodevelopment

6.1 INTRODUCTION

National parks and reserves represent the single most important method of conserving biological diversity worldwide (Brandon, K. and Wells, M. 1992). Biodiversity conservation and protected area (PA) management are both dynamic processes that change over time and space (Bajracharya *et al.* 2007, Budhathoki P. 2004). In the past several decades, governments have recognized the role of Protected Areas (PAs) in the overall national land use and economic development (McNeely 1993). But, despite many contributions of PAs to the modern society (Heinen and Youzon 1994), they suffer from the problems of weak national constituency, conflicts with local people, insufficient management and insecure / insufficient funding.

Most of the costs (including the opportunity costs) of conservation, particularly in developing countries, are borne by forest-edge communities, while the benefits accrue mainly to global communities and future generations (Wells *et al.* 1992). This imbalance between costs and benefits (Dixon J.A. 1991) often causes communities at the forest edge to opt for conflicting forms of land use (Bhardwaj & Badola 2007). Excluding people who live adjacent to PAs from use of these resources, without providing them with alternatives, is increasingly viewed as politically infeasible and

ethically unjustifiable (Brandon & Wells 1992). In response, projects which link the conservation of biological diversity in PAs with local social and economic development have been implemented, which all can be grouped under the heading of *Integrated Conservation-Development Projects* (ICDPs) (Wells 1992). Integrated Conservation and Development Projects (ICDPs) aim to protect biodiversity by providing local communities with tangible incentives for conservation management (Sekhran 1996). The needs and aspirations of local people must be considered if the biodiversity conservation initiative have to progress further (Dudley et al. 1999, Gadgil 1992, Kothari 1998, and Srivastava 2003). A clear incentive system for community conservation must be created that offsets the possible financial and resource-use losses that are often implied by PAs (Bhardwaj & Badola 2007). Recognizing the above facts, the government of India initiated Ecodevelopment projects (Panwar 1992) in 40 PAs in India through a centrally sponsored scheme in early 1990's (Mishra *et al.* 2009). Later on, India Ecodevelopment Project (IEDP) and World Bank aided Forestry Research Education and Extension Project (FREEP) was initiated simultaneously in 1995-96 in nine protected areas to test participatory biodiversity conservation in the country. FREEP project initiated in Kalakad-Mundanthurai Tiger Reserve, the present study site, as a pilot project in ecodevelopment.

An essential element in the design of every ecodevelopment is the consideration of the linkage between the conservation and development objectives (Bhardwaj & Badola 2007). All material benefits of a project must be clearly tied to its conservation actions (Owen-Smith and Jacobsohn 1988). In simple terms, while the core objective of ecodevelopment projects is protected area conservation, the projects aim to achieve this by promoting socioeconomic development and providing local

people with alternative income sources which do not threaten to deplete the plants and animals within the PA (Brandon & Wells 1992). The major objective of ecodevelopment is to reduce the anthropogenic pressure on a protected area. Projects seek to accomplish this goal through activities which generate benefits to local communities.

It has been discussed in chapter 4 and 5 regarding change in resource dependency and human pressure on KMTR after implementation of ecodevelopment in order to find the linkage between conservation and local socio-economic development. It was evident that both resource dependency and pressure on park reduced in the initial 5 years (98-99 and 04-05) of ecodevelopment implementation, but the human pressure on park didn't reduce at the same pace between 04-05 and 10-11 like initial years. In fact, in some areas near eastern boundary, it even showed the reverse trend. If we look at the desired linkage between the rural development practiced under the name of ICDP worldwide, or ecodevelopment in India, and the conservation outcome of such efforts, very few projects across the world succeeded in achieving the goal. Many ecodevelopment projects experimented in the fringes of PAs not even started properly, or in many cases the funding agencies withdrawn the project before it's official completion due to lack of any progress. In this backdrop, the socio-economic change which the KMTR management able to brought in the life of forest dependent families along with economic empowerment of women folk, can be termed as a major success of the program. The conservation linkage of such progress became evident from the statistically significant percentage reduction of fuel wood head loaders and cattle herds through park boundary between 98-99 and 10-11. Now,

there is a requirement to analyse the project components in a scientific manner in order to find out the socio-economic drivers of change.

In this chapter, an attempt has been made to understand the level of various inputs in terms of investments and range of activities carried out for different Ecodevelopment committees (VFCs), supporting Self Help Groups (SHGs), and individual households. Major changes in terms of processes; and legal, administrative and institutional structures to accommodate the new participatory approach of management have also been discussed. Efforts has also been made to understand the broad issues of the FREEP-KMTR project as well as steps taken for sustainability of the project initiatives in Post FREEP period.

6.2 METHODOLOGY

6.2.1 Collection and Review of Primary and Secondary Informations Regarding KMTR Ecodevelopment

All the 74 user villages identified during the reconnaissance described earlier are heterogeneous with respect to demography, community structure, livelihoods, and interactions with KMTR. These prominent variables were used to carry out a cluster analysis for grouping them. From each group, 15 percent of user villages were randomly selected for primary data collection (Fink 1995 and O'Donnell 1992). To capture the maximum heterogeneity of communities, above sample was supplemented by few more VFCs which appeared unique and representative as per

the knowledge and understanding of the researcher, and altogether 11 VFCs were taken as sample for socio-economic analysis.

To document and analyse the extent, activities and conservation linkages of KMTR ecodevelopment, secondary informations relevant to the study area were collected through perusal of existing documents and official records. To get informations on above parameters, secondary data were collected from various records kept in VFCs, forest department, block statistical offices, KMTR ecodevelopment status report 2004, published research papers and project reports.

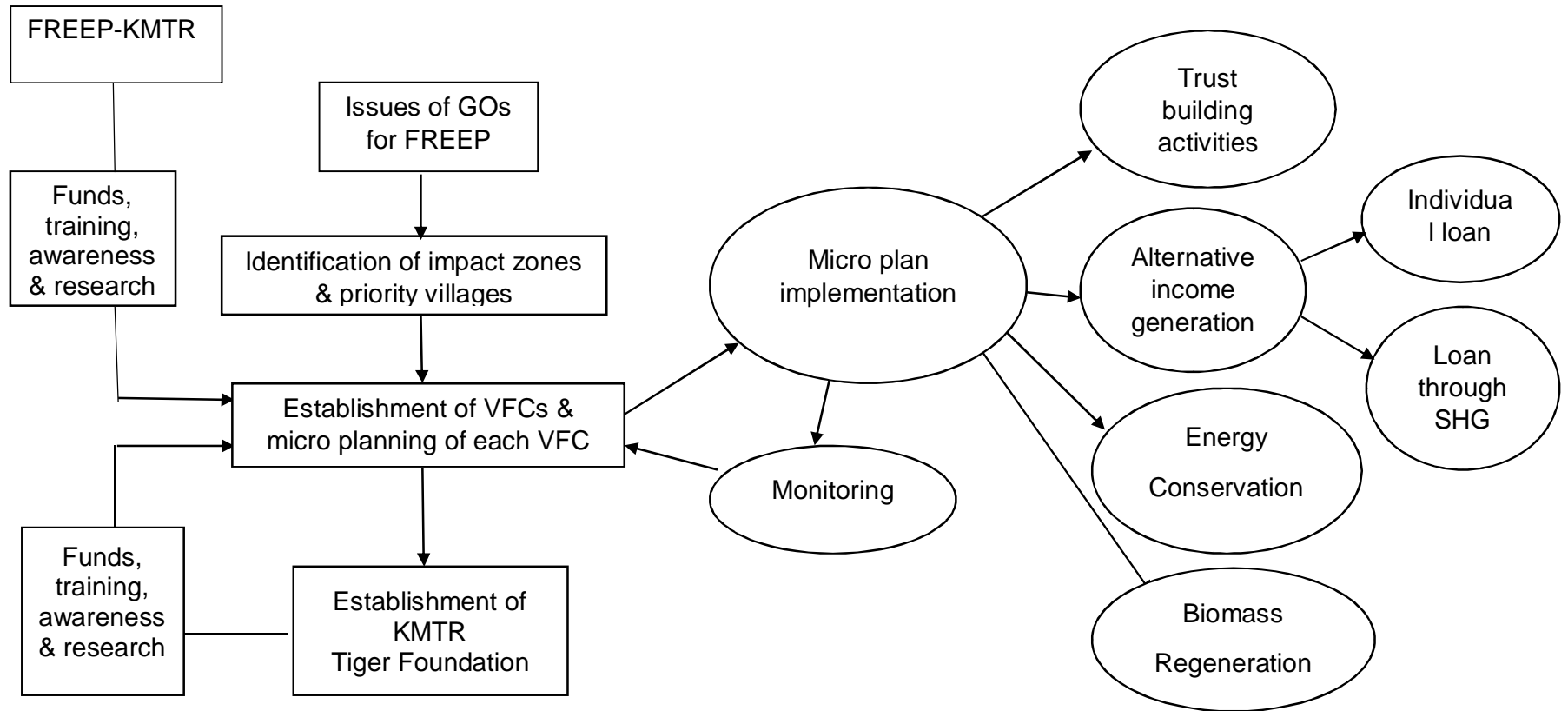
6.3 RESULTS

6.3.1 FREEP KMTR Project Initiatives

The Forestry Research, Education and Extension Project (FREEP) document prepared for World Bank funding (1993) defined ecodevelopment as a 'strategy for protecting ecologically valuable areas from unsustainable or otherwise unacceptable pressures resulting from the needs and activities of people living in and around such areas'. As part of FREEP project in India, conservation of biodiversity through improved park management and ecodevelopment was initiated in KMTR in south and the Great Himalayan National Park (GHNP) in Himachal Pradesh in north as a pilot project involving local people in conservation (Annamalai, R. 2004). This five-year project (1994 – 1999) extended by another two years (1999 -2001) with an outlay of INR 118.24 million for KMTR is envisaged to generate valuable experience and information on causes, concerns and outcome of local people's involvement in conservation of

biodiversity (Annamalai, R. 2004). The main focus of KMTR ecodevelopment was to 'reduce human pressure on eastern side of Tiger Reserve by offering economic incentives mainly to forest dependent population to compensate the opportunity cost bear by them for conservation, through alternative non-forest based income generation scheme.' In addition, provision of alternative energy resources and energy saving devices (wood and non-wood) through loans, and biomass regeneration in villages through village level ecodevelopment institutions (VFCs) were also practiced, but in much more lower scale than the first one. The broad processes and the inputs of the project are described in Figure 6.1.

Figure 6.1: Broad processes of FREEP- KMTR and post FREEP



6.3.1.1 Creating an Enabling Environment

For the successful implementation of FREEP it was necessary to have appropriate policy, legal, and institutional support. Therefore changes in the legal, administrative and managerial environment were made.

6.3.1.1.1 Legal and Administrative Framework

It was found after discussion with forest officials that during Pre-FREEP period, the community related program was mainly driven through approved annual plans for the reserve and the activities were carried out in the traditional mode of departmental working. To provide legal backup for the implementation of FREEP, Government of Tamil Nadu came out with sequential Government Orders (GOs) from 1995 to 1999 (Table 6.1). These GOs provided the necessary backup of the policy support and institutional mechanisms for the implementation of the FREEP and post FREEP sustainability.

6.3.1.1.2 Institutional Framework

An elaborate institutional mechanism for implementation of the FREEP in KMTR under the umbrella of new legal framework of the state was put in place (Table 6.2). These institutions ensured the participation of different stakeholders, quick decision making at the PA and state level and facilitated the implementations of FREEP at the grassroots level.

6.3.1.1.3 Management Focus

The inward looking focus of the management gradually provided space for addressing the nearby village community - KMTR interface conflict issues. Participation of local communities in different protection and management initiatives became an important facet of KMTR. The micro plans were prepared for all the village forest committees (VFCs) to build community assets, strengthen livelihoods of local people, reduce resource use pressure on PA, and strengthen community support for protection of KMTR. It involved active participation of people and was based on Participatory Learning and Action methods. Memorandum of Understanding (MoUs) with VFCs defined the mutual duties and responsibilities of the VFCs and park management. The salient features of VFCs duties and responsibilities and role of forest department staffs are mentioned in table 6.3. Through implementation of the program, the exclusive protection approach of the management gradually transformed into participatory protection.

6.3.1.2 Impact Zone of Ecodevelopment

According to forest department, the selection criteria for implementation areas were that the sites are representative of variety of conservation problems that are affecting the PA and that there should be a real chance of measurable and demonstrable success in the project life time (T. Sekar 2013). On the basis of informations generated through initial surveys of the department, area up to 5 km radial distance from KMTR eastern boundary was taken up as impact zone of the project. Official records estimated 113 villages consisting a population of 80,317 initially participated in the project. From 20,020 families in these villages, 15,298 (76%

families) joined as members of the Village Forest Committees (VFCs) during first phase of the project (T. Sekar 2013). This population mainly comprised of backward (56%) and scheduled caste (40%) communities sustaining on rain fed rice production and forest resources.

Table 6.1: Government Orders (GO) issued for enabling the process of change in KMTR management

| Government Order (GO) | Issues Addressed | Outcome |
|--|--|---|
| G.O.Ms.No.634 Environment & Forests (FR.V) Department, Dated 10.9.90 | Redeployment of post of research officer & re designated as ecodevelopment officer | One IFS officer deputed exclusively to look after and control various initial implementations of KMTR ecodevelopment |
| Minutes of the second state project implementation committee (C.No. 4729/94/P dt. 28.3.95) | Rules for the constitution of village forest committee | Process, structure and responsibilities of village level institution in place |
| Minutes of the fifth state project implementation committee (C.No. 7309/96/P dt. 4.10.96) | Implementation of approved Micro plans by village forest committee - procedure, formalities & guidelines | Detail guidelines and plans for implementations of alternative income for forest dependent, alternative energy and biomass regeneration by VFC formulated |
| G.O.Ms No. 288 Environment & Forests (FR.V) Department, Dated 19.11.96 | Fund transfer mechanism for village forest committee | Mechanism for seed money and subsequent fund transfer from project to VFC for micro plan implementations were formulated |
| G.O.Ms.No. 326 Environment & Forests (FR.V) Department, dated 30.12.96 | Exemption from Madras financial code. 192 for FREEP | Legal backup for TN forest department to launch community development, energy conservation & biomass regeneration in the fringe villages. Duties and responsibilities of VFC members and role of eco rangers, foresters officially framed |
| G.O.Ms. No. 3 Environment & Forests (FR. V) Department, dated 7.1.97 | Exemption for doing civil works inside the reserve forest and outside | Forest department can do any infrastructural & community asset creation work within KMTR and within villages designated for world bank ecodevelopment |
| G.O.Ms. No. 30 Environment & Forests (FR. V) Department, Dated 11.2.97 | Inclusion of collector, Tirunelveli as one of the member in the State project implementation committee | Advantage for forest department to approach other govt. departments and bodies for cooperation & input in ecodevelopment implementations in community level |
| Minutes of the seventh state project implementation committee (C. No. 835/98/P dt. 23.07.98) | Construction of Eco Centers, formation of Self Help Group (SHG). Fund transfer to village forest committee (VFC) & future strategy | All the village forest committees in KMTR were registered bodies under Tamil Nadu Societies Act 1975. It was decided that the fund generated in each VFC during project period would remain as revolving fund and would continue to be their property after official completion of project. |
| GO, Government of Tamil Nadu | GO for establishment of Kalakad Mundanthurai Tiger Conservation Foundation as a trust | Institutional arrangement for sustainability of the ecodevelopment programme beyond FREEP in place |

Source: Ecodevelopment status report (2004) and KMTR Tiger Conservation Foundation website

Table 6.2: Institutional framework for FREEP and beyond

| Institution | Structure | Role |
|--|--|---|
| Village Forest Committee (VFC) | General body consisting of all the VFC families in a village, represented by any two adult members from each house (female & male). Executive committee with adequate representation of all sections of village, minimum 50% member to be women. | Basic village level body for planning and implementation of ecocodevelopment. |
| PA level coordination committee (PACC) | Chairmanship of Field Director, KMTR with members from development agencies, public representatives and NGO | Decentralized body for quick decision making at the level of KMTR management as well as space for involvement of different stakeholders |
| State level project implementation committee of FREEP-KMTR | Secretary, Department of Environment and Forest, Field Director, KMTR, Eco Development officer, scientists, and local NGO representatives | Decentralized body for quick decision making at the level of KMTR management as well as space for involvement of different stakeholders |
| Office of the Ecocodevelopment Officer(EDO) | Ecocodevelopment officer and his/her support team of field and office staff. Creation of separate Eco Range offices with an officiating Eco Range officer and forester exclusively looking after ecocodevelopment with a group of NGO representatives. | Solely focussing on FREEP-KMTR ecocodevelopment implementations |
| Micro-plan implementation support team | Eco Ranger, Forester, Forest guards and NGO representatives | Facilitate micro-planning process |
| KMTR Tiger Conservation Foundation | Government trust | To carry on the processes and programs set in motion under FREEP by providing continuing financial, institutional and technical support |

Table 6.3: VFCs responsibilities and forest staffs role in VFCs

| VFCs responsibilities | Role of Forest Staffs in VFCs | MoU | Objectives of MoU |
|---|--|---|---|
| A GB meeting to be held once in every three months to review the functioning of the executive committee. Eco Range Forester to be present as Member Secretary, but don't have any voting rights | Eco forester and range officer will attend GB & EC meetings and tender advice, but will not vote | Signed between ecodevelopment officer and executive committee members of each VFC | a)Reduction in number of head loads from forest |
| VFC members, individually and collectively will: | Forest and wildlife law breakers VFC membership may get cancelled by range officer by the recommendation of EC | Undertaking given by EC members in the MoU were as follows: | b)Reduction in grazing inside KMTR |
| a)Ensure protection against grazing, fires and illegal extraction of forest produce in accordance with micro plan | | a)To implement micro-plan with sincerity | c) Reduction in scrub cattle |
| b) Make other non-member villagers aware of the importance of forest | | b) Prevent livestock grazing within KMTR | d) Creation of biomass resources of fuel and fodder in and around villages outside KMTR |
| c) Assist forest officers in carrying out forestry works in accordance with ecodevelopment plan | | c) Stop fuel wood, timber and MFP collection from KMTR | |
| d) Identify beneficiaries in accordance with approved ecodevelopment plan | | d) Villagers will protect KMTR for future and will extend all sorts of cooperation to Forest Department in KMTR biodiversity conservation | |

Source: Ecodevelopment status report (2004) and VFC micro plan documents

6.3.1.3 Micro-planning

Immediately after the identification of impact zone and priority villages, the process of micro-planning was started. In few other sites like Gir National Park, Great Himalayan National Park, the task of micro-planning was given to prominent NGOs and the results of these arrangements was not very encouraging (World Bank 2004, Wani and Kothari, 2007). In KMTR, the task of micro-planning was carried out in collaboration with villagers, ecodevelopment rangers, foresters, forest guards and local NGO representatives. It was a real team effort of the three main stakeholders i.e. fringe village community, forest department, and NGOs. Participatory Rural Appraisal (PRA) method carried out during preparation of village micro plans for ecodevelopment which provided opportunity of mutual learning and understanding of the program to staff as well as communities. Communities were involved in social mapping, resource mapping, semi-structured interview, wealth ranking, institutional diagram, pair wise ranking, and seasonality analysis. Micro planning for each VFCs included community asset building, alternative income generation for forest dependents, alternative energy and energy conservation devices, bio mass regeneration and human resource development. After it was ready from all respect, village micro plan for the implementation of ecodevelopment finally got approval of Field Director KMTR, and then subsequently implemented by VFC. Copies of micro-plans were made available to the VFC members in Tamil language to ensure transparency.

6.3.1.4 Constitution of Ecodevelopment Committees

As per the provisions of GOs issued by Government of Tamil Nadu during 1995, VFCs were constituted in prioritized fringe villages. Initially 132 villages were covered under FREEP – KMTR (1995-1999). Due to the successful implementation of project, World Bank extended financial aid for another two years, which was up to 2001. Due to proper functioning of most VFCs after stipulated project period, continuous funding is being provided from the Project Tiger scheme from 2002 onwards. 75 VFCs were formed under Project Tiger. At present, eco-development committees were formed in 207 fringe villages. One uniqueness of KMTR Village Forest Committees were that the VFCs registered under the Tamil Nadu Societies Act 1975, and thus become a statutory body attracting the provision of the act. All the 180 VFCs of KMTR were established over a period of 8 years, maximum being formed during second year of the project (Figure 6.2). Demographically the fringe villages around KMTR were extremely varied with a very small hamlet like Thirupaniyapuram with only 32 families to Dana VFC consisting 477 families. Care was taken to include all SC, OBC, ST and women headed households in the VFCs. Among surveyed households in sampled VFCs, 26% were women headed.

Any two adult members from each family became member of VFC provided at least one of them being a woman. One rupees member⁻¹ month⁻¹ were levied as membership fee. General Body (GB) meeting in each VFC scheduled to be held once in every three months, and the quorum was at least 50% of households represented by one of the adult members from each family. Similarly, the Executive Committee

(EC) of each VFC also should have at least 50% elected members women. EC members had to get elected in each year. As per VFC guidelines and rules, EC members would meet once in a month or whenever needed. EC members would choose VFC chairman among themselves through voting for two years term, wherever same person not to be elected as chairman for more than two terms. One representative of voluntary agencies / NGOs were also included as non-elected member along with concerned eco-forester of the area as member secretary. Both of them did not have any voting rights according to the constitution of VFC. The Field Director, Ecodevelopment Officer or the Eco Range Officer gave directions from time to time for smooth and proper functioning of EC which would be binding on the committee.

6.3.1.5 Inputs

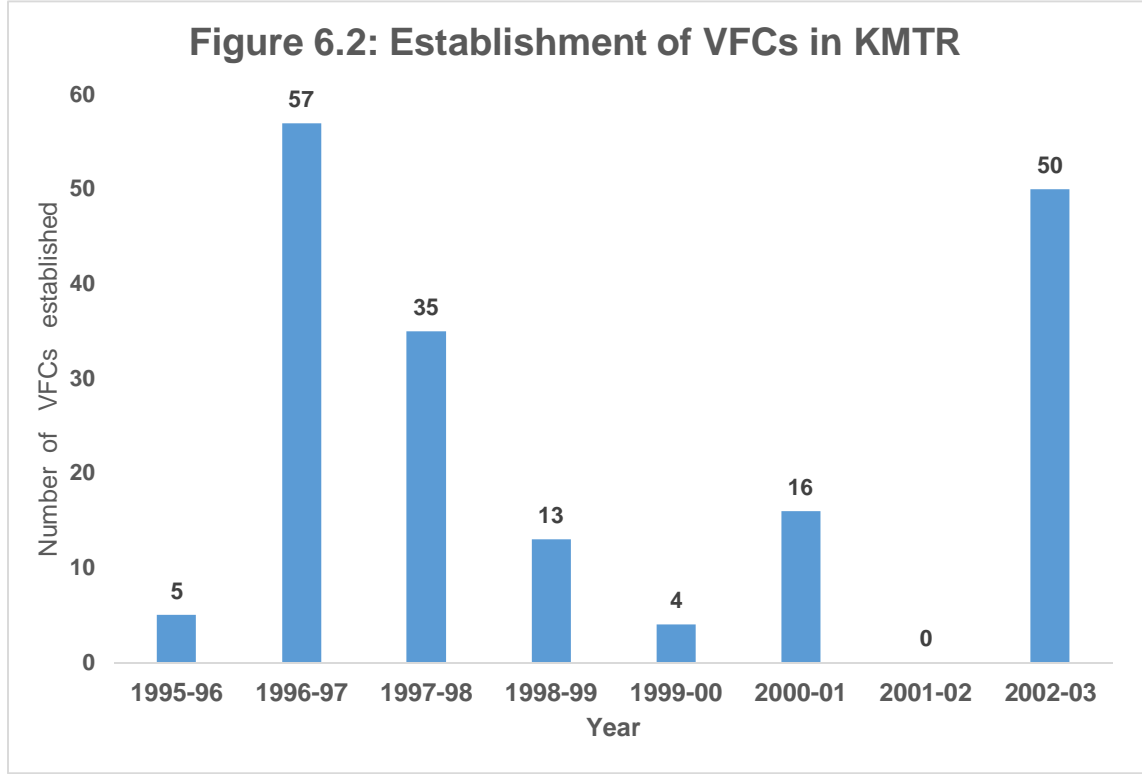
As part of the FREEP, inputs not only financial terms but also in terms of efforts and capacity were provided. The following section describes the financial and qualitative inputs provided as part of the FREEP-KMTR.

6.3.1.5.1 Financial Investments

During FREEP period, an amount of Rs. 11.52 crores had been invested on different activities of KMTR. The seed money disbursed from the Project and Project Tiger fund allocation during the period of implementation was Rs. 6.84 crores, which has grown to a corpus of Rs. 9.69 crores (42% increase) as on March 2013, which showed the quantum of people's participation unique among 10 sites selected almost simultaneously for FREEP and IEDP together. The average investment per household

on ecodevelopment activities has been Rs. 7730, whereas in Periyar Tiger Reserve ecodevelopment in Kerala the per household investment amounts to Rs. 13,570. Definitely the per household investment in KMTR is not very high, and therefore, might not have been a clear booster to stir people involvement in the project. Despite this, overall people's response towards KMTR ecodevelopment is quite outstanding and the total coverage of fringe villages is very high. Though it was also found in socio-economic survey of sample VFCs (chapter 7) that the attendance of members in VFC meetings, especially male, decreased significantly in later stages (04-05 to 10-11) of ecodevelopment.

At the end of World Bank project tenure by 2001-02, a total of 132 VFCs were functioning. With further funding support from the Project Tiger, 96 more VFCs were added by 2012, thus bringing the number of villages covered to 228. Broadly the investments had gone in three major areas of the management. These are civil works inside and outside PA as part of improved PA management, village ecodevelopment programme, effective and extensive support for ecodevelopment. The last item covered two important areas of investments i.e. environmental education and awareness program and impact monitoring and research.



During initial phase of project, various activities like provision of drinking water, roads and check dams in villages, bore well, drainage, facilities and infrastructure for schools, renovation and construction of temples, churches etc. were done as 'entry point activities' to win over trust of village communities, and as an initial channel of communications with forest resource dependent population who were naturally hostile and antagonistic towards forest department. There were three major areas in KMTR ecodevelopment viz. alternate employment opportunities for the forest dependents, provision for biomass regeneration in and around prioritized villages, and energy substitutes for wood and provision of fuel efficient devices. Though it was found during household survey and sample VFCs record analysis that the major on field thrust of management was towards alternative livelihood generations, and in reality the other two activities was mostly on paper (chapter 7 and 8). On the basis of approved micro plan, Ecodevelopment Support Fund (EDSF) is transferred to the VFC bank account, which is jointly operated by chairman and member secretary of the committee implementing the micro plans for village ecodevelopment.

Looking at the overall picture (Table 6.4), it is seen that maximum investment had made in ecodevelopment support fund in KMTR (51%), which was much higher in comparison to neighbouring Periyar Tiger Reserve ED initiative where 35% of investment made for ecodevelopment, and 57% investment made for improved park management. Clearly the park management of KMTR were more focussed on basic principles of ecodevelopment, and maximum thrust were given to reduce forest resource dependency of poor villagers who are designated by World Bank as 'Special Needs Group' (SNG).

Among ecodevelopment implementations, nearly 6.6 million were spent for 'entry point activities' (EPAs). Within loan components (3.35 crores), nearly 80% (2.67 crores) sanctioned for alternate income generation scheme by providing micro credit to individuals and later on by formation of Self Help Groups (SHGs). Rest 20% (6.8 millions) utilized for energy conservation. The project enabled supply of husk chullah (2,048), hot-point stove (1,048) LPG (956) and biogas plant (348) to a total of 4,400 families where 25% of the cost bore by the beneficiary (in kind, if not in cash) and 75% given from project as loan with interest.

Other than these, different strategies were adopted to create alternative biomass production and augment fuel, fodder and other resources. Nearly 10,749 households were benefitted through the supply of 0.143 million fruit seedlings for home garden, and about 0.063 million miscellaneous seedlings for patta land plantations. As community resource base, 171.75 km Road Avenue, 182.65 ha of poramboke plantations and 18.25 ha of fodder plots were raised. The total investment made for biomass regeneration was 5.97 million in Indian rupees. Though it was found during household survey in sample VFCs that effectively very little had been done regarding biomass generation in buffer areas. (Chapter 7 and 8).

Table 6.4: Total financial investment under FREEP-KMTR

| Sl. No | Major Components | Investment (Rs in Crores) | % |
|--------|---|---------------------------|-------|
| 1 | Civil works | 2.05 | 21.78 |
| 2 | Ecodevelopment support fund | 4.77 | 50.69 |
| 3 | Effective and extensive support for ED <ul style="list-style-type: none"> • Training & workshops • Studies & consultancies • Public awareness • Research & monitoring | 2.59 | 27.52 |
| | Total | 9.41 | |

Source: Ecodevelopment status report 2004

Comparatively much lesser amount allocated for studies and consultancies (3.15 million or 2.74% of budget), public awareness generation (4.79 million or 4.16% of budget) and research & monitoring (8 million or 6.94% of budget).

If solely expenditure on major components of KMTR ecodevelopment implementations (Figure 6.3) are considered, maximum investment made for alternative income generation for resource dependents (38%), whereas almost similar investment made for community asset building (10%), energy conservation (10%) and biomass regeneration (9%). Similarly almost equal investment made for various training and workshops (14%) for forest staffs and village communities, and research and monitoring (12%) of various aspects of plant and animal biodiversity, as well as long term impacts of ecodevelopment implementations. Recent data (2013) suggests, that the total seed money given for alternative employment was Rs. 5, 01, 45,941, and the total corpus fund available with people and bank for 228 VFCs is Rs 8, 48, 99,946.

When the three major thrust areas in ecodevelopment implementations i.e. improved PA management, village ecodevelopment and awareness, training, research and monitoring is compared between KMTR, and other notable IEDP sites like Periyar, Gir and Buxa, it shows that among them, management of KMTR made maximum investment towards village ecodevelopment, and training, research and monitoring (Table 6.5), and the coverage of real forest dependent population in VFCs alternative employment scheme was much more robust than other comparable ecodevelopment sites. This was one area where the able officers in charge of initial stage of implementations visualized and targeted the main issue of 'conservation through reduction in forest resource dependency' far more efficiently than others.

Following usual government policies in India, least investment was made for scientific studies, research and consultancies (5%) by various independent agencies expert in the above mentioned field of investigation, and for generating public awareness (7%) regarding value of KMTR biodiversity and the need of conserving it. Though it is required to mention here that despite of minimum and insufficient investment in scientific studies and research, quality scientific reports and extremely valuable baseline informations generated by certain research team which is very useful for Tamil Nadu forest department in their present and future plan of action towards conservation of biodiversity in KMTR through ecodevelopment (Table 6.6). This was again became reality due to the fact that KMTR management had chosen right kind of institutions like Wildlife Institute of India, French Institute etc. who are capable of generating valuable baseline informations in the field of ecological and socio-economic study. Similarly renowned NGOs like Dhan Foundation Madurai, Vivekananda Kendra, Kanyakumari, Arumbugal Trust, Tirunelveli etc. were helped

Forest Department in sharing their expertise in ecodevelopment micro planning, microfinancing through formation of SHG, biodiversity awareness among fringe communities etc. The hand holding of local professional NGOs, and their local on field representatives became real assets for KMTR ecodevelopment implementations. Most of these NGO members taken responsibility of different VFCs were women.

Table 6.5: Comparison in major areas of investment made in KMTR, PTR, Gir and Buxa Tiger Reserve ecodevelopment programme

| Sl. No | Major Components | Percentage of investment | | | |
|--------|--------------------------------|--------------------------|-----|-------|---------|
| | | KMTR | PTR | GIR | BUXA TR |
| 1 | Improved PA management | 21.78 | 57 | 26.34 | 44.9 |
| 2 | Village ecodevelopment | 50.69 | 35 | 66.89 | 46.3 |
| 3 | Awareness, training & research | 27.52 | 7 | 6.77 | 8.4 |

Table 6.6: Research and monitoring covering conservation and human aspects

| Institutions | Research output |
|---|---|
| Wildlife Institute of India, Dehradun | Research project reports on various aspects of plant, animal diversity, habitats, rare and endangered species, anthropogenic pressures, social and economic aspects of ecodevelopment initiatives, management plan, and monitoring protocols to assess the impacts of ecodevelopment in reduction of human pressure |
| French Institute, Pondicherry | GIS Maps, reports on plant taxonomic status survey |
| Tropical Botanical Garden and Research Center, Kerala | Research reports on biodiversity status of KMTR |
| Manonmanian Sundaranar University, Tirunelveli | Research and monitoring report |

6.3.1.5.2 Village Ecodevelopment Implementations

Ecodevelopment in KMTR was mainly focussed on three areas i.e. compensating forest dependents by offering alternative livelihood through micro financing, provision of non-wood energy sources and fuel efficient oven and cooking gadgets, and regeneration of fuel wood species and other bio resources in and around KMTR dependent villages. Percentage of beneficiaries in alternative livelihood, energy conservation and biomass regeneration were given for all the VFCs formed during project period, and the eleven sampled VFC data for the same period in Table 6.7. Nearly 73% of non-forest based alternative livelihood loans were given to most dependent families (red group) during World Bank project period from 1995-2001, whereas the red group loan receivers for sampled VFCs were found to be 77% of the total loans. Remaining 25% loans were given to families partially dependent (yellow group) on KMTR resource who might visit Tiger Reserve occasionally for collection of fuel wood and other resource for own consumption. Only 4% of total loan were given to green group families who might have no direct dependency, but occasionally employ head loaders, or customer of forest fuel wood. The identification of poor forest resource dependent households were done in KMTR through a prior demographic survey, and it helped the management to plan eco-development accordingly. Tamil Nadu forest department were focussed towards these families from the beginning of eco-development, and the state Government GO also made use of the survey findings, and clearly prescribed priority for the weaker sections during micro planning and implementation of eco-development activities. In comparison to other parks in India, it had been observed that clear GOs for KMTR and Periyar paved the way for institutionalization (PEACE – ELDF report 2004). Women empowerment remained as one of the main theme of KMTR eco-development project. Of the total loans distributed

during project period, women received 59%, and in sampled households the proportion of women loan receiver were 62%. In energy conservation programme, all the non-wood energy sources and fuel efficient devices were promoted by the project with a monetary / equivalent kind contribution in the ratio of 3:1, where project provided 75% of the cost as 12% per annum interest rate loan, and the member contributed remaining 25%. It was observed that by taking a policy of partial contribution of the member in procurement of alternative energy sources, the percentage of return got higher in comparison to programmes where the total cost was given to the beneficiary as loan from the project. Among a total of 4608 households, nearly 45% received husk chullah from the project, with another 23 and 21 percent families got hot-point stove and LPG. Only 4 – 6 % families got pressure cooker as energy saving cooking device. This may linked to the in general disliking for pressure cooker cooked food among rural communities. Seedlings and seeds of many popular fuel wood species, fruit and fodder species were distributed among VFC families during project tenure to regenerate biomass in the outer buffer of KMTR to reduce pressure on park. It is to be mentioned here that funding from Project Tiger office were made during post World Bank Ecodevelopment to continue all the efforts given during project to reduce local forest dependency and henceforth anthropogenic pressure.

From VFC sample survey, the percentage of major alternative income generation activities and energy conservation initiatives were determined (Figure 6.4).

Figure 6.3: Major project expenditures

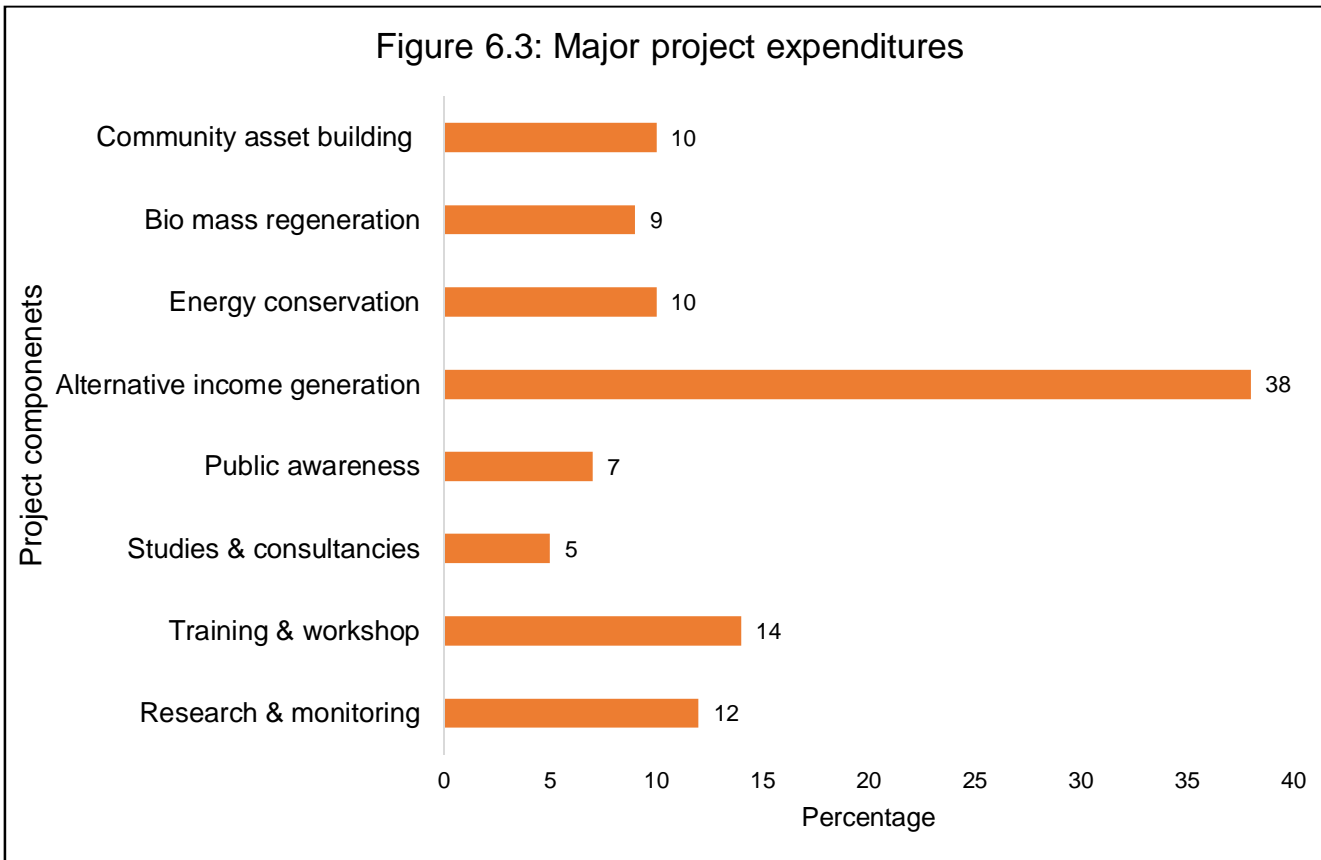


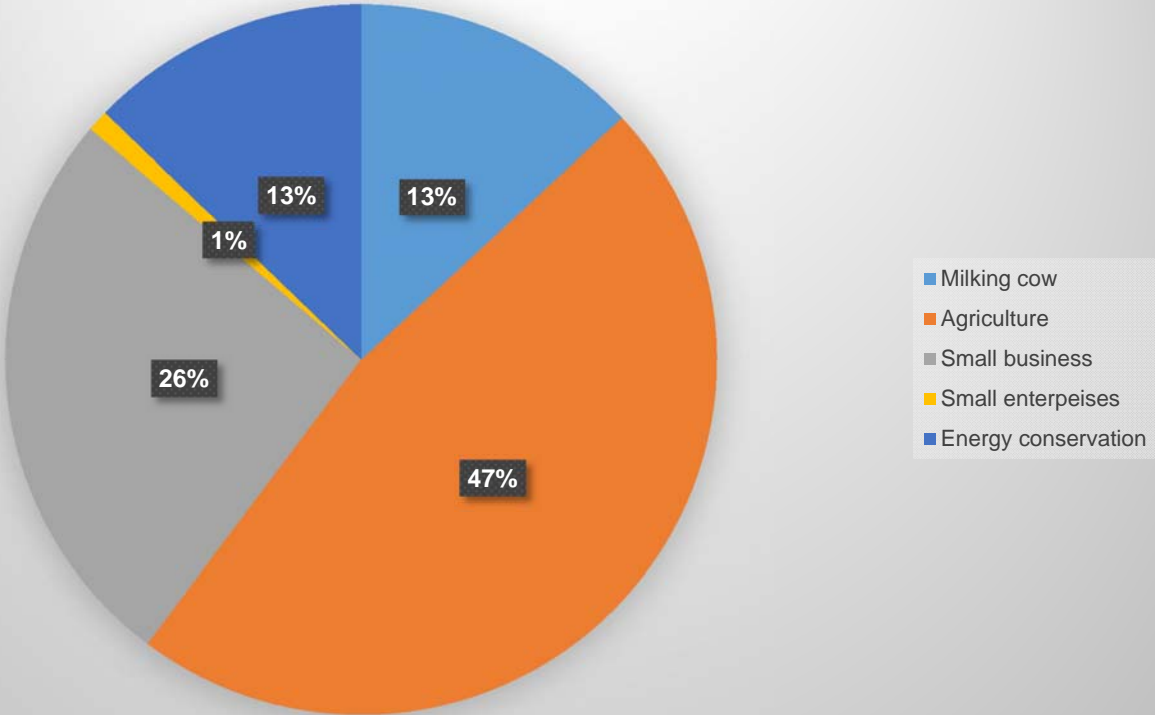
Table 6.7: Percentage of beneficiaries in all the VFCs and sampled VFCs till 2004

| VFC | Alternative livelihood | | | | | Energy Conservation | | | | | | | Biomass generation |
|----------------|------------------------|--------------|------------|--------------|--------------|---------------------|-----------------|-------------|-----------|-------------------|------------|--------------|--------------------|
| | R | Y | G | M | F | Husk Chullah | Hot-point stove | LPG | Bio gas | Smokeless Chullah | Cooker | Total family | Benefited family |
| 129 VFCs | 10447 (73) | 3584 (25) | 449 (4) | 6209 (42) | 8775 (59) | 2048 (45) | 1048 (23) | 956 (21) | 24 (1) | 348 (8) | 184 (4) | 4608 | 10749 |
| 11 Sample VFCs | 1096 (77) | 301 (22) | 34 (3) | 562 (39) | 880 (62) | 75 (19) | 83 (21) | 141 (36) | 3 (1) | 3 (1) | 23 (6) | 395 | 1597 |

R indicating Red, Y Yellow and G Green VFC families. M means Male and F means Female VFC members

Percentage of total given in parenthesis

Figure 6.4 : Major non-forest alternatives in KMTR ecodevelopment



From records of eleven sampled VFCs, it was found that majority of families (47%) had taken loans for agriculture purposes, followed by various types of locally suitable alternative source of income (26% families) like tea stall, vegetable and fish vending, idli shop, groceries, clothe selling etc. In KMTR ecodevelopment, large number of families (13%) had taken loans to bought milking cow for selling milk to other households, milk cooperative and tea stalls located in large number everywhere. Another 13% families had taken loan for LPG, hot point stoves, husk chullah etc. It was found that percentage of loan recovery was quite high in KMTR ecodevelopment in comparison to similar initiatives in other Protected Areas (PAs) of India. After three years from official completion of World Bank ecodevelopment assistance, till March 2004, 100% loan recovery recorded in 60 VFCs (32% of total) out of 182 total VFC functioning till date. Only there were 13 VFCs (7% of total) where loan recovery rate accounted less than 60% (Table 6.8). During sample survey of VFCs in 2009-10, it was found that out of total 56 VFCs in Papanasam eco-range, which one supposed to be the largest consortium of VFCs, the rate of loan repayment was 100% in 20 VFCs, where in remaining 36 VFCs it was within 80 – 99%, which was highly satisfying in comparison to other Protected Area ecodevelopment initiatives in India. Though it was also revealed that out of these VFCs, there were 17 committees where conflicts going on regarding repayment of alternative income generation loans. Ironically, contrary to the popular belief, conflicts were going on in villages belonging to same caste composition (10 SC, 2 mixed and 5 Nadar & SC dominated villages) rather than mixed villages.

Under enterprise development and business support, large number of beneficiaries particularly women were benefited. Small loans had been availed by

women through Self Help Groups (SHGs) for initiating micro enterprises and self-employment initiatives through group business activities. Support had been given both for individual as well as group activities. The real success of KMTR ecodevelopment lies on the capability of mobilization and empowerment of women folk (Badola and Ogra 2014). There was significant presence of women from local NGOs to EC and GB members within village forest committees (VFCs). In all the above organizations, there were significantly higher participation of women in comparison to men. It was made possible by clear order by Government of Tamil Nadu that at least half of the elected members of the Executive Committee of any VFC should be women, and it's motivated implementation by park management. This gave women a firm voice in decision making in the VFC. Applying Wilcoxon signed rank test it is found that both the number of only women SHG ($Z = 0.017$) and average number of women SHG members in each sample VFCs ($Z = 0.031$) had significantly increased between 2004 and 2009, means significant women participation in KMTR ecodevelopment even continued long after formal completion of world bank monetary assistance in the year 2001. Management of Periyar Tiger Reserve (PTR) learnt lessons from KMTR ecodevelopment, and also given special focus on women centric activities in India Ecodevelopment Programme (IEDP) introduced in PTR after FREEP-KMTR. There were 540 women SHGs formed in KMTR ecodevelopment, and the number of women beneficiaries were 6980. The amount invested from project as loan to the women SHG members was 94 lakhs INR, and the percentage of loan recovery from the beneficiaries reached almost 96%. Till 2012, the total number of SHGs had grown to 940, among which 837 were women SHGs. Support had been given both for individual and group activities. Many alternative activities like idli making, wire and leaf basket preparation, clothe selling, sewing and stitching, pickles jam papad preparation, selling

flower garlands, preparing wig hair etc. were predominantly women centric activities. These alternatives were tried through SHG activities. But along with such encouraging facts, it also been noticed that most of the time highest position in VFC, the chairman, occupied by male members. It was found that till 2004, only 35% of VFCs (63 out of total 182 VFCs) were having women as chairman, whereas there were always more number of women members (average 4 women members in 7 member executive committee in each VFC) in EC empowered to elect chairman in village forest committee for a duration of two years.

When there was conservation linkages in provision of non-wood energy alternatives and milking cows to forest dependent poor families, the significance of highest percentage of loans for agricultural purposes was not clear. If the agriculture loans provided to landless farmers taken lease land or farming in some others land, to improve productivity, and henceforth increase of income for landless labour families, then it had some significance. But in reality benefits went to farmers with large land holding, and thereby not linked with conservation objective of ecodevelopment.

Table 6.8: Loan recovery status till March 2004

| Percentage of loan recovery | Number of VFCs | Percentage of VFCs |
|-----------------------------|----------------|--------------------|
| 100 | 60 | 32 |
| 90-99 | 38 | 22 |
| 80-89 | 35 | 20 |
| 70-79 | 17 | 9 |
| 60-69 | 18 | 10 |
| < 60 | 13 | 7 |

6.3.1.5.3 Capacity Building

After initiation of ecodevelopment in fringe villages, the emphasis on training had gradually enhanced. With a view to improve the skills of villagers for choosing their livelihood, various trainings like tailoring, embroidery, driving, computer, animal husbandry, handicrafts, food processing, training for proper use of biogas etc. were organized in VFCs on behalf of project. About 2281 members benefitted from such trainings (Dr. T Sekar, 2013). When percentage (Figure 6.5) of participant members (04-05 data) in various skill development programmes are analysed, it is found that 49% participants received training in handicrafts & food processing, followed by 25% in tailoring, and most of them were women. Other than these, 12% of participants trained in animal husbandry, and 8% in driving. It was observed during survey, and later on advocated by others that the training extended to the women particularly on tailoring and embroidery helped to build up their skill to pursue the avocation using the loan amount. Similarly, some of the male members found employment after trained in driving skill. It is estimated that nearly INR 10.65 lakhs of expenditure was made in skill development till 2004, and the projected average earning was INR 2022 per month per person during that period. In reality, it was found that after acquiring such skills from project, nearly 922 (40%) out of 2281 participants found gainful employment. 73% participants in 11 sample VFCs were trained in employable vocations like driving, computer training, tailoring, various handicrafts and food processing (Table 6.9), and another 28% participants received trainings in vocations like fishing, poultry, mushroom, wooden handicrafts, biogas training etc. where they require to market the product and some value addition to it was needed for business profit. No such training on product marketing or value addition were organized for them by the project. Training regarding Self Help Group (SHG) microfinancing were

organised only in one sample VFC. That also was organized only for once or twice. Skill development initiatives hadn't started till 2010-11 in the villages under Thirukurangudi eco-range located in the southern end of KMTR's eastern boundary. Similar like 2004-05, more women received alternative skills trainings than men in sample VFCs during 2010-11. 66% members trained in vocations which were primarily women oriented, and only around 15-20% members trained in vocations which were men oriented. A total of 276 participants (47% of member) out of 583 members trained in sample VFCs till 2011, received training in tailoring, handicrafts and food processing, and most of them were SHG members of their VFCs.

From VFC sample survey, a list of various capacity and awareness building programmes are given with all details (Table 6.10). Trainings also organized regarding VFC structure and functions, entrepreneurship and employment generation, micro financing, self-help groups, and on various uses of medicinal plants found in KMTR. In-house trainings were mostly organized by technical staff (sociologist, ecologist, economists from local universities like Manonmanian Sundaranar University, Tirunelveli) hired by the project. Other trainings were carried out with the technical support of a number of local and national level institutions. These include Vivekananda Kendra, Kanyakumari, Dhan foundation, Madurai, Abhay ashram, Tirunelveli, Socio economic development trust (SEED, Tirunelveli), and Wildlife Institute of India, Dehradun. A field trip was organized for KMTR VFC members to get real life experience in market linkages / earning avenues of alternative livelihoods for forest dependents in ecodevelopment initiatives went on almost simultaneously in Periyar Tiger Reserve in Kerala.

Figure 6.5: Percentage of participant members in skill development programs during 04-05

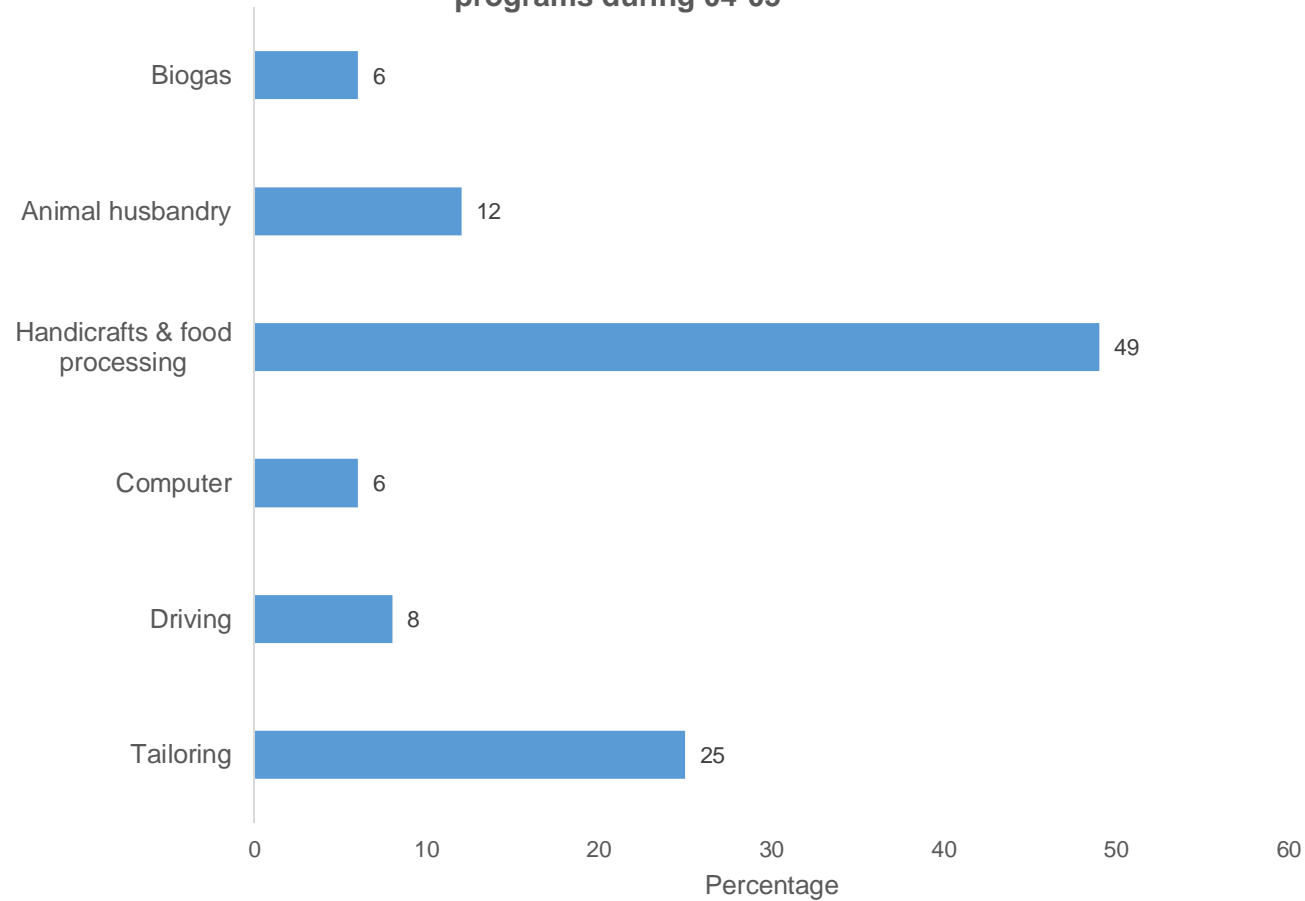


Table 6.9: Skill development in sample VFCs during 10-11

| Sample VFCs | Employable skills | | | | Small scale business skills | | | | | Institutional |
|-----------------------|-------------------|-------------|----------------|-------------------------------|-----------------------------|--------------|-----------------|----------------------|---------------------------|----------------------------|
| | Driving | Computer | Tailoring | Handicrafts & food processing | Brass & wooden handicrafts | Fishing | Poultry animals | Mushroom cultivation | Biogas Technical training | About SHG & microfinancing |
| Rajapudur | 5(1) | | | 60(2) | | | | | | |
| Ayan Singampatti | | | 23(1) | 20(1) | | | | | | |
| Sambankulam | 5(1) | | 26(1) | | 15(3) | | | | | |
| Dana | | | | | | | | | | |
| Anavankudiyiruppu | 5(1) | | 25(1) | | | | | | 30(1) | |
| Pethanpillaikudiyi | 5(1) | | 5(1) | | | | | | | |
| Chettimedu | | | | 10(1) | | | | | | |
| Kalyanipuram | 5(1) | 2(1) | 40(2) | 20(2) | 10(1) | 20(2) | 20(2) | 20(2) | | |
| Agasthiyar Kanikudiyi | 5(1) | 5(1) | 15(1) | 20(1) | | | | | | |
| Moolachi | | | | | | | | | | 150(3) |
| Mungiladi | 5(1) | | 12(2) | | | | | | | |
| Total | 35(8) | 7(2) | 146(33) | 130(30) | 25(6) | 20(5) | 20(5) | 20(5) | 30(7) | 150(34) |

For individual VFC, value in parenthesis indicate the frequency of training in corresponding skill. At the end, value in parenthesis indicates the percentage of participants learned that skill

Table 6.10: A list of different training and awareness programmes organized in sample VFCs

| Sl No | Organization / N.G.O | Frequency of events | Programme description |
|-------|---|--|---|
| 1. | Arumbugal Trust Tirunelveli | Once in two years from 97 to 99 | Generated awareness regarding ecosystem and biodiversity value of KMTR for the village communities through street play, folk dance etc. involving village children. |
| 2. | SWAN(Society for Weak & needy), Tirunelveli | Once in 3 months(97 to 99) | Environment awareness programme. |
| 3. | Abhay ashram Tirunelveli | | Expert in rural self-sufficiency, entrepreneurship and employment generation, they trained and aware village communities about VFC structure and functions. |
| 4. | Socio economic development Trust(SEED) | | Skill development for village folk in various food processing like jam, jelly, pickle, papad etc. to self-help group(SHG) members(female). Trained 3 women members SHG ⁻¹ Candle, incense making. |
| 5. | KMTR management (forest department) | Departmental stall during Adi Amabassai festival in Sorimuthunaiyur Temple(located in the centre of reserve forest) each year in the month of July | 5 members from each VFC in a total of 50 VFCs in Papanasam eco-range, that means nearly 250 members were deputed each year from the last few years to distribute cloth bags in place of plastics within forest to the pilgrims. |
| 6. | KMTR management(forest department) | Temporary appointment of fire watchers from VFC members during forest fire (March to May). | 5 members / VFC appointed for watching, informing and control forest fire on site with forest staff during fire season. Fire watchers were given Rs.50 day ⁻¹ from VFC funds for the tusk (participation in forest management) along with dress for forest watching and cooked food. |
| 7. | Dhan foundation, Madurai | Trained KMTR ecodevelopment NGO representatives in 2002 | Renowned Madurai based NGO expert in the field of micro financing (SHG) for rural resource dependent and poor. They trained KMTR NGOs about minute details of structure and modus operandi of women self-help groups (SHGs). Organize celebration of world wildlife day in VFCs of KMTR. |
| 8. | KMTR management | Jyoti run – marathon for conservation of KMTR natural resources | Held once at the beginning |
| 9. | KMTR management | Learning tour to witness ecodevelopment implementations in Periyar tiger reserve | A group consisting 20 chosen VFC members (chairman, executive committee members, other interested members) visited Periyar tiger reserve (Kerala) to get real life experience in market linkages / earning avenues of alternative off-farm livelihoods in Periyar like boating in lake, as tourist guide in TR, as driver of vehicle meant for wildlife safari. |
| 10. | KMTR management | Awareness regarding medicinal plants in KMTR (Once) | Siddha medical college (central institute) in Tirunelveli trained VFC members on plant identification, available habitat, ayurvedic value, use etc. |
| 11 | Vivekananda Kendra, Kanyakumari | Help in formulation of KMTR ecodevelopment planning | Before the initiation of KMTR ecodevelopment, Vivekananda Kendra helped Tamil Nadu Forest Department in planning of ecodevelopment |

6.3.1.5.4 Awareness

Environmental education and awareness generation among local folk was not intensive in reality. The task was mainly assigned to few locally reputed NGOs. Major initiatives regarding this was taken during establishment of VFCs in the project between 1998 to 2000, and basically there was no follow-up of the same later on. Initially, Arumbugal Trust, a Tirunelveli based NGO, well versed in traditional performing arts, were given the task to aware fringe villagers about the watershed value of KMTR ecosystem, role of KMTR as the source of irrigation water in the region, importance of biodiversity conservation, and the necessity of maintenance of natural resources for long term benefit of forest dependents. Conservation messages were given through traditional folk theatre / street theatre. Oylattam, Kummi, Karagam etc. were planned simultaneously.

During the first year of ecodevelopment, nearly 20-25 villages were selected and the project introduced through the cultural programme of Arumbugal Trust. At the beginning, they conveyed the aims and objectives and message of the project to the villagers, which facilitated the formation of VFCs in those villages. The constant interactions of Trust workers with the Eco team helped make the project approach and methods clear to the NGO performers, which ultimately improved the quality of their folk performance. Later, NGO groups like SWAN (Society for weak and needy, Tirunelveli), Dhan Foundation, Madurai etc. also extended their professional skills in generating environmental awareness among forest dependent rural communities.

The second phase of awareness programmes comprising informations on how to run the VFC, the role of committee members, forest protection etc. More than 60

folk media programmes were conducted. The third phase concentrated on capacity building in villages about alternative livelihood loans, recovery / return methods, sustainability of programmes etc. So far, Arumbugal Trust had conducted more than 450 programmes in all the villages and hamlets. Other than this, awareness through film shows, posters, handbills were also done. Conduction of cycle rallies, suzhal jothi, celebration of World Forestry day, Wildlife Week, and involvement of VFC members in regular wildlife census were others notable aspects of Department – Local people interactions.

6.3.1.5.5 Institution Building

FREEP had brought in major institutional changes in KMTR. Institution building process had been continued during the project and post project period. This process can be seen in terms of institutional structures as well as improved community organization through generation of social capital. During project ran from 1995 to 2007 (7 years), 132 VFCs were formed, and 96 more added in post project period thereby creating 228 VFCs (95%) out of 241 hamlets and villages situated in the influence zone of ecodevelopment. To provide statutory backing to VFCs, all have been registered under the Tamil Nadu Societies Act 1975. Institutional sustainability has been ingrained in the project itself with an objective of continuing the participatory momentum in the co-management of forests. Exclusive eco development staff (Eco Ranger & Forester) was sanctioned and still maintained in the post project period for carrying out the project activities for ensuring continuum. In line of five territorial Forest Ranges located in eastern boundary, five Eco Ranges created from where all VFC related implementations were organized by trained NGO representatives under proper supervision of Eco Rangers and Foresters dedicated towards participatory

management. These frontline staffs and NGOs were persuading the principles of 'biodiversity conservation through social justice' with their commitment for the job, and acted like a bridge of communications between fringe communities and forest department. This is one of the most unique feature of KMTR ecodevelopment. Impressed by the initial positive trends with relatively lesser investment, World Bank as the international funding agency decided to select KMTR as one of the Field Learning Center of Ecodevelopment, and agreed to grant INR 75 lakhs for the improvement of infrastructure facilities needed for a field learning center. After initial success in the project, continuous funding is being provided from the project tiger scheme from 2002 onwards during post project period for the continuation of ecodevelopment.

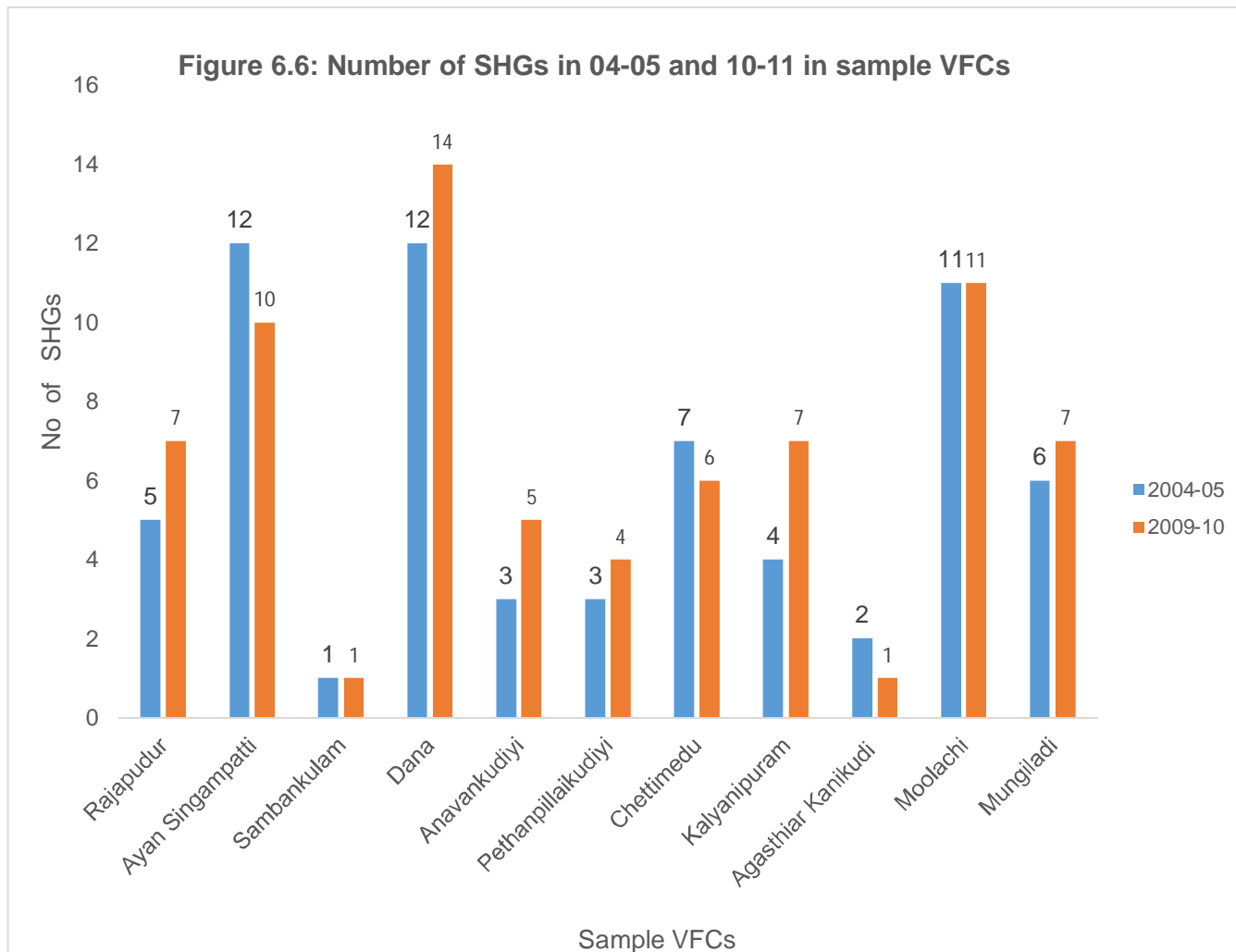
Another successful aspect of FREEP-KMTR was establishment of all women SHGs (Badola and Hussain 2003) in microfinancing for enterprise generation. The SHGs play a vital role in the management of revolving fund. Before ecodevelopment, there was no Self Help Group established in this area from any other rural development project either from government or NGO. The number of SHGs that were 312 at the time of project closure in 2002 has grown to 940 (837 are Women SHGs) by 2012. SHGs proved to be uniformly successful in handling the loan amount, as there was more cohesiveness and commonality of purpose in utilizing the loan amount for useful group-based economic activities. The excellent recovery (nearly 100%), of funds in microfinancing through SHGs enables further deployment of the amount for creating more opportunities for rural employment, raising family income and created wealth. It becomes a learning experience for other PA managers in India interested to initiate ICDP in their respective areas. In comparison to 2004-05, number of Self Help

Groups (SHG) had increased in 6 out of 11 sample VFCs in 2009-10 (Figure 6.6). Number of SHG had decreased in 3 sample VFCs, whereas it remained same in the other 2 VFCs. Male groups (all male SHGs) were also formed in some villages, like it had been found in Anavankudiyiruppu, one of the sample VFC for study, which is innovative and really encouraging. But it has also been observed in figure 6.10 that number of SHGs were more in villages like Dana, Ayan Singampatti, Moolachi etc. where most of the families have own agricultural land and relatively less dependent on forest in comparison to Sambankulam, Anavankudiyiruppu or Pethanpillaikudiyiruppu where number of SHGs were less. It has been observed that number of SHGs were more in relatively developed villages where people have better opportunities of income, and not directly dependent on forest resources. In such cases, the incentives for economic well-being were not been directed towards right kind of population.

6.4 Issues of Forestry Research, Education and Extension Project (FREEP) - KMTR

FREEP brought in major changes in the management of KMTR. The exclusive approach of management got transformed into an inclusive and participatory approach. Management of KMTR no longer remained as the management of wildlife and habitats, but it also included the management of fringe area rural communities. In fact, the villages and hamlets (241 villages) falling within 5 km radial distance from KMTR eastern boundary, is to be declared as buffer zone of the park, and will come under direct control of KMTR management.

Community livelihood and participation of local people in forest management became important issues. In spite of these gains, there were many new issues which came up after the formal completion of World Bank project in 2002. One of the major issues was the sudden drop in the level of investment in KMTR ecodevelopment programme. Though nearly 75 VFCs formed and still functioning by getting continuous funding from project tiger scheme after the formal completion of FREEP in KMTR, it was observed and documented that the KMTR management now found it difficult to maintain salaries and other services required for smooth functioning of Eco Ranges and corresponding VFCs. The expectations of the communities also became high from KMTR management. The massive institutional structure in the form of VFCs created during FREEP still require the umbrella of regular management for their functioning. They are still far from functioning independently without technical, moral and financial support from Forest Department. There were other issues related to the introduction of ecotourism in the dams and water falls through tribal VFCs which may reduce forest dependency of Kani forest dwellers, continuation of high intensity awareness programs through NGOs able to generate awareness about natural resource value of KMTR for the economic development of present and future generations, arrangements for uninterrupted communications with VFCs for future co-management of KMTR, continuation of very able local NGO representatives with proper remuneration who had played the most significant role in the initial success of the project, capacities of the frontline staff to handle ecodevelopment initiatives, and most importantly extension of ecodevelopment program to the communities / villages which could not be covered during FREEP.



6.4.1 Establishment of Kalakad-Mundanthurai Tiger Conservation Foundation

Government of Tamil Nadu ordered for establishment of a trust named Kalakad-Mundanthurai Tiger Conservation Foundation, as a mechanism of sustainability of FREEP initiatives. The KMTR Foundation had a flexibility of an NGO and an authority of a government. Such trust was constituted by the government with the twin objective of biodiversity conservation and livelihood support to the local communities in KMTR and its adjoining landscape. After completion of FREEP-KMTR ecodevelopment project, as per recommendation of World Bank, a proposal was sent to Government of India for establishment of a centre of Excellence as the Field learning Centre at KMTR under Bio diversity Conservation and Rural livelihood Improvement Project (BCRLIP) at a cost of INR 3.85 crores. Post FREEP, BCRLIP envisaged as a multi sector, multi theme project on a landscape. An appropriate configuration of the landscape that takes an integrated view of conservation and livelihoods aimed to be realized through rational management zoning. The project may help the management by reducing pressure further, and also lead to amelioration of forests and pastures restoring the degraded 'dispersal' habitats in the areas outside PA. This BCRLIP also aimed at protection of flora and fauna with the involvement of rural public which may leads to co-management of KMTR in future with much real participation of fringe communities. In future, activities of field learning centre and BCRLIP will be executed through the Tiger Conservation Foundation. Governance structure of the Foundation provided space for involvement of other stakeholders both at the decision / policy level (Governing Body) and at implementation level (Executive Committee). Foundation has the scope of raising its income from regional, national and international sources in the form of donations and institutional charges undertaking research and capacity building

programs. At the very onset, KMTR Foundation can take up initiative to create a federation of VFCs for mutual interaction and learning.

6.5 DISCUSSION

6.5.1 Income Generating Activities for Conservation with Social Change

Pilot project in community based initiative of biodiversity conservation was undertaken in Kalakad-Mundanthurai Tiger Reserve (KMTR) along with Great Himalayan National Park (GHNP) under the banner of Forestry Research Education and Extension Project (FREEP) between 1994 and 2001 (World Bank 2000, Melkani, 2001). When the ecodevelopment project in GHNP was withdrawn in December 1999 because of poor progress and unsatisfactory performance, KMTR ecodevelopment got another two years extension and even been recommended to become a field learning centre for small scale enterprise development through microfinancing. It was even been observed that in a span of nearly one decade (98-99 to 10-11), there was an overall trend in the reduction of fuel wood cutting and grazing pressure from the eastern side of the park, which was earlier difficult to tackle by enforcing law through territorial forest guards, watchers and rangers. The initial achievement of KMTR was encouraging and strengthened the belief that communities depended on PA resources may respond in a positive manner towards the agenda of conservation of forest department if proper package offered to them to compensate the immediate loss of access they suffer due to existence of PA. It was observed by experts that when the initial failure of GHNP project was due to improper implementations, KMTR got right kind of park managers to address the issue of 'social justice and forest dependency' together with a proper backing from Government of Tamil Nadu in issuing clear cut

GO (Government Orders) to enable the managers to focus towards most forest dependent communities. Proper identification of most dependent families (red group) in each VFC through demographic survey prior to the launch of alternative income generation scheme, and a commitment towards proper disbursement of loan amount to the actual 'target' population is behind the long lasting sustenance of KMTR project. With far less investment in comparison to other seven IEDP sites (only 9.41 crores in comparison to 32.27 crores in Periyar) selected for ecodevelopment just after FREEP, KMTR achieved initial success in terms of community development and women empowerment. At the same time, it was also observed that the percentage decrease in number of fuel wood head loaders and free grazing cattle within park considerably slowed down in the last phase (04-05 to 10-11) of the project. The initial rate of reduction of PA resource dependency in fringe villages could not be maintained in later stage of the project. At initial stage, KMTR management decided to increase income of families depended on PA for livelihood by providing them low-interest loans to choose new ways of earning a living, and nearly 60 different non-forest based enterprises were encouraged in a participatory manner. All these enterprises were enlisted through PRA and informal meetings held between Field Director and other higher officials and village communities.

6.5.2 Participatory Management in KMTR

Another major achievement of the ecodevelopment program in KMTR has been in terms of management approach. The traditional isolationist protectionist approach of PA management has given away to participatory approach. Active as well as passive support from the communities has provided additional vigil for KMTR and reduction of resource use from the reserve, both these phenomenon documented and

analysed in this research. Through successful establishment and functioning of VFCs among fringe communities, department and local communities, these two main stakeholders of KMTR both understand each other's stakes – that of people in the security of livelihoods and resources and that of park staff in effective protection and conservation of the diverse park values. Local committed NGO representatives also played a very vital role of bridge between forest department and communities, and as independent facilitators of the project. It has been proved in many cases that systematic multi-stakeholder participation, and more equitable sharing of benefits to the actual 'forest dependents', generates more effective program (Greenberg and Brown 2006). It had been observed by independent analysts that among 10 ecodevelopment sites came up almost simultaneously as FREEP and IEDP sites in India, only KMTR, Periyar and GHNP (interestingly in post project period), had successfully integrated the issue of biodiversity conservation with social justice in terms of project benefit sharing concern (PEACE 2004).

6.5.3 Ideal Setting for Community Participation

In another way, it can be said that KMTR had all the perfect setting of becoming among the first sites for ecodevelopment in Indian Protected Areas. Main conservation problem in KMTR is biotic pressure from eastern boundary arising out of huge number of forest dependent population located in the surroundings in a densely populated and economically active landscape behind. Incidences of poaching and timber theft is negligible though stray incidences reported from western side of park adjoining to PAs located in Kerala. Numerous enclaves located in the mid elevation plateau of the park to be dealt legally and administratively either relocating or offering compensation to

stay outside of the park territory. The large number of forest dependents are mainly scheduled caste and other backward caste population, and basically landless agricultural labourers. Efficient park managers of KMTR rightly pointed out this clear cut resource dynamics arising out of population pressure and poverty at earlier stages of planning and implementation and very carefully went by the basic guidelines of micro plan. More focus was given to women daily wage labourers, and their active participation through formation of large number of SHGs avoided large scale internal social conflicts in VFCs, and achieved speedy recovery of loans due to similar local need based activities. It is found that among the ecodevelopment sites, KMTR management spent maximum percentage of the project expenditure (38% of project activity expenditure) for alternative income generations of villagers. If we compare first stages of implementations in GHNP and KMTR project, one of the major reasons of failure in initial level local institution building and micro planning in GHNP had been inadequate awareness and communication with local level institutions at the time of initiation of the program (World Bank 200, Wani & Kothari 2007). In KMTR, all the high rank forest officers along with frontline staffs sit and discussed program objectives and road maps of community development with dependent population in their respective villages, participated in meaningful discussions including general apprehension of public, and generated lot of awareness about the project prior to PRA exercise and micro planning. This initial direct transparent communication about likely outcome of the project gave the initial momentum and 'hand holding' job based on which villagers responded well in partnering forest department in establishment of VFCs and formulating micro level planning for village ecodevelopment. This initial mode of communication put KMTR project on a much better foundation which helped its later on smooth progress in community development.

6.5.4 Grass root Institution Building

It has been realized that even most well formulated ICDPs cannot succeed unless there are interconnected institutions in place for implementation (Bhardwaj & Badola 2007). Also it is now accepted that establishment of strong village-level institutions can be the single most effective behaviour which contributes to the conservation of biological resources (McNeely 1988). The ecodevelopment programme has broadened the constituency for conservation of KMTR through the formation of institutions like Village Forest Committee (VFC) and Self Help Group (SHG) at a very large scale in the buffer zone outside PA. Initiatives of awareness and dialogue within these social institutions have generated some amount of social capital among the communities for conservation as well as their own development.

6.5.5 Scaling Up of KMTR Ecodevelopment

According to the Theory of Island Biogeography (MacArthur and Wilson 1967), smaller habitat pockets sustain less biodiversity. The implication is that conservation areas have to be large if they are to serve a conservation purpose. Extending biodiversity conservation initiatives through the approach of ecodevelopment beyond KMTR landscape is another issue which requires additional resources and collaborations with other stakeholders. Scaling up community-level work to landscape or ecosystem scales greatly increases the complexity of first-generation ICDPs, and will require innovative capacity building and decision making processes. A first step towards this direction was the establishment of Kalakad-Mundanthurai Tiger Conservation Foundation, and under it's initiative, a proposal was sent for a Biodiversity Conservation and Rural livelihood improvement Project (BCRLIP) in KMTR

to take ecodevelopment into a landscape level. Recently, Agasthyamala Biosphere Reserve (ABR) combining KMTR in Tamil Nadu and Neyyar, Peppara and Shendurney Wildlife Sanctuaries adjoining to the western side of KMTR in Kerala is selected for a second phase of landscape level project. FREEP KMTR has provided good basis for the expansion of the effort on to a landscape level. This would ensure coverage of penumbra habitats located both in eastern side of KMTR, and western side of the three WLS located in Kerala under Agasthyamala Biosphere Reserve, and eventually will ensure holistic biodiversity conservation in future.

6.5.6 Insufficient Tenure of the Project

Although significant contributions were seen due to the implementation of FREEP, it has brought up many new issues also. In KMTR the FREEP was implemented over a period of nearly 7 years, about 90% of the investments seem to have been made in a period of less than 5 years, and then again in post project period during 2003-03 from Project Tiger Office. The initial fund flow was slow due to administrative delays, and lot of groundwork needed prior to village ecodevelopment implementations. The 5-year FREEP timeframe was unrealistically inadequate. It has been found that projects such as this, which break new ground and seek a synergic link between seemingly adversarial 'conservation' and 'well-being of people', essentially have to be process driven and cannot work on simplistic time bound targets. A realistic pacing would require the first two to three years for selection and posting of key PA personnel, surveys, studies, issue of enabling GOs, PA planning, micro planning for ecodevelopment, and importantly all round capacity building and running some pilot trials for firming up the evolving trust. It was observed that though the pilot ecodevelopment project in KMTR launched in the year 1995, the first two

years were spent in propagating ecodevelopment objectives and functionalities to fringe villagers, trust building efforts, PRA and preparation of micro plans for each VFCs. It was only from the end of 1997 onwards, village ecodevelopment based alternative livelihood program got its momentum, and the programme officially ended in the year 1999, though extended up to 2001 by World Bank. Such project need 2-3 initial years for ground work, and then a minimum of a 5-year period of full scale implementation of ecodevelopment would entail an overall term of seven to eight years. Even it can be suggested that the best will be a ten years project term, with last two three years for impact monitoring and analysis, and required adjustment to be made in ecodevelopment with the changing status of pressure on PA, and the building up of self-reliance and social capital within communities. The initial success in reduction of livelihood dependency and biotic pressure on park became evident over a period of more than a decade, suggesting that sufficient time period required to influence behavioural changes in target population (Baral et al. 2007).

7

DRIVING FACTORS OF CHANGE

7.1 INTRODUCTION

Poverty, access rights and environmental degradation are major challenges to the biodiversity conservation movement today, particularly in the developing world (Western *et al.* 1994). Though still quite a large number of conservation biologists and wildlife enthusiasts in India believe in strict application of wildlife law in Protected Areas (PAs), by early 1990s, it became clear that the current system of wildlife protection was not working. An emerging view developed among conservationists that the successful management of protected areas (PAs) must include the cooperation and support of local people. Excluding people who live adjacent to PAs from use of these resources, without providing them with alternatives, is increasingly viewed as politically infeasible and ethically unjustifiable (Brandon & Wells 1992). In response, projects which link the conservation of biological diversity in PAs with local social and economic development have been implemented. Many program designs reflect the wish to create both positive development and conservation outcomes, in what are frequently described as 'win-win' objectives (Bhardwaj & Badola 2007). After 1990s, all these sporadic efforts in India gradually took the shape of a complete or integrated program approach.

Integrated Conservation-Development Projects (ICDPs) or ecodevelopment as referred to in India, attempt to link biodiversity conservation in PAs with social and economic development in surrounding communities (Bhardwaj & Badola 2007). 'But whether in reality ICDP measures are able to reduce park-people interface conflict, and fulfill the very basic objective of conserving biodiversity?' – is the question repeatedly asked by scientific communities, forest management practitioners and donors as well. We do not know whether such projects improve the effectiveness of PAs by reducing human pressure on park and gather support for conservation within local communities, as very few projects were rigorously monitored or analyzed. 'Even if there was any success, what was its recipe, and is it possible to replicate the same in other parks in future?' – are the questions asked by scientific communities. These questions and concerns surfaced since the implementation of the first generation projects of ICDPs in the early 1990s. It was realized that these projects have been hampered by factors like insufficient life cycle and funding, short term strategies, a haste to show early success within project life cycle, top down approaches, competition between conservation organizations, small scale implementations, passive participation of local communities, and many government laws and policies operating against the principles of biodiversity conservation. Perceived needs included sufficient time frame and adequate funding for all stages of the program, a system rather than a project approach, long term strategies, a committed leadership from implementing agencies, both top down and down top approach, proper collaboration of government agencies and professional NGOs, scaling up of program, active participation of local communities through community mobilization, and proper backing of local government by issuing appropriate government orders and policy support

(Brandon & Wells 1992 ; Brandon K E Brown & Wyckoff – Baird 1995;, Larson et al 1998).

In KMTR ecodevelopment, the number of fuel wood extractors from PA decreased significantly during ecodevelopment implementations, but most of the decrease took place in the first five years of implementation. Similarly, significant decrease in cattle grazing within park also took place in the initial stage of ecodevelopment. Though, most of the other ecodevelopment sites in India had even failed to made that initial progress, it can be said that there was a decline in enthusiasm observed in later phase which the project generated in initial years. The decrease in forest dependency within fringe villages of KMTR got reflected in habitat improvement near boundary with an ascendancy in wildlife population in the periphery. Now, there was a requirement of proper scientific analysis of all the critical driving factors of change in terms of resource dependency and human pressure in order to find out the ways by which the initial positive changes can be made sustainable, and forest habitat improve with time. This scientific evaluation of KMTR ecodevelopment processes was necessary to find what 'works' and what 'not' to find the necessary conservation linkages of the programme.

In this chapter, a detailed analysis to identify the driving factors of change, with respect to resource dependency and anthropogenic pressure were done. Changes observed between 98-99 and 04-05, 04-05 and 10-11, and overall between 98-99 and 10-11. Community well-being in fringe villages, male and female participation in ecodevelopment, change in forest dependent families after provisions of alternative non-forest livelihood, household energy requirement, VFC fund status, , family

occupation, household economic status, man-animal conflict, forest offences, and attitude of forest staffs and local communities were analyzed in 11 sample VFCs selected for detail investigation. Changes in overall socio-economic conditions at VFC level were analyzed from VFC records.

7.2 METHODOLOGY

7.2.1 Change in Socio-Economic Conditions at Sample Village Level

As mentioned in chapter 6, a total of 11 sample villages were identified to study various socio-economic parameters, resource dependency pattern at village level, and impact of ecodevelopment activities in terms of i) level of participation ii) change in non-forest based occupation, iii) annual income of beneficiaries, iv) use of alternate fuels, v) adoption of fuel saving devices, vi) conservation awareness of local people, and vii) attitude of people towards PA conservation. Both semi-structured open ended and structured close ended questions were administered (Clarke 1986) for socio-economic investigation at the village level. Change in socio-economic condition in 11 sample villages during ecodevelopment was measured by:

- i) Collection of data in a structured format from corresponding eco range offices which were kept in repository of informations like PRA records, micro plans, minutes of meetings (both executive and general body), loan ledgers, accounts etc. Data regarding forest offences during ecodevelopment were collected for forest ranges situated in the boundary of PA as well as for interior plateau area. Records regarding this was kept in Ambasamudram Forest Range office. All the changes were measured between 98-99, 04-05 and 10-11. Data procured with the help of local NGO representatives'

assigned responsibility to keep, maintain and update the VFC level records from time to time. Forest staffs like eco ranger and foresters were consulted during data procurement.

- ii) Conducting structured and semi-structured interviews at household level in 11 sample VFCs

7.2.1.1 Questionnaire Survey

Structured questionnaires involved asking the same question in the same order to different individuals so that response may be comparable. Structured questionnaires included two types of questions namely, open-ended and close-ended questions. Open-ended questions provided an opportunity to the respondent to express his/her views freely. These questionnaires are appropriate where there is a small range of information, but the disadvantage is the coding process of the response (Clarke, 1986). Close-ended structured questionnaires have a small range of response, and may not elicit what a respondent really thinks, but it is easy to code and analyse the data gathered. Both the types were administered during household survey. Supplementary questions were added to the major questions, which enabled them to be fully answered. Major parameters covered during household questionnaire interview were demographic structure, household amenities, land holding, livestock holding, fuel consumption, alternative income from ecodevelopment, major occupation during ecodevelopment, change of income during ecodevelopment, conservation attitude, and crop damage aspect.

To collect information on demographic set-up and socio-economic changes during ecodevelopment, the head of each family was interviewed. Information on

caste, family size, literacy, land holding, change in occupations, income, and conservation attitude were recorded in computer compatible formats. Even though the head of family became the main respondent, care was taken to involve others in the family to arrive at a consensus. Female members participated significantly, helping to answer some of the questions. The morning time was usually avoided for questionnaire survey since most of the family members were busy in different routine works. Therefore, the interview was conducted individually as well as in groups in the evening time when most family members were at home. It is interesting to note that overall response regarding ecodevelopment was positive in villages with lower caste forest dependent population, and somewhat indifferent or negative in upper caste villages where families were mostly dependent on agriculture or other non-forest based income.

7.2.1.2 Members Participation in VFC Meetings

The level of male and female participation was separately analysed by comparing the percentage of male / female VFC member with average percentage of male / female members present in GB meetings in sample VFCs during initial (1998-99), middle (2004-05), and final phase (2010-11) of ecodevelopment in KMTR. A score of 0–15% was considered very low (1), 16–30% considered low (2), 31-50 % considered medium (3), 51-70% considered high medium (4), 71-85% considered high (5), and 86-100% considered very high (6), and ranked accordingly. The change in participation between 1998-99, 2004-05, and 2010-11 were analysed for both male and female population.

7.2.1.3 Monitoring of Fuel Wood Head Loading and Livestock Herds in Village Trails

To estimate the number of head loaders and free grazing animals, all the entry/exit points at the village boundary were monitored for 3 consecutive days in the month of May during 98-99 and 04-05. Data for the period 10-11 was collected in May, 2011. May is the peak time of the summer season when the livestock are definitely expected to be sent to the forest because of scarcity of fodder at farmer's house as well as in the community lands, and therefore, this time of the year was chosen for this particular study.

7.2.2 Change in overall Socio-Economic Conditions at VFC Level

The 11 sample VFCs in particular, and some other VFCs were considered for investigating change with respect to investments in VFCs, economic status of VFCs, percentage of loan recovery, change in resource dependency and overall social capital. Related secondary data were collected from VFC records for the period 98-99, 04-05 and 10-11. The VFC meticulously maintains records and registers like micro plan, PRA data, '*chanda*' register, minutes of meetings, loan ledger, etc. (a total of 13) which contains valuable socio economic information extremely useful for tracking changes.

7.2.3 Change in Attitude

7.2.3.1 Attitude of Forest Staff

Both fixed response and open ended type questions were asked to find out the overall attitude of staff. Questions were framed to understand the attitude of departmental staff to deal with participatory management approach of KMTR, and their

skill in implementing the objectives of the ecodevelopment project. Questions were asked to executive officers, frontline staff and NGO representatives closely associated with KMTR ecodevelopment field level implementations. Interview of higher level officers involved in overall supervision and policy making could not be undertaken partly due to their reluctance to answer, and partly due to unavailability. Views of NGO representatives were taken, as they were working as a complete unit with executive and frontline forest staff as far as KMTR ecodevelopment project was concerned.

Assessment of the staff attitude was carried out to understand different parameters of KMTR conservation, the impacts of ecodevelopment on conservation, and the involvement of staff in ecodevelopment. In overall attitude score on the eighteen parameters, 0.1 – 1 was considered as very low, 1.1 – 2 considered as low, 2.1 – 3 considered as medium, and 3.1 – 4 was considered as high score. Initially separate attitude score was assigned for executive officers, frontline staff and NGOs, and then overall attitude score was calculated.

7.2.3.2 Attitude of Local Community

To understand the attitude of local people about PA conservation and ecodevelopment program as a whole, both open and close ended question were asked to randomly selected respondents. This assessment was carried out at two levels - at the level of executive committee of VFC, and also at household level (Burgess 1982). Questions were framed in view of capturing any qualitative change of attitude among villagers towards the PA and forest department, and an overall sense of ownership among them.

Similar to staff attitude survey, overall change in community attitude after ecodevelopment was analysed by scoring important community attitude survey parameters. A score of 0.1 – 1 considered very low, 1.1 – 2 as low, 2.1 – 3 as medium, 3.1 – 4 as high medium, and 4.1 – 5 as high attitude score for the community.

7.2.4 Data Analysis

Socio-economic data collected either from respective Eco Range offices or VFCs (secondary data), or by structured and semi-structured interviews (primary data), first stored and analysed in Excel 2013. Statistical analysis of these data (Das, D. 2010, Mishra, B.N.1983 and Rangaswamy, R. 2010) was done in IBM SPSS Statistics 20 statistical package. Both parametric and non-parametric statistics were used for data analysis according to the distribution of data. Statistics like paired t test, Wilkoxon signed rank test, Mann-Whitney U test etc. were used for final analysis.

7.3 RESULTS

7.3.1 Community Profile of Sample Villages

Fringe villages surrounding eastern boundary of KMTR are both homogeneous and heterogeneous in caste composition, and the rural population is mainly composed of scheduled (SC), backward (BC) and other backward caste (OBC) families along with general caste (Table 7.1). From household survey (Total household 78, Total respondents 156) in eleven sample villages, it was found that most of the villages were inhabited both by scheduled caste and general caste families, which belonged to 29% and 26% of total families respectively. Apart from this, backward, other backward and

minority Muslim and Christian communities were residing at few pockets in the eastern side of park. Other backward communities (OBC) were mostly living in southern side of PA boundary, whereas maximum minority presence was observed in northern side of park boundary. Among total families in sample villages, 32% were other backward communities, and 15% were minority population. All the families (137) belonged to Muslim community in Sambankulam village located in the northern periphery of PA boundary. Nearly 20% families in sample villages belonged to backward castes (BC). One Kani tribe village situated in the interior of park was taken as a unique representative sample of inner settlements in KMTR. Among sample villages / VFCs, Pethanpillaikudiyiruppu (90%) and Moolachi (70%) had maximum SC families, and Mungiladi situated in Kalakad region had maximum (87%) OBC population. Villages like Rajapudur, Ayan Singampatti, Chettimedu and Mungiladi were dominated by Nadars - one dominant, influential OBC community in southern Tamil Nadu. Upper caste economically middle class families were present more in villages like Dana and Kalyanipuram located adjacent to Vickramsingapuram Municipality, the main commercial hub located centrally on the eastern boundary of KMTR. Either homogeneous presence of one caste group, or proportionately equal presence of different castes in fringe villages created a social advantage for the ecodevelopment implementers to distribute benefits to all communities. According to forest department ecodevelopment status report 2004, 54% VFC chairman belonged to backward communities and another 37% from scheduled castes. Similarly, 56% of VFC membership owners were from backward communities, and 40% belonged to scheduled castes. In the same report it was mentioned that 64% of project beneficiaries were families belonging to backward communities, and 31% beneficiaries were from scheduled caste population. It can be stated that presence of

relatively higher proportion of backward caste population in this region of Tamil Nadu, and the right percolation of project benefits towards them is one of the main reason of healthy continuation of ecodevelopment for a decade in KMTR.

Table 7.1: Community profile of sample villages

| Sample village | Number of families | | | | | | | Total |
|-------------------------------|--------------------|-----------------|----------------|--------------|----------------|-----------------|---------------|-------------|
| | SC | OBC | BC | MBC | Gen | Minority | ST | |
| Rajapudur | 102 (51) | 100 (50) | - | - | - | - | - | 202 |
| Ayan Singampatti | - | - | 331(69) | 28(6) | 68(14) | 51(11) | - | 478 |
| Sambankulam | 1 (1) | - | - | - | - | 137(100) | - | 138 |
| Dana | - | - | - | - | 180(78) | 51 (23) | - | 231 |
| Anavankudiyiruppu | 74 (57) | - | - | - | 58 (44) | - | - | 132 |
| Pethanpillaikudiyiruppu | 50 (90) | - | - | - | 6 (11) | - | - | 56 |
| Chettimedu | 79(19) | - | 130(31) | - | 134(32) | 75(18) | - | 418 |
| Kalyanipuram | 70 (37) | - | - | - | 90 (47) | 30(16) | - | 190 |
| Agasthiyar Kanikudiyiruppu | - | - | - | - | - | - | 44 (100) | 44 |
| Moolachi | 180 (70) | - | - | - | 80 (31) | - | - | 260 |
| Mungiladi | 26 (13) | 174 (87) | - | - | - | - | - | 200 |
| Total | 582 (29) | 274 (32) | 461(20) | 28(1) | 616(26) | 344 (15) | 44 (2) | 2349 |

SC = Scheduled Class, OBC = Other Backward Class, BC = Backward Class, MBC = Most Backward Class,

Gen = General Class, ST = Scheduled Tribe *Values in parentheses refer to the percentage of total*

7.3.2 Socio-Economic Profile of Sample Villages

Data from 11 sample VFCs revealed that majority of the population fell in the age group of 41 to 60 years (Figure 7.1), which supports the earlier statement that some emigration of young population (15 to 40 years) did happen especially from VK Puram-Papanasam area due to downsizing of daily wage manpower in Madura Coats factory, which was the only source of industrial employment in that area.

About 60% of the surveyed families were landless. Average male and female literacy in the sampled households (Figure 7.2) were 55 and 45 percent respectively, which were lower than the Tirunelveli district average (89% male and 76% female literate according to 2011 census).

Maximum workforce in the surveyed households were landless labourer (67% of surveyed households) engaged during seed sowing, field preparation and harvesting tusk during cropping seasons (Figure 7.3). Fortunately, villages located adjacent to eastern boundary of KMTR receive plenty of irrigation water channelized from rivers like Manimuthar and Tamirabarani, and their numerous tributaries originating from KMTR. It was observed that villagers produce paddy thrice in a year in a cycle of three months from sowing to harvest. Other than agriculture, this same population engaged in various types of daily waged jobs, and often bring fuel wood and minor forest products (MFPs) to sell in the market. Though it is reported that landless labourers in this region are getting much higher employment than rest of the country due to better implementation of National Employment Guarantee Scheme (Saravanan 2013). Agriculture was the main occupation for 23% of sampled families,

and the average landholding of these families have 1.5 acre family⁻¹. In nearly 21% of sampled households, women were engaged in bidi rolling on contract basis. Many of them reportedly left going forest for fuel wood cutting and selling after getting the contract of bidi rolling on a daily basis. Most of them considered it less strenuous than head loading, and an opportunity to work at home also attracted them. Though many women mentioned about sufferings from respiratory and bronchial diseases due to tobacco during questionnaire survey in sampled villages. Regarding forest resource dependency, 59% of surveyed households belonged to most resource dependent 'red' group, 27% to 'yellow' group who were directly or indirectly dependent on forest, and 14% were least PA resource dependent 'green' group families.

Figure 7.1: Age structure of members in sample VFCs

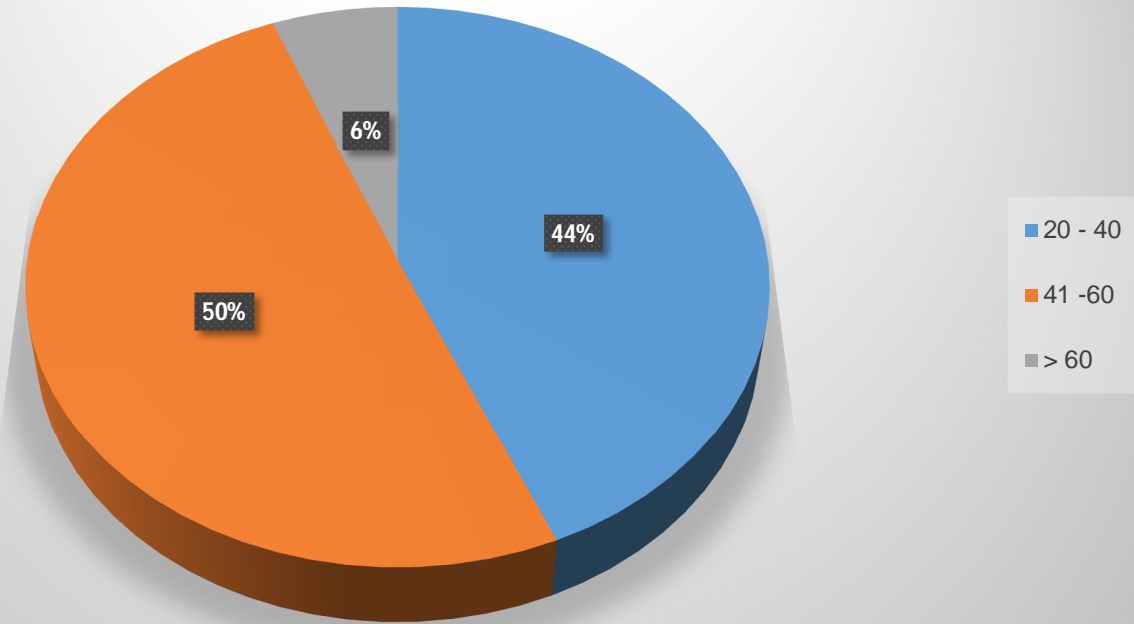


Figure 7.2: Percentage of literate male and female in sample VFCs

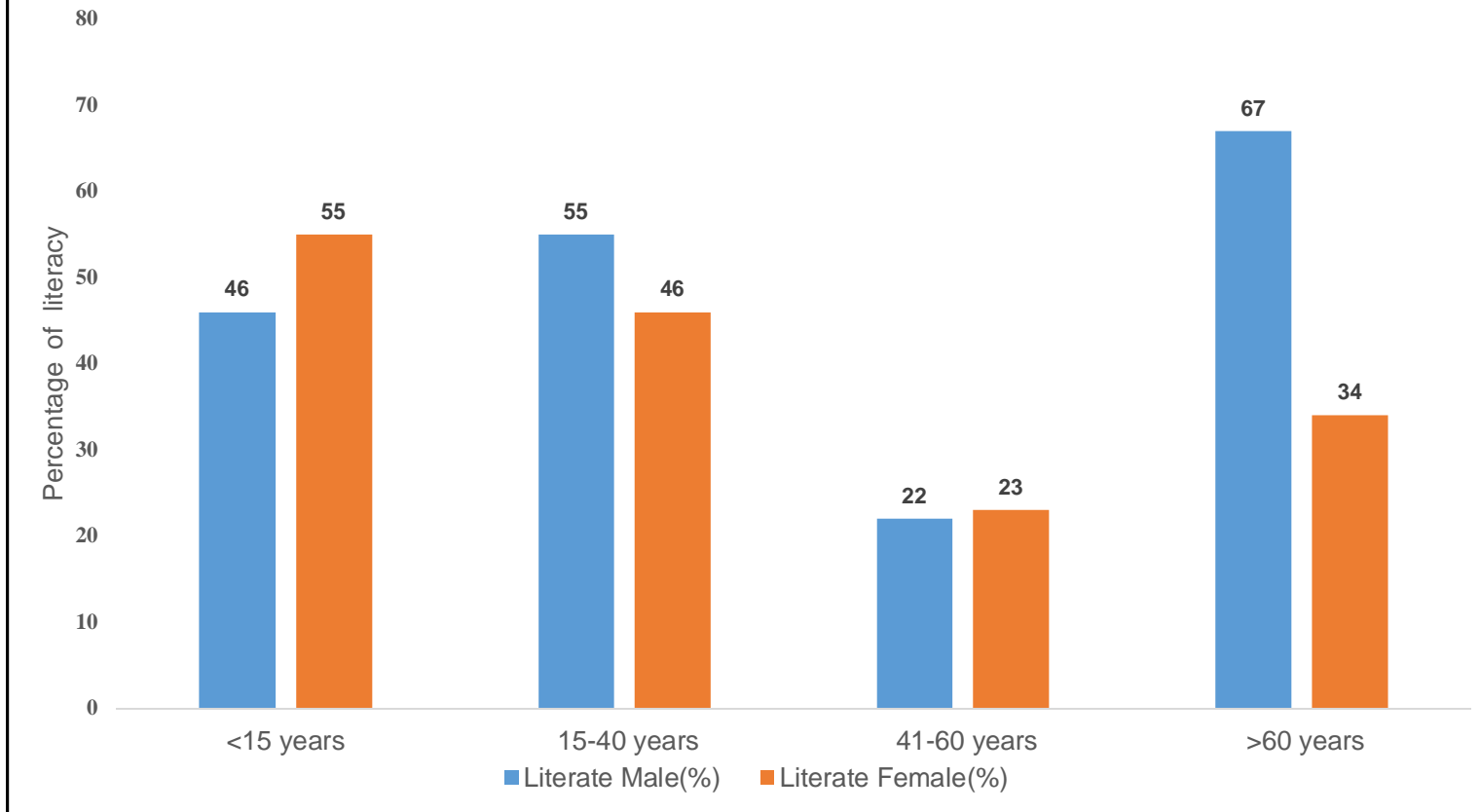
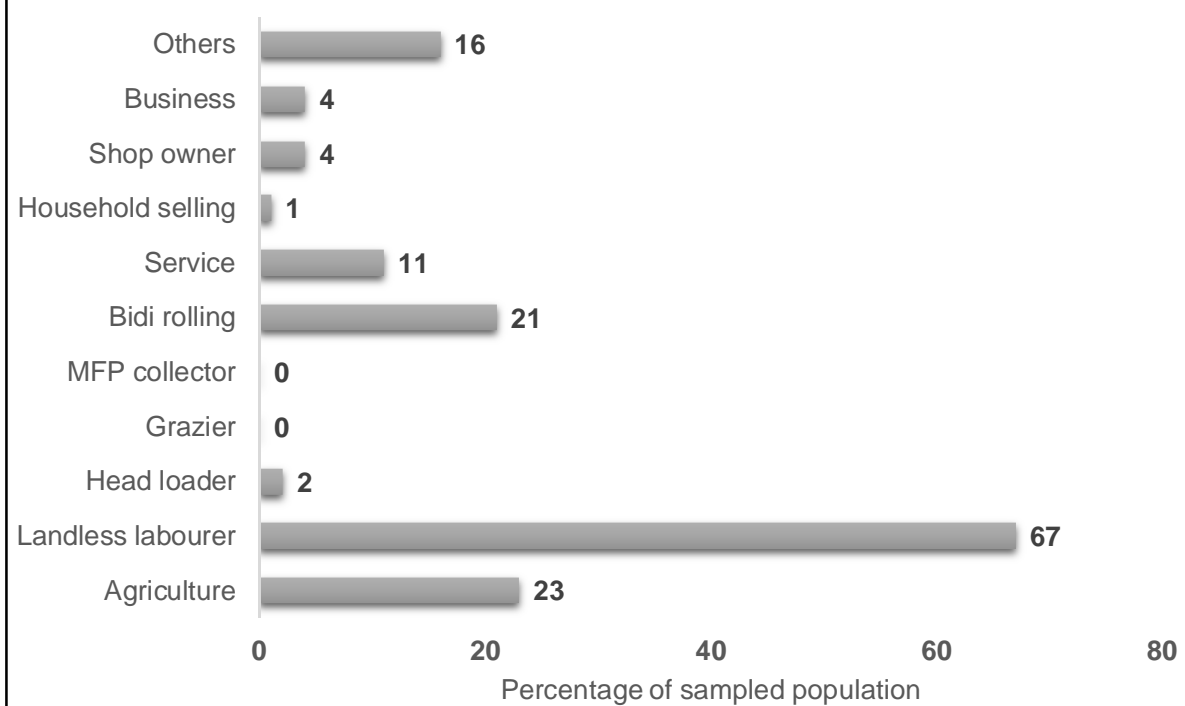


Figure 7.3: Occupations in sample VFCs



7.3.3 Community well-being in sample VFCs

Different types of indices have been used from time to time to interpret well-being of human population. The most comprehensive one is Human Development Index (HDI). Following the same line, few parameters like economic status, housing, available amenities, land holding, level of education, and status of hygiene were taken for assessing the socio-economic well-being of the sampled VFCs during 2010-11 study period. Parameters like level of forest resource consumption in house construction and waste disposal in forest were also considered to look at the impact of villagers' lifestyle on the conservation of KMTR. Then the overall well-being score for each sample VFC was measured, and ranked accordingly (Table 7.2). Rajapudur VFC on the southern end of eastern boundary, Sambankulam VFC on the northern end, and Agasthiyar Kani Kudiyiruppu situated within KMTR (27% VFCs) were ranked as 'poor' (well-being score 0.6 - 0.9). Nearly 50% of sampled VFCs were considered 'medium' (well-being score 1.1 – 1.5). Villages like Dana, Moolachi and Mungiladi among eleven sampled villages were ranked as 'high medium' category (well-being score 1.6 – 2). Average well-being score for all the sample villages was 1.32 which can be considered as 'medium'. As there was no earlier study on the socio-economic status of VFCs before inception of ecodevelopment in 1997-98, it was not possible to measure any improvement in overall socio-economic well-being in VFCs after ecodevelopment.

Among surveyed households, 60% families were agricultural landowners, and 40% were landless. On an average, immovable asset value of one acre fertile land was estimated INR 178000, while for a non-fertile fallow land the value was estimated INR 28000 only, somewhat 500% less than fertile land. Milking cow were stall fed,

whereas families owned buffaloes were send in the forest and sometimes to the buffer zones outside PA boundary during post-harvest for free grazing. Many times during 10-11 forest survey, buffalo herds were seen within jungle. It was also found that 82% of goats reared by sampled households were sent to the forest for free grazing. Nearly 50% of stall fed cattle in sampled households were bought in ecodevelopment loans.

Table 7.2: Socio-economic well-being of sample VFCs

| Sample VFC | Economic status | House | Amenities | Land | Education | Hygiene | Well-being score | Rank |
|----------------------------|-----------------|-------------|-------------|-------------|-------------|-------------|------------------|---------------|
| Rajapudur | 1 | 1.44 | 0.81 | 0 | 0.44 | 1.22 | 0.82 | Poor |
| Ayan Singampatti | 1.75 | 1 | 1.83 | 0.5 | 1.88 | 1.13 | 1.35 | Medium |
| Sambankulam | 1.13 | 1.88 | 0.83 | 0.13 | 0.94 | 0.56 | 0.91 | Poor |
| Dana | 1.5 | 2.25 | 1.81 | 0.29 | 3.07 | 1.36 | 1.71 | High medium |
| Anavankudi | 1.33 | 1.89 | 0.97 | 0.67 | 2.33 | 1.5 | 1.45 | Medium |
| Pethanpillaikudi | 1.67 | 2 | 1.33 | 0.56 | 0.67 | 2 | 1.37 | Medium |
| Chettimeedu | 1.71 | 1.76 | 1.24 | 0.43 | 1.07 | 0.79 | 1.17 | Medium |
| Kalyanipuram | 1.43 | 1.86 | 1.1 | 0.43 | 0.71 | 2 | 1.26 | Medium |
| Agasthiyar Kanikudiyiruppu | 1 | 1.33 | 0.17 | 0 | 1 | 2 | 0.92 | Poor |
| Moolachi | 2 | 2.08 | 1.83 | 0.75 | 2.88 | 2.25 | 1.97 | High Medium |
| Mungiladi | 1.75 | 2 | 1.33 | 0.75 | 2 | 1.94 | 1.63 | High Medium |
| Av Total Score | 1.48 | 1.77 | 1.20 | 0.41 | 1.54 | 1.52 | 1.32 | Medium |

7.3.4 Change in Level of Male and Female Participation in Sample VFCs

7.3.4.1 In General Body (GB) Meetings

According to implementation guidelines for functioning of VFC in KMTR ecodevelopment, there should be 4 General Body (GB) meetings year⁻¹ VFC⁻¹. The average number of GB meetings held in sample VFCs were less than that, and the frequency of General Body (GB) meeting year⁻¹ decreased significantly ($Z = 2.032$, $p = 0.042$, Wilcoxon signed rank test) within 1998 – 99 (2.45 ± 0.51 year⁻¹) and 2010 - 11 (1.18 ± 0.18 year⁻¹) in sample villages. GB meeting became less frequent in later phase of ecodevelopment. Along with this the decrease in percentage of male and female VFC members during this time suggests a lack of interest and attachment towards ecodevelopment among a section of villagers in the post-World Bank period.

Average percentage of male became VFC members in sample villages decreased significantly from 56% in 98-99 to 39% during 10-11 (17% decrease, Wilcoxon sig. 0.019) (Table.7.3). A drastic decrease in percentage of male memberships was observed during last phase of ecodevelopment. The percentage decreased significantly from 49% during 04-05 to 39% in 10-11 (10% decrease, Wilcoxon sig. 0.033). Interestingly, the period of maximum decrease in male memberships in sample VFCs coincided with introduction and increase in large number of women Self-Help Groups (SHG) from 2002-03 onwards when loans for alternative enterprises were provided only through SHGs. The male participation decreased a lot in post project period (after 2001) from high to low and then very low in villages like Rajapudur and Kalyanipuram, and it was all the time low in Moolachi. In contrary, male participation in ecodevelopment was initially low in Sambankulam VFC, a Muslim village located near northern side of the PA boundary, but gradually enhanced to medium level in middle and final phase of the project. Similarly, female

participation too was low in that village during initial days of program, but enhanced to medium and then to high-medium as ecocodevelopment proceeded. Average percentage of male members attending GB meetings in sample VFCs increased from 41% during 1998-99 to 45% in 2004-05, and again decreased to 37% in 2009-10, suggesting a lack of interest among men in the post project period, and specifically after greater emphasis was given to women SHG groups towards providing alternative livelihood, which were more in number than the men groups.

Similarly, significant decrease (13% decrease, Wilcoxon sig. 0.047) in percentage of female membership (Table 7.4) in sample VFCs was observed between 98-99 and 10-11, but unlike male, the percentage of female became members decreased slightly from 49% in 2004-05 to 46% in 10-11. It had been observed earlier that within a decade of ecocodevelopment in fringe areas of KMTR (98-99 to 10-11), percentage of female fuel wood collectors decreased from 44% of total during 98-99, to 23% in 10-11, whereas proportion of male collectors increased from 56% during 98-99, to 77% in 10-11. It was found that average percentage of female members present in GB meeting increased a lot from 45% during 98-99 to 63% (18% increase) during 2004-05, clearly indicating a boost in women participation in sample VFCs after formation and functioning of women SHGs in the study area. However, the attendance of female members also decreased to 56% in 10-11 (7% decrease), suggesting an overall decrease in enthusiasm during last phase. Like male counterparts, the level of female participation became very low in Rajapudur and low in Kalyanipuram village during post project phase. Overall the female participation was more than male participation during 04-05 and 10-11 in sample VFCs.

Table 7.3: Level of male participation in sample VFCs during 98-99, 04-05 and 10-11

| Sample VFCs | April 1998 – March 1999 | | | | April 2004 – March 05 | | | | April 2009 – March 10 | | | |
|-------------------------|-------------------------|----------------------------------|------------------------------|----------------------------|-------------------------|----------------------------------|------------------------------|----------------------------|-------------------------|----------------------------------|------------------------------|----------------------------|
| | % of male become member | Av. % of male mem. present in GB | Av. male participation score | Male participation ranking | % of male become member | Av. % of male mem. present in GB | Av. male participation score | Male participation ranking | % of male become member | Av. % of male mem. present in GB | Av. male participation score | Male participation ranking |
| Rajapudur | 6 | 3 | 4.5 | High | 3 | 3 | 3 | Medium | 1 | 1 | 1 | Very low |
| Ayan Singampatti | 3 | 4 | 3.5 | High medium | 3 | 4 | 3.5 | High medium | 3 | 4 | 3.5 | High medium |
| Sambankulam | 2 | 1 | 1.5 | Low | 2 | 4 | 3 | Medium | 1 | 4 | 2.5 | Medium |
| Dana | 4 | 3 | 3.5 | High medium | 4 | 3 | 3.5 | High medium | 2 | 3 | 2.5 | Medium |
| Anavankudiyiruppu | 6 | 3 | 4.5 | High | 5 | 4 | 4.5 | High | 5 | 3 | 4 | High medium |
| Pethanpillaikudiyiruppu | 2 | 4 | 3 | Medium | 3 | 5 | 4 | High medium | 3 | 5 | 4 | High medium |
| Chettimedu | 2 | 5 | 3.5 | High medium | 3 | 4 | 3.5 | High medium | 2 | 4 | 3 | Medium |
| Kalyanipuram | 3 | 2 | 2.5 | Medium | 3 | 3 | 3 | Medium | 2 | 1 | 1.5 | Low |
| Agasthiyar Kanikudiyi | 6 | 3 | 4.5 | High | 6 | 3 | 4.5 | High | 5 | 2 | 3.5 | High medium |
| Moolachi | 1 | 3 | 2 | Low | 1 | 1 | 1 | Very low | 1 | 1 | 1 | Very low |
| Mungiladi | 6 | 2 | 4 | High medium | 6 | 1 | 3.5 | High medium | 6 | 1 | 3.5 | High medium |
| Mean percentage ± SE | 56±10.49 | 41±5.75 | | | 49±9.75 | 45±7.24 | | | 39±9.72 | 37±8.5 | | |

Table 7.4: Level of female participation in sample VFCs during 98-99, 04-05 and 10-11

| Sample VFCs | April 1998 – March 1999 | | | | April 2004 – March 05 | | | | April 2009 – March 10 | | | |
|-------------------------|---------------------------|------------------------------------|--------------------------------|------------------------------|---------------------------|------------------------------------|--------------------------------|------------------------------|---------------------------|------------------------------------|--------------------------------|------------------------------|
| | % of Female become member | Av. % of Female mem. present in GB | Av. Female participation score | Female participation ranking | % of Female become member | Av. % of female mem. present in GB | Av. female participation score | Female participation ranking | % of female become member | Av. % of female mem. present in GB | Av. female participation score | Female participation ranking |
| Rajapudur | 6 | 3 | 4.5 | High | 3 | 5 | 4 | High medium | 1 | 1 | 1 | Very low |
| Ayan Singampatti | 4 | 3 | 3.5 | High medium | 3 | 6 | 4.5 | High | 3 | 6 | 4.5 | High |
| Sambankulam | 2 | 1 | 1.5 | Low | 2 | 4 | 3 | Medium | 2 | 5 | 3.5 | High medium |
| Dana | 3 | 4 | 3.5 | High medium | 4 | 3 | 3.5 | High medium | 3 | 4 | 3.5 | High medium |
| Anavankudiyiruppu | 5 | 3 | 4 | High medium | 5 | 2 | 3.5 | High medium | 5 | 2 | 3.5 | High medium |
| Pethanpillaikudiyiruppu | 2 | 5 | 3.5 | High medium | 3 | 5 | 4 | High medium | 3 | 5 | 4 | High medium |
| Chettimedu | 2 | 4 | 3 | Medium | 3 | 4 | 3.5 | High medium | 2 | 5 | 3.5 | High medium |
| Kalyanipuram | 3 | 3 | 3 | Medium | 3 | 3 | 3 | Medium | 2 | 1 | 1.5 | Low |
| Agasthiyar Kanikudiyi | 6 | 3 | 4.5 | High | 6 | 3 | 4.5 | High | 5 | 3 | 4 | High medium |
| Moolachi | 3 | 3 | 3 | Medium | 1 | 6 | 3.5 | High medium | 3 | 6 | 4.5 | High |
| Mungiladi | 6 | 3 | 4.5 | High | 6 | 3 | 4.5 | High | 6 | 4 | 5 | High |
| Mean percentage ± SE | 59±9.31 | 45±5.09 | | | 49±9.67 | 63±7.18 | | | 46±8.08 | 56±8.81 | | |

7.3.4.2 In Executive Committee (EC) Meetings

Unlike Governing Body (GB) meetings, frequency of Executive Committee (EC) meetings (average 10 – 11 EC meetings year⁻¹) in sample VFCs remained almost same in 98-99, 04-05 and 10-11. It was observed that core members and VFC chairman were in continuous contact with eco rangers and foresters which enabled frequent EC meetings (once in a month) according to the guidelines of micro plan. As per the constitutional guidelines for Village Forest Committees (VFCs), at least 50% members in any EC had to be represented by women members to ensure women participation in ecodevelopment. In reality, it was observed that women participation was even higher than 50% from the beginning with average 4 women members in a 7 member EC including the chairman of VFC. It was found that women members were significantly higher than men counterpart in ECs (Mann-Whitney U sig. 0.029 in 98-99, sig. 0.008 in 04-05 and sig. 0.011 in 10-11) during initial, middle and final phase of KMTR ecodevelopment. In 10-11, there were even 6 women out of 7 EC members in many VFCs. The policy decisions regarding higher women participation and its proper on field implementation by KMTR officials made it possible. It is needed to mention here that even after this phenomenal achievement, it was found that till 2004, around 65% of VFC chairman were men. So the controlling power vested upon men.

Regarding level of participation a lack of interest and involvement was observed among EC members, which got reflected in their attendance during meeting as time progressed. With only 7 EC members including VFC chairman, almost hundred percent attendance was expected in most of the meetings. With passage of time attendance of EC members decreased significantly in later phases of

ecodevelopment. There were significant decrease (paired t test sig. 0.014) of EC meetings with hundred percent member's attendance within 98-99 and 10-11.

7.3.5 Provision of Alternative Livelihood

Village commons outside KMTR were in very much degraded state. Therefore it was not feasible to find substitutes of forest fuel wood species or to make provision of grazing outside the boundary of KMTR to meet the forest resource demand of local communities. So an attempt was made to provide alternative non-forest based livelihood to the forest dependent population through provision of low-interest loans. Transparency in the fund flow mechanism was assured by mandating the release of funds from the VFC account to eligible loan applicants only with the approval of two-third majority of the VFC members (Sekar 2013). However in reality very less percentage of members were actually present in GB meetings (average 41 male and 55 female members in sample VFCs) where major decisions were taken.

Records regarding loans provided as alternative livelihood option from 98-99 to 10-11 for the sample VFCs were procured from VFC loan register. Total 3459 families benefited in 11 sample VFCs. There were approximately 61 different types of micro enterprises listed for which loans were provided. These micro enterprises were suggested by villagers during conduction of Participatory Rural Appraisal (PRA). It was found that direct or indirect possibility of forest resource exploitation was there in some micro-enterprises chosen by dependent families. Therefore the disbursed loans were classified as forest consumptive, forest non-consumptive and non-forest types based on either potential forest consumption or no potential or negligible forest consumption in the chosen activity. 10% families (345 families) took loan categorized as forest

consumptive, whereas the rest 46% (1582 families) and 44% (1532 families) took alternative livelihood loans categorized as forest non-consumptive and non-forest alternatives, respectively.

Loans that fell under forest consumptive category included rearing of goat for meat, fuel wood based tea or food stall within village, wood based earthen stove, selling beedi leaves, brick making, fuel wood stall etc., where there were chances of forest fuel wood use and grazing within PA. 10% families (345 families) took such loans, among them 5% (170 families) were to establish fuel wood based tea / food stall within village.

Loans for milking cow, petty shops, vending of fish, vegetables, clothes etc. were forest non-consumptive type alternative income sources. A large number of families (338 families, 10% of total loan receivers) took loan to buy milking cow (average INR 15,000 cow⁻¹) which gradually replaced scrub cattle from the fringe villages. Increase in demand for cow milk due to increase in tea stalls was the reason behind this. Moreover, ecodevelopment managers also persuaded families to purchase milking cow from eco loan. Total 1582 families (46% of loan receivers) in sample VFCs took loan for 40 – 50 different forest non-consumptive alternative income sources.

Within non-forest alternatives, maximum 35% (1209 families) loans were disbursed for agriculture purpose (average INR 15,000 family⁻¹) in sample VFCs. All the VFCs encouraged families to take loan for agricultural improvement - for fertilizer / manure assistance, to buy iron plough, ploughing machine etc., - to reduce forest

dependence through improvement in agricultural productivity. Here the aim is reduction of dependency by higher agricultural return, and ecodevelopment loans were taken from landless to marginal, and even by established farmers.

Forest Department provided loans for non-wood energy substitutes like LPG, kerosene stove, hot point stove etc., and pressure cooker as energy saving device. A total of 239 families (7% of total loan) in sample VFCs received loans to procure above mentioned non-wood energy substitutes. But despite the overall policy regarding transparency in loan disbursement, many GB members complained about selective distribution of loans for alternative energy sources and energy saving devices to chairman and families of EC members in some sample VFCs. Education loan for children in resource dependent families was also tried in few VFCs as a tool of social and economic development among communities.

Critiques of ecodevelopment suggests that if the rights of choice of alternative to forest extraction solely given to forest dependent communities, there is always some chance of picking up some alternative invariably causing some damage to forest ecosystem either directly or indirectly.

7.3.6 Change in Forest Dependent Families in Sample VFC

In each VFC micro plan, villagers were categorized as red, yellow and green group families based on their level of dependency on KMTR resources. Red families were the potential agents of KMTR habitat degradation as they were completely dependent on tiger reserve for living, like forest fuel wood extractors, paid herdsmen taking village cattle to the jungle for free grazing, and other collectors of fodder, honey, amla, bidi patta, tamarind, medicinal plants etc. The yellow group families were daily wage labourers occasionally going to the forest to procure fuel wood for family requirement during slack period, or sometimes to get free fuel wood for their employer. Green families were employed, educated, land owner middle class within village, occasionally employ daily wage agriculture labourers working in their land. They purchased forest fuel wood from head loaders.

There was significant decrease (41% decrease, Wilcoxon sig. 0.033) in red group families in sample VFCs within a span of ten years (98-99 to 10-11) (Table 7.5). When separately seen, neither the percentage decrease in red group families during initial five years (28% decrease between 98-99 and 04-05, Wilcoxon sig. 0.10) nor during post project period (19% decrease between 04-05 and 10-11, Wilcoxon sig.0.328) were statistically significant. It indicated that still some families in fringe villages depended on PA resources for livelihood. It needs to be mentioned here that similar statistical findings were observed regarding percentage of fuel wood headload reduction through park boundary. Even the values of percentage decrease in head loads removal from KMTR, and percentage reduction in red group (forest dependent) families between 98-99 and 10-11 were almost similar (39% reduction in head load from PA boundary and 41% reduction in red group families in surrounding villages).

While there was an average decrease of 31 families (average 111 red families in 98-99 to average 80 families in 04-05) in red group category, at the same time, average 39 families increased in yellow category (average 36 yellow families in 98-99 to average 75 families in 04-05). Partly the increase in yellow families took place due to enhancement of economic status from red to yellow, and partly due to migration of families from other neighbouring areas towards KMTR. Nearly 29% male and 26% female population increased in just five years (04-05 to 10-11) in the sample VFCs, which was possible only if immigration of some families took place, or the provided data was wrong. Though similar kind of immigration towards conservation areas to avail the benefit of incentives offered by Forest Department has been reported in some other parks of the world after initiation of ICDP (Brandon and Wells 1992).

Table 7.5: Changes in forest dependency in sample VFCs

| Changes (Mean ± SE) | Years | | | Percentage changes in forest dependent groups | | |
|------------------------|--------------------------|-------------------------|--------------------------|---|----------------------|-----------------------|
| | 1998-99 | 2004-05 | 2010-11 | 98-99 & 04-05 | 04-05 & 09-10 | 98-99 & 10-11 |
| Male population | 305 ± 53.93 (56 ± 10.49) | 346 ± 80.91 (49 ± 9.75) | 448 ± 87.96 (39 ± 10.29) | | | |
| Female population | 298 ± 46.04 (59 ± 9.31) | 325 ± 74.56 (59 ± 9.28) | 410 ± 76.65 (44 ± 8.92) | | | |
| Red group | 111 ± 17.51 | 80 ± 21.04 | 65 ± 15.53 | 28% decrease(P>0.05) | 19% decrease(P>0.05) | 41% decrease(P<0.05) |
| Yellow group | 36 ± 11.26 | 75 ± 15.76 | 107 ± 22 | 108% increase(P<0.05) | 43% increase(P>0.05) | 197% increase(P>0.05) |
| Green group | 10 ± 3.23 | 15 ± 3.98 | 21 ± 8.14 | 50% increase(P<0.05) | 40% increase(P>0.05) | 110% increase(P<0.05) |

The percentage of population became VFC member given in parenthesis

7.3.7 Change in Fund Status in Sample VFCs

The most significant aspect regarding management achievement in KMTR was creation of a healthy fund during pre and post project phase, and its continuation till now. Local NGO representatives worked (52 from nine local NGOs) relentlessly in close connections with eco rangers and foresters deputed from forest department to look after ecocodevelopment. Successful formation and functional Self Help Groups (SHGs), especially large number of women groups in each VFC over 5 – 6 years was the reason behind financial stability of KMTR ecocodevelopment. First, micro credit advanced from the project fund to selected beneficiaries for alternative economic activities which carried a simple annual interest of 12%. The recovered loan amount with interest formed the revolving fund, facilitating further assistance to other needy members, and the revolving fund grew like this.

The average investment made between 98-99 and 04-05 in sample VFCs amounts to INR 304186 VFC⁻¹, and nearly 39% of the total investment was made between 04-05 and 10-11 which was average INR 512398 VFC⁻¹. The percentage increase in average investment VFC⁻¹ between 04-05 and 10-11 was found to be statistically significant in Wilcoxon signed rank test (P = 0.003). So after formal completion of World Bank pilot project in 2001, KMTR continued to receive sufficient funding assistance from Project Tiger office for successful continuation of alternative income generation activities in each VFC, which was the main theme of KMTR ecocodevelopment. Similarly KMTR management also remained focussed towards proper and equitable disbursement of funds towards microenterprise development in each VFC. The average circulation fund built up in sample VFCs was INR 350744 VFC⁻¹ during 98 – 99, which increased up to INR 559820 VFC⁻¹ in 04-05, and then up

to INR 824488 VFC⁻¹ in 10-11. Circulation fund increased significantly (60% increase in fund, Wilcoxon sig. 0.004) between 1998-99 and 2004-05 in sample VFCs, the peak project period. The fund increase was not statistically significant (47% increase in circulation fund, Wilcoxon sig. 0.075) between 2004-05 and 2010-11, in the post project period. On an average the revolving fund in each VFC increased 135% between 1998-99 and 2010-11 (Wilcoxon sig. 0.007). The circulation fund in VFCs did not increase significantly between 2004-05 and 2010-11 when there was an overall decrease in both male (decreased to 39% from 49%) and female (decreased from 59% to 44%) memberships in sample VFCs. A decrease in enthusiasm among VFC members regarding ecodevelopment was observed just after formal completion of project.

7.3.8 Change in Energy Requirements in Sample VFCs

There was no statistical difference in per household fuel wood consumption (Wilcoxon sig. 0.33) in sample VFCs between 1998-99 and 2010-11 (Table 7.6). Earlier during 1998-99 the fuel wood requirement was estimated at 4 kg household⁻¹ day⁻¹ (121 ± 10.22 kg month⁻¹), and the same was found to be 3.5 kg household⁻¹ day⁻¹ in 2010-11 (107 ± 9.38 kg month⁻¹). During 2010-11 socio-economic survey, it was observed that nearly 20% families in sample villages used only non-wood energy like LPG (Liquefied Petroleum Gas) and kerosene as household energy source. These are either farming villages with large land holdings or villages situated closer to the largest township near PA, Vickramsingapuram. Villagers used either fuel wood and kerosene (3 lit household⁻¹ month⁻¹ rationing) or fuel wood and LPG in combination for cooking, water heating, making cattle feed etc. It was revealed during questionnaire survey in

sample villages that on an average a 5 adult member family used one LPG cylinder for two and half or three months indicating that fuel wood remained as the main household fuel even after a family owned LPG. Inability to pay high market price of gas cylinder frequently was the main reason. It was found during 10-11 survey that fuel wood still remained as main household fuel for 70% surveyed families in sampled VFCs, whereas only 20% household were using only non-wood energy like LPG and kerosene. LPG was either taken from ecodevelopment loan from VFC, or free connection was provided via another rural development scheme simultaneously ran by Tamil Nadu Government during that period. Similarly, 65% families in sample VFCs used conventional wood stove to cook meals, whereas only 12% each used fuel efficient chullah and hot point kerosene stove provided in ecodevelopment. Only 10% families used pressure cooker to cook food. Door to door survey revealed that families were not trained about effective use of fuel efficient chullah and complained about smoke and other technical problems. On the other hand villagers were not keen in using pressure cooker for cooking as it is non-compatible with wood as fuel, and due to disliking for pressure cooked food.

Though there was no significant decrease in average household fuel wood consumption within last ten years (from 1998-99 to 2010-11) in the fringe villages of KMTR, the monthly expenditure per family for fuel wood significantly increased in the same period. The fuel wood purchase expenditure enhanced from INR 2008 \pm 231.01 family⁻¹ year⁻¹ in 1998-99 to INR 3547 \pm 261.54 family⁻¹ year⁻¹ in 2010-11 (Wilcoxon sig. 0.003). That's why still there is significant demand for fuel wood in the vicinity of KMTR, though reduced during ecodevelopment. It was found during dependency study that still 26% of fuel wood demand in the locality was met from KMTR in 2010-

11. The demand for forest fuel wood decreased in comparison to past (it was estimated at 67% during 1998-99 study), but the 10-11 estimated demand was also not very less. It was also observed that maximum decrease in fuel wood head loaders in forest trails were took place in the initial stage of ecodevelopment, which slowed down considerably in the later stage (04-05 and 10-11).

Number of head loads at entry/exit points of sample VFCs during peak summer (May) gradually decreased over time between 1998-99 and 2010-11. During 1998-99, the average number of head loads found in sample villages were 9 head load day⁻¹ VFC⁻¹ (9 ± 1.8), which decreased to 5 head load day⁻¹ VFC⁻¹ (5 ± 0.87), and then further decreased to 3 head load day⁻¹ VFC⁻¹ (3 ± 2.03). But there was no statistical significance (P>0.05) of all these differences. Average number of grazing animals through entry/exit points of samples villages / VFCs during same period were estimated as 88 livestock day⁻¹ VFC⁻¹ (88 ± 23) in 1998-99, which increased to 115 livestock day⁻¹ VFC⁻¹ (115 ± 42.59) in 2004-05 and then decreased to 22 livestock day⁻¹ VFC⁻¹ during 2010-11. Though visible as high percentage of decrease (75% decrease between 1998-99 and 2010-11) in grazing animals, this difference was also not significant due to high variance (P > 0.05).

Table 7.6: Energy requirement in sample VFCs

| Household fuel | % of families | Fuel wood consumption (kg day ⁻¹ HH ⁻¹) | | Monthly fuel wood expenditure (INR) | |
|----------------------|---------------|--|--------------------------|-------------------------------------|--------------|
| | | 98-99 | 10-11 | 98-99 | 10-11 |
| Fuel wood | 29 | 4 kg day ⁻¹ | 3.5 kg day ⁻¹ | 167.36±19.25 | 295.54±21.79 |
| Fuel wood & kerosene | 29 | | (P > 0.05) | | (P < 0.05) |
| LPG | 14 | | | | |
| Fuel wood & LPG | 11 | | | | |

The percentage of sampled households using particular fuel given in parenthesis

7.3.9 Status of Alternative Income Generation in Sample VFCs

An attempt had been made to find the overall status of Alternative Income Generation (AIG) implementation in KMTR ecodevelopment till 2010-11 through household survey of sampled VFCs. As mentioned earlier, some microenterprises chosen by VFC members as alternative livelihood were actually directly or indirectly forest exploitative. During socio-economic investigations in 2010-11, it was observed that many beneficiaries utilized ecodevelopment loan for a completely different purpose than the stated or recorded one. A number of respondents utilized loan for purposes like repayment of local money lender's loan, house renovation, son's education, jewellery for daughter's marriage, or simply agriculture related expenditure. At the beginning of program beneficiaries were guided in using the credit amount in the first place to break the debt trap of the money lenders and in the second to start non-forest dependent microenterprises. In reality, many beneficiaries went on fulfilling even their other social responsibilities one after another in the name of non-forest enterprises. By this, the image of forest department among communities improved, but there was no guarantee that the loan receiver would refrain from further exploitation of PA resources in future, if situation arise. In many cases what the community wanted did not make sense within the project context. Sometimes the chosen alternative livelihood like establishment of fuel wood based tea stall, renovation of thatched house which require woods and poles, rearing of free grazing animals like buffaloes, goats etc., was against conservation act. In other Integrated Conservation-Development Projects (ICDPs) also there are a number of cases where the linkage between the conservation objective and the actual utilization of incentives was very weak or absent (Brandon and Wells, 1992).

On an average, each surveyed family received loan thrice (Table 7.7) in sample VFCs. Villages like Sambankulam (7 loans family⁻¹), Dana (6 loans family⁻¹) and Pethanpillaikudiyiruppu (5 loans family⁻¹) received higher number of loans. Sambankulam is a Muslim inhabited village in the northern fringe of KMTR boundary, and many villagers were involved in fuel wood extraction and livestock grazing in past, so as village like Pethanpillaikudiyiruppu. There was intense conflict between forest department and villagers and both the parties did not trust each other. During ecodevelopment, relentless persuasion by the Field Director, Ecodevelopment Officer, and other officials brought situation under control and gradually villagers got involved in the project. On the contrary, in well to do village like Dana, many families not directly dependent on forest for livelihood, also availed the facility of low interest ecocodevelopment loan to maximize household income. Each family in sample villages received average INR 8605.00 as loan to build up alternative non-forest enterprises. Members in villages like Rajapudur (INR 12857 family⁻¹), Anavankudiyiruppu (INR 10971 family⁻¹) and Kalyanipuram (INR 14667 family⁻¹) received higher amount. It is ironical that attendance of general members in the VFC meetings was extremely low in Rajapudur and Kalyanipuram.

During household survey, the percentage of families that chose conservation linked alternative enterprises, and the percentage that chose enterprises having no link with conservation were separately found. 52% (n=40) of respondents chose alternative microenterprises linked with conservation objective, and the rest 48% (n=37) respondents chose microenterprises not linked with the basic objective of conservation. For example, if a landless agriculture labourer took loan to buy fertilizer to enhance production, is there any guarantee that he / she will not collect fuel wood

during slack season? What's the guarantee that a forest dependent member after receiving loan for children's education will not send scrub cattle during dry seasons to KMTR if strict vigilance is not there? Instead, loan for a petty shop may enhance monthly family income which in due course may exceed the income from selling fuel wood; or the income from milking cow over due course may offset the profit made from selling scrub cattle dung as agriculture manure. Such loans were categorized as loans having conservation linkage. The difference of percentage between households that chose alternative livelihood linked with conservation, and households that chose alternatives not linked with conservation, was not statistically significant (Mann-Whitney U sig. 0.767). When the actual utilization of ecodevelopment loans was investigated, it was found that 52% (n=40) chosen microenterprises were not linked with the conservation objective of forest department; moreover 13% (n=10) households used the loan in some activity that directly or indirectly destructed forest resource. 35% (n=27) households actually utilized the ecodevelopment loan assistance in some pro conservation activities. Both the household percentage differences between pro conservation and no linkage alternatives (Mann-Whitney U sig. 0.166), and pro conservation and against conservation alternatives (Mann-Whitney U sig. 0.166) were statistically insignificant.

All the sampled households (100%) in Ayan Singampetti village dominated by *Thevar* - an upper caste agriculturist community, procured loan to start enterprises that essentially go with the objective of conservation, but used it for some other activity not at all linked with conservation. Same pattern followed in other agriculturist communities. High percentage of beneficiaries in villages like Pethanpillaikudiyiruppu (73%), Chettimedu (83%) and Kalyanipuram (83%) also utilized loan amount for a

purpose not linked with conservation. For example, many fuel wood head loaders in Pethanpillaikudiyiruppu used the loan for daughter's marriage or house electrification, which enhanced the goodwill of forest department. But did the incentives serve any conservation purpose? In some cases, beneficiaries took loan for a non-forest vocation, but could not continue such vocation either due to lack of training or less developed market in the vicinity, or sometimes failed in value addition. For example, many women in Chettimedu village bought sewing machine after getting loan, but could not sustain in tailoring business. Villagers from northern and southern end of PA boundary bought milking cow but failed to make profit by selling milk, and then sold the cow again. The same alternative was found profitable in villages near Vickramsingapuram, the municipal area located very close to KMTR boundary, and a commercial place with many hotels and tea stalls. In addition, milkmen can sell the product to the milk cooperative there which were non-existent in northern or southern part. So solution will not be the same everywhere when ecodevelopment is implemented for large area. Economically better off families (green group) even purchased land and constructed new house after getting monetary assistance (Kalyanipuram VFC) from ecodevelopment. Does it guarantee that in future, they are not going to employ the agriculture labour working in their field to fetch a bundle of fuel wood for domestic purpose? In fact, many respondents had this view that the observed decrease in percentage of head loaders extracting fuel wood and free cattle grazing within TR was due to stricter protection of forest during ecodevelopment rather than the impact of Alternative Income Generation (AIG). Average level of forest protection found enhanced from low in 98-99, to medium in 04-05 and 10-11. Large number of respondents' utilized loan for alternative non-forest livelihood not linked with PA conservation in Dana (58%) and Moolachi (60%) VFCs. One respondent in Dana

village had now established a wood stall (2010 -11) after successfully running a petty shop he established 8 years back from Ecodevelopment assistance. What's the guarantee that the man would not try to maximize profit by procuring forest fuel wood? Similarly, in Moolachi, where most of the families were well to do farmers with own land, beneficiaries utilized VFC loan for child's education, but depended on forest fuel wood as main source of household energy.

It was found during investigation that 50% sampled households in Rajapudur VFC located in southern end of KMTR boundary, and Agasthiyar Kani settlements located within park, utilized ecodevelopment assistance in resource extraction activities like renovation of thatched hut, procurement of forest fuel wood etc. Many of them even admitted that they refrain to collect forest fuel wood due to strictness maintained by forest staff during ecodevelopment period. It must be mentioned here that during household survey in 2010-11, it was found that irrespective of economic status, majority of households still depended on fuel wood to fulfil daily energy requirements.

Table 7.7: Alternative income generation status within sample VFCs

| Sample VFC | Average no. of loans family ⁻¹ | Average loan amount (INR) family ⁻¹ | Loan purpose (%) | | Utilization (%) | | |
|---------------------------|---|--|----------------------|------------------|------------------|----------------------|------------------|
| | | | Conservation linkage | No linkage | Pro conservation | Against conservation | No linkage |
| Rajapudur | 2 | 12857 | 29 | 71 | 38 | 50 | 13 |
| Ayan Singampatti | 2 | 5110 | 100 | 0 | 0 | 0 | 100 |
| Sambankulam | 7 | 8000 | 88 | 12 | 88 | | 12 |
| Dana | 6 | 7838 | 42 | 58 | 33 | 8 | 58 |
| Anavankudiyiruppu | 2 | 10971 | 47 | 53 | 50 | 6 | 44 |
| Pethanpillai Kudiyiruppu | 5 | 7737 | 27 | 73 | 18 | 9 | 73 |
| Chettimedu | 2 | 5727 | 71 | 29 | 0 | 17 | 83 |
| Kalyanipuram | 4 | 14667 | 33 | 67 | 17 | 0 | 83 |
| Agasthiar Kanikudiyiruppu | 3 | 5667 | 50 | 50 | 50 | 50 | 0 |
| Moolachi | 2 | 9818 | 40 | 60 | 40 | 0 | 60 |
| Mungiladi | 3 | 6273 | 50 | 50 | 50 | 0 | 50 |
| Mean ± SEM | 3 ± 0.55 | 8605 ± 946.52 | 52 ± 7.24 | 48 ± 7.24 | 35 ± 7.52 | 13 ± 5.8 | 52 ± 9.86 |

7.3.10 Change in Family Occupation in Sample VFCs

The family occupation of both executive and general members in sample VFCs were investigated during socio-economic survey (2010-11). It was found that maximum percentage of families (34%) were landless labourer (figure 7.4). Most of them left PA extraction due to strict attitude of forest staffs in recent time, and after getting alternative livelihood assistance from department. But they bound to collect firewood from PA for household purpose and set their cattle and goat free for grazing within PA. Another 21% families were non-forest landless labourer - not dependent on any form of forest resource in their day to day life as they were started using non-wood energies for household. 19% families had agricultural land and depended on farming. 12% did service, either in organized or unorganized sector. 6% households ran by the income of women members engaged in bidi rolling. Only 5% families mentioned newly acquired non-forest alternatives as their main source of income. 3% households depended on income from some kind of park resource extraction. It is clear that most of households in surrounding villages were landless labourers depended on daily work and wages. Though many of them abandoned forest fuel wood selling mainly due to strict vigilance by forest guards, the domestic energy dependency on fuel wood still existed as they couldn't afford a single non-wood form of energy as their only energy source or reluctant to spend money on energy when free availability is there in surroundings. They were categorized as forest dependent landless labourers. Very few families (in VFCs like Anavankudiyiruppu) changed to non-forest based alternatives of ecodevelopment in the later stage of investigation (2010 – 11).

In order to find the whole spectrum of dependency, type of household energy and grazing was also considered while analysing change in family occupation in sample VFCs. As mentioned above, many families shifted to non-forest based livelihood. But still most of them maintained using fuel wood and kept free grazing goats and buffaloes. Many of them were landless, so could neither grow fodder, nor could afford to purchase fodder from market. Because of high penalty and punishment, villagers resorted to collecting sticks of thorny stunted vegetation from agricultural land fencing that was insufficient and inferior quality fuel. Though members kept silent about occasional visit to PA, it was obvious that the fuel available in fringes was insufficient. Such families were still categorized as forest dependent. Some poor families managed to compensate fuel wood with LPG and kerosene as they had small family size. They were categorized as non-forest households. Few families managed fuel budget with combination of all fuel types like one bundle (50-60 kg) fuel wood, bunch of coconut leaves (100 leaves bunch⁻¹), kerosene (3-5 lit month⁻¹), saw dust and LPG (1 cylinder /2.5 to 3 months). By this manner they reduced the quantum of fuel wood requirement which usually amounted to 3 to 5 bundle (150 kg month⁻¹) in other families using fuel wood and kerosene, or fuel wood and LPG as combination. Some households that received ecodevelopment loans to purchase goats or buffaloes were bound to send livestock for free grazing. They were observed to send animals for grazing just near forest boundary, but definitely would not hesitate entering herds within PA if boundary supervision loosen up. In fact during 2010-11 survey, many times buffalo herds were observed within PA in plateau area near natural water sources.

Nearly 74% (74±9.39) families continued with forest depended occupation and rest 26% (26±9.39) was able to maintain non-forest based occupation both during

1998-99 and 2004-05 survey (Table 7.8). A 5% decrease in forest dependent occupation (70 ± 10.03) occurred during last survey (2010-11), but the percentage decrease was statistically insignificant (Wilcoxon signed rank test sig. 0.317). The initial decrease in fuel wood head loading from PA and free cattle grazing within park slowed down considerably between 04-05 and 10-11 as most of the families in fringe still very much dependent on fuel wood as energy source and many of them could not afford to buy fodder for livestock or grew in the field.

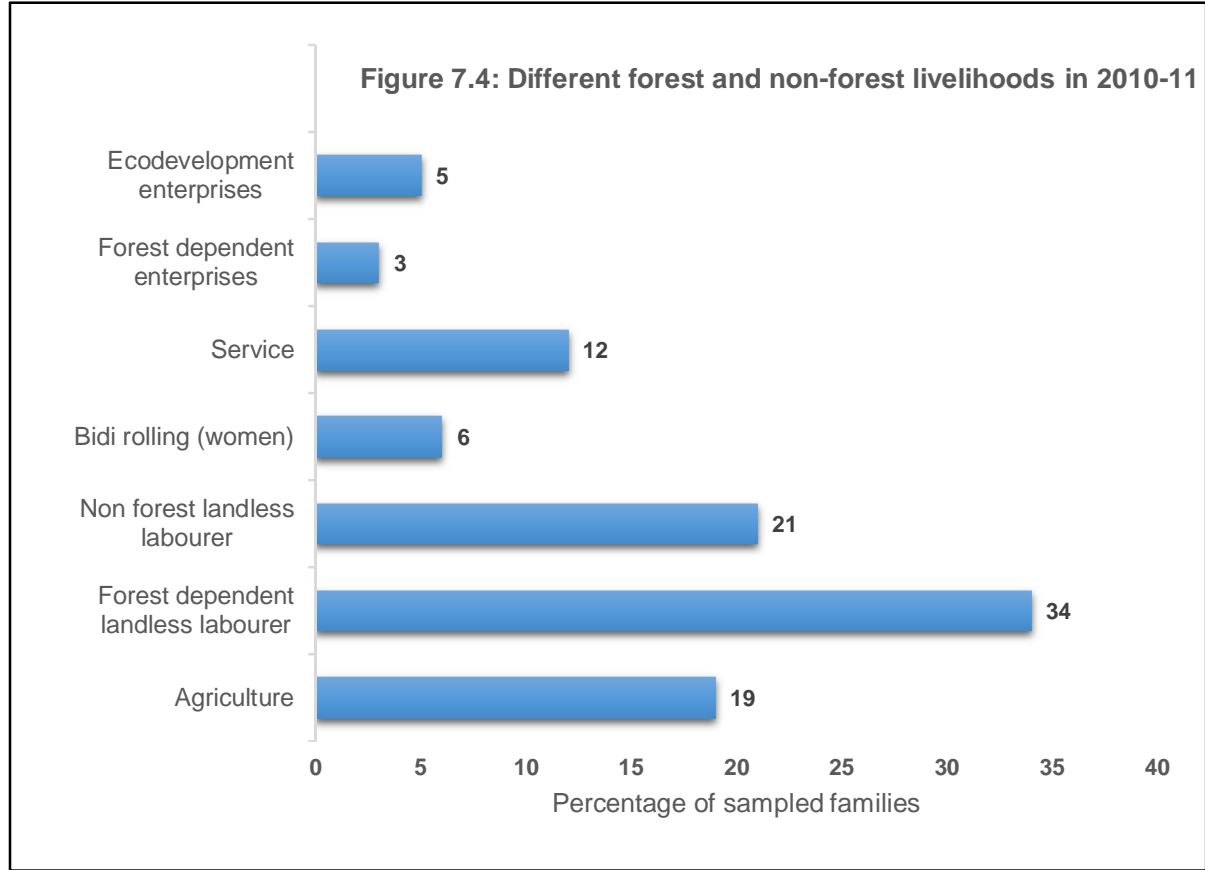


Table 7.8: Change in forest dependent occupations in sample VFCs

| Sample VFCs | Main family occupation | | | | | | Change in forest dependent occupations between 98-99 & 10-11 (%) |
|---------------------------|------------------------|----------------|----------------------|----------------|----------------------|-----------------|--|
| | 98-99 | | 04-05 | | 10-11 | | |
| | Forest dependent (%) | Non-forest (%) | Forest dependent (%) | Non-forest (%) | Forest dependent (%) | Non-forest (%) | |
| Rajapudur | 100 | 0 | 100 | 0 | 100 | 0 | 5% decrease in families engaged in forest dependent occupations (P > 0.05) |
| Ayan Singampatti | 25 | 75 | 25 | 75 | 25 | 75 | |
| Sambankulam | 100 | 0 | 100 | 0 | 100 | 0 | |
| Dana | 33 | 67 | 33 | 67 | 33 | 67 | |
| Anavankudiyiruppu | 83 | 17 | 83 | 17 | 33 | 67 | |
| Pethanpillaikudiyiruppu | 88 | 12 | 88 | 12 | 88 | 12 | |
| Chettimeedu | 100 | 0 | 100 | 0 | 100 | 0 | |
| Kalyanipuram | 43 | 57 | 43 | 57 | 43 | 57 | |
| Agasthiar Kanikudiyiruppu | 100 | 0 | 100 | 0 | 100 | 0 | |
| Moolachi | 100 | 0 | 100 | 0 | 100 | 0 | |
| Mungiladi | 43 | 57 | 43 | 57 | 43 | 57 | |
| Mean ± SEM | 74.09±9.39 | 26±9.39 | 74.09±9.39 | 26±9.39 | 70±10.03 | 30±10.03 | |

7.3.11 Change in Economic Status in Sample VFCs

Analysis of household survey data revealed that there was significant increase in monthly family income in sample VFCs between all the three stages defined to track changes during ecodevelopment (Table 7.9). Average monthly income increased from INR 1882(1882±267.67) in 1998-99 to INR 2400 (2400±254.07) in the year 2004-05, which means an average increase of 28% (Wilcoxon signed rank sig. 0.007, paired t test sig. 0.001). Similarly average monthly income of family increased from INR 2400 in 2004-05 to INR 3312 (3312±393.35) in the year 2010 – 11, which was an increase of 38% (Wilcoxon signed rank sig. 0.003, paired t test sig. 0.002) in another five years of span. The overall increase in sampled households' monthly income amounts to 76% between 1998-99 and 2010-11 (Wilcoxon signed rank sig. 0.006, paired t test sig. 0.002).

When asked about main reasons of steady increase in monthly family income during this period, 73% respondents (Mann-Whitney U sig. 0.001, independent t test sig. 0.000) told assistance by forest department for an alternative source of income as the main reason. Rest 27% respondents cited different reasons other than ecodevelopment behind increase in household income. It is evident that KMTR ecodevelopment programme was able to enhance income level of forest dependent rural population in the vicinity of Tigre Reserve (TR) over a decade. It is one of the most positive outcomes for KMTR ecodevelopment experiment as a tool for conservation. Interestingly, there was high variation in incomes of the sampled VFCs in the initial stage of ecodevelopment (1998-99), and this variation narrowed down

after ten years (2010 – 11). The pattern clearly demonstrates that the benefits of ecodevelopment had percolated down to many VFCs.

Very high percentage of interviewee in sampled villages like Rajapudur, Sambankulam, Anavankudiyiruppu, Pethanpillaikudiyiruppu, Chettimedu etc., agreed that alternative livelihood programme of ecodevelopment was the reason behind increase in family income in recent years. These are the villages situated in close proximity to KMTR, inhabited by large number of 'red' group forest dependent households, basically landless labourers and marginal communities. By making them happy KMTR management advanced one basic step quite firmly on the ground. It very much fulfilled the objective of reaching the real forest dependent population, and to a large extent helped their economic growth along with a homogeneous growth across various sections of communities in the study area. Anavankudiyiruppu on the foothills of KMTR was inhabited by almost hundred percent forest dependent marginal communities observed 50% increase in monthly family income between 2004-05 and 2010-11, and interestingly 50% of sampled families changed forest dependent occupation to non-forest one in the same period. 92% of respondents in this village attributed ecodevelopment for the enhancement of income level during this period.

Table 7.9: Change in economic status in sample VFCs

| Sample VFCs | Average family income (INR) month ⁻¹ | | | If income increase, due to | | Change in income (%) | | |
|--------------------|---|--------------------|--------------------|----------------------------|-------------------|----------------------------|----------------------------|----------------------------|
| | 98-99 | 04-05 | 10-11 | Eco dev. (%) | Other reasons (%) | 98-99 & 04-05 | 04-05 & 10-11 | 98-99 & 10-11 |
| Rajapudur | 1800 | 2230 | 2700 | 100 | 0 | 28% increase (P < 0.05) | 38% increase (P < 0.05) | 76% increase (P < 0.05) |
| Ayan Singampatti | 1080 | 1410 | 1790 | 33 | 67 | | | |
| Sambankulam | 1650 | 1770 | 1885 | 100 | 0 | | | |
| Dana | 4040 | 3740 | 3780 | 43 | 57 | | | |
| Anavankudiyiruppu | 1650 | 2400 | 3600 | 92 | 8 | | | |
| Pethanpillaikudiyi | 1000 | 1300 | 1700 | 100 | 0 | | | |
| Chettimeedu | 1500 | 2150 | 3000 | 75 | 25 | | | |
| Kalyanipuram | 1200 | 2100 | 4000 | 57 | 43 | | | |
| Agasthiar | 2100 | 2900 | 3750 | 50 | 50 | | | |
| Kanikudiyiruppu | | | | | | | | |
| Moolachi | 1800 | 2500 | 4100 | 75 | 25 | | | |
| Mungiladi | 2880 | 3900 | 6130 | 80 | 20 | | | |
| Mean ± SEM | 1882±267.67 | 2400±254.07 | 3312±393.35 | 73±7.25 | 27±7.25 | | | |

7.3.12 Change in Crop Damage by Wild Life

Respondents were also asked structured and semi-structured questions regarding changes in quantum of crop damage by wild animals like wild boar, sambar, spotted deer, sloth bear, peacock etc., during ecodevelopment project period. About 50% of the surveyed villages were situated within 1 – 2 km from the eastern boundary of KMTR. The agricultural lands were also situated adjacent to the park boundary, so crop damage by wildlife and concurrent loss of farmers were yearly features even before ecodevelopment. This southern part of Tamil Nadu (Tirunelveli District) is mainly rice growing belt along with banana as cash crop. Rice is grown and harvested thrice in a year for a span of three months each. Therefore most of the families heavily depended on economic return from agricultural productivity. In this backdrop, the man-animal conflict on the eastern boundary of KMTR is one of the most contentious issue between KMTR management and local population, and perhaps the biggest hurdle before forest department to overcome in creating a friendly atmosphere of mutual cooperation and faith towards the common objective of better management of KMTR's resources. Contrary to this, if buffer zone habitat of KMTR improved due to less human pressure on park during ecodevelopment, there would be more presence of wildlife near boundary forest, which can be considered a very positive sign of habitat improvement after ecodevelopment. So an increase in crop damage incidences in the last decade actually indicates improved forest health in the zone of interference.

100% of the interviewed VFC members (n=158) suggested an increase in quantum of crop damage between 1998-99 and 2010-11 in the sample villages. The incidences of crop damage progressively increased in 2004-05 in comparison to 1998-

99, and then in 2010-11 in comparison to 2004-05. Similarly, higher percent of wildlife presence was recorded (68 ± 3.73) near eastern boundary than domestic animals (14 ± 6.08) during 2010 -11 survey, indicative of improvement in forest habitat in the last decade. The statistical significance (both Mann-Whitney U test and t test) of the difference further confirms the field observation.

42% respondents told wild boar as the main destroyer of paddy as well as banana plantain. Another 43% members told about the damage inflicted by sambar, spotted deer, sloth bear and peacock. People had the opinion that due to protection and less human interference, sambar population increased manifold in the buffer zone becoming a new threat to crops. It needs to be mentioned that sambar was sighted in crop lands and orchards close to boundary at dusk during 2010 -11 survey. Each year, nearly 1 acre of crop got destroyed by wild animals which amounted to a loss of nearly INR 10000 for a farmer. To prevent and drive out wild animals from the field at night a farming family required to spend INR 3000 to 5000 month⁻¹ to build a shade and keep a high power torch, fire wood, crackers etc. Respondents from Chettimedu village situated within 500 m from PA also told about lifting of goats and watch dogs by leopard at midnight. Incidences of human mauling by wild elephants were took place between 2008 and 2010. All these confirmed the increase of wildlife near foot hills during ecodevelopment.

Interview also revealed that most of the landless farmers were not aware of the procedure to apply for compensation of crop destruction by wild animals, or hesitated from doing so. Many of them were encouraged by forest department to grow other

cash crops like ginger or chilly which remain unattractive to animals like wild boar or sambar. Farmers did not consider alternative crops as they were unaware of their farming procedures. They even felt the need for proper training by agriculture department in collaboration with the forest department. Electric fencing was installed recently in some very critical location to prevent the entry of wild herbivores in the adjacent agricultural field, but how far it is effective is a matter to be investigated. Many villagers told about faulty construction and insufficient power during night. Some told about lack of maintenance by the department where the increasing grass height from below made the electric fencing ineffective.

7.3.13 Change in Forest Offences during Ecodevelopment

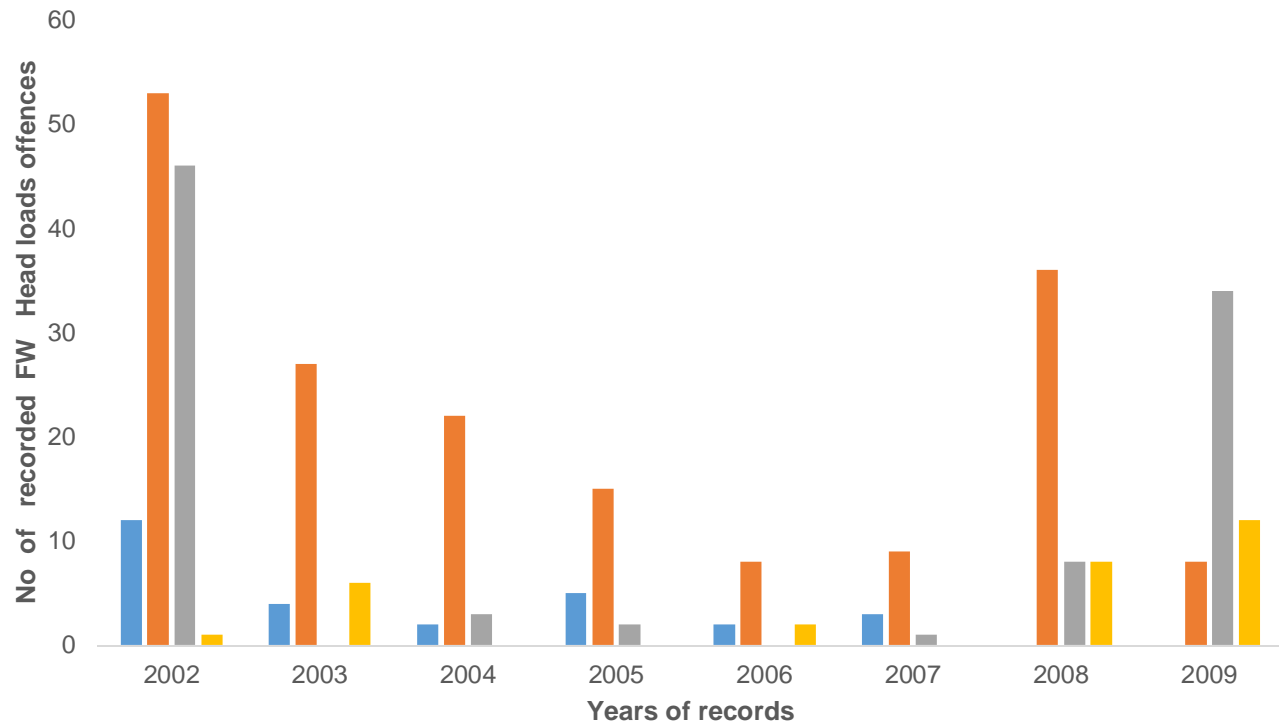
Records regarding illegal fuel wood head loads, ceased wood vehicle loads (in metric tons), and livestock grazing within PA from 2002 to 2009, were analysed to find out change in recorded forest offences after implementation of ecodevelopment. According to Forest Department the vehicle loads of woods were actually ceased wood in excess than the amount permitted to be taken from plantation forests situated in the buffer zone. To find out changes in head load pattern during ecodevelopment, offence records from three peripheral forest range office were analysed, namely Kadaiyam range situated at the northern part of eastern boundary, Papanasam range situated south to Kadaiyam where the main entrance toward dam sites located, and the Ambasamudram forest range situated in the middle of eastern boundary of KMTR. Mundanthurai forest range records were also analysed along with the three peripheral ranges, as it is situated in the interior plateau area disturbed by human interferences originating from inner settlements.

A gradual decrease in fuel wood head loads was observed (Figure 7.5) during post project period in Papanasam forest range, where huge number of head loading cases were registered in the initial years, and was known for large scale fuel wood extraction in the past. The head loading cases reduced from 53 in 2002 and 27 in 2003 to 8 in 2006 and 9 in 2007. All the years displayed a decreasing trend except a sharp increase in fuel wood cases (36) in 2009. Similar trend was also observed in PA foot trail monitoring exercise. During 1998-99 baseline survey, average 48 and 65 FW head loaders visited park per day in rainy season through major forest trails located within Papanasam forest range. The number drastically reduced to 4 and 28 head loader day⁻¹ during 2004-05 survey, and similarly to 5 and 30 head loader day⁻¹ during 2010-11 monitoring. In fact, the first sample trail (48 head loaders day⁻¹ in 1998-99) mentioned above, was found almost abandoned from 2004 onwards due to strict protection during ecodevelopment. The boundary of Ambasamudram forest range is surrounded by forest dependent communities. Fuel wood head loading drastically reduced from 46 in 2002 to only 3 in 2004 and 2 in 2005. But simultaneously an indication of resurgence in FW head loading offences was observed in both the ranges from 2008-09 onwards. Fuel wood head loading cases dropped to almost nil in 2008-09, from 12 recorded cases in 2002 in Kadaiyam forest range. Two major representative forest trails in Kadaiyam area also showed a decrease from 14 and 34 head loads day⁻¹ in 1998-99 survey to 8 and 9 head loads day⁻¹ in 2004-05, and 10 and 8 head loads day⁻¹ in 2010-11 survey. Contrary to this, Mundanthurai range located in the interior of KMTR showed an increase in FW head loading offences from 2002 to 2008-09, which was also confirmed by signs of higher biotic pressure in plateau than boundary of PA (chapter 5) when both the status were compared in 10-11. It is already discussed in chapter 4 that level of forest protection improved from

low in north side of boundary in 98-99 to medium in 04-05 and 10-11, and improved from very low in 98-99 to low in 04-05, and medium in 10-11 in the central part of PA. Similarly, a steady decrease in yearly ceased wood weight from plantations located in the buffer zone was observed from forest department's records (Figure 7.6). Offences of trees cut for timber within PA almost reduced to zero after 2004-05 in the above mentioned forest ranges. The trees cut for timber were *Azadirachta indica*, *Tectona grandis*, *Santalum album*, *Anogeissus latifolia*, *Grewia tiliaefolia* and *Pterocarpus marsupium*.

Free livestock grazing within KMTR also reduced from 2002 to 2009 (Figure 7.7). Comparatively higher number of scrub cattle and buffalo grazing incidences happened in Mundanthurai and Papanasam forest range. It also became evident during transect survey that though reduced, still a sizable number of livestock, especially buffaloes freely grazed in Mundanthurai plateau in the interior of PA (chapter 5). Most of them were told as livestock belonging to Electricity Board Employees located in the plateau area.

Figure 7.5: Change in FW headloading offences during ecodvelopment



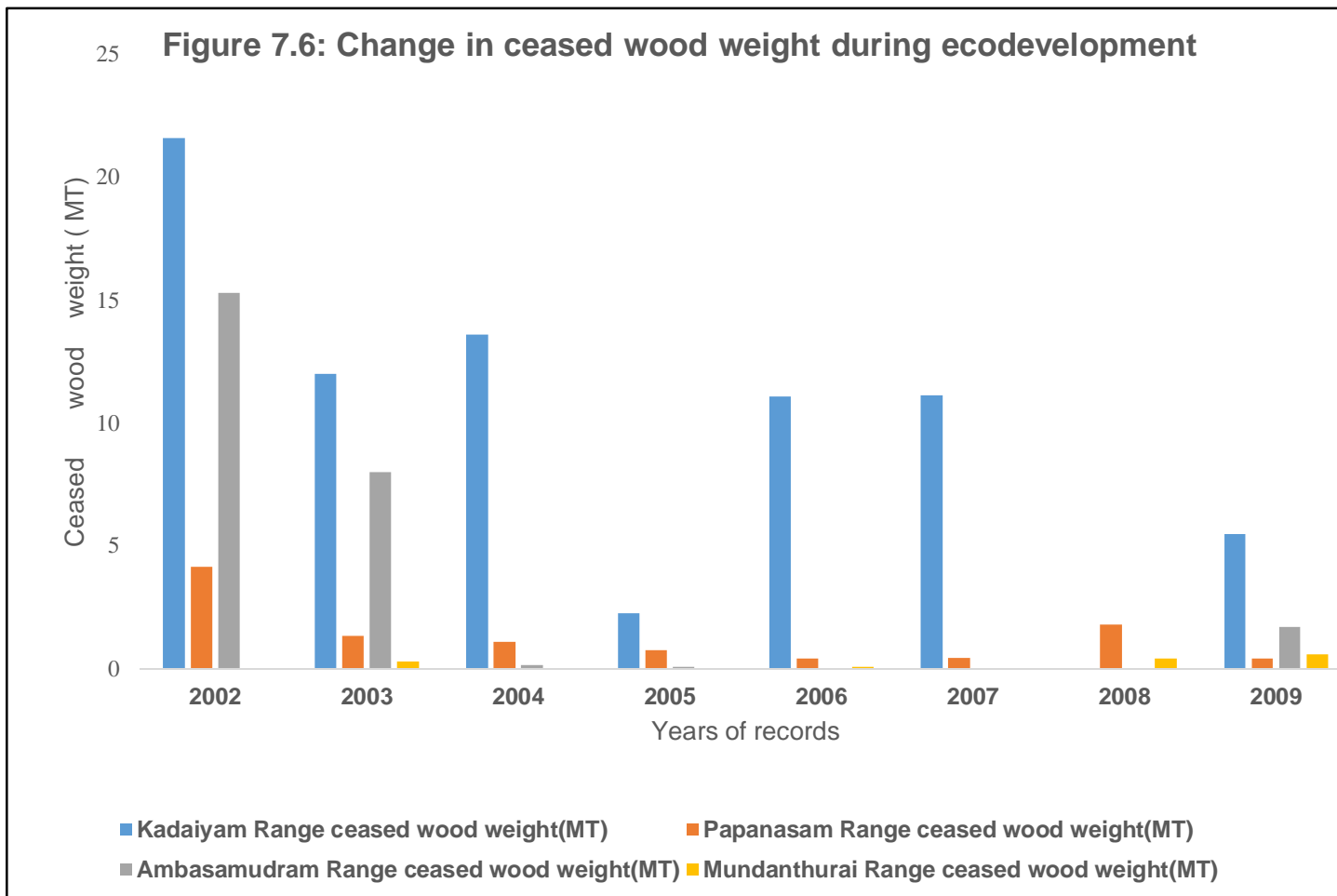
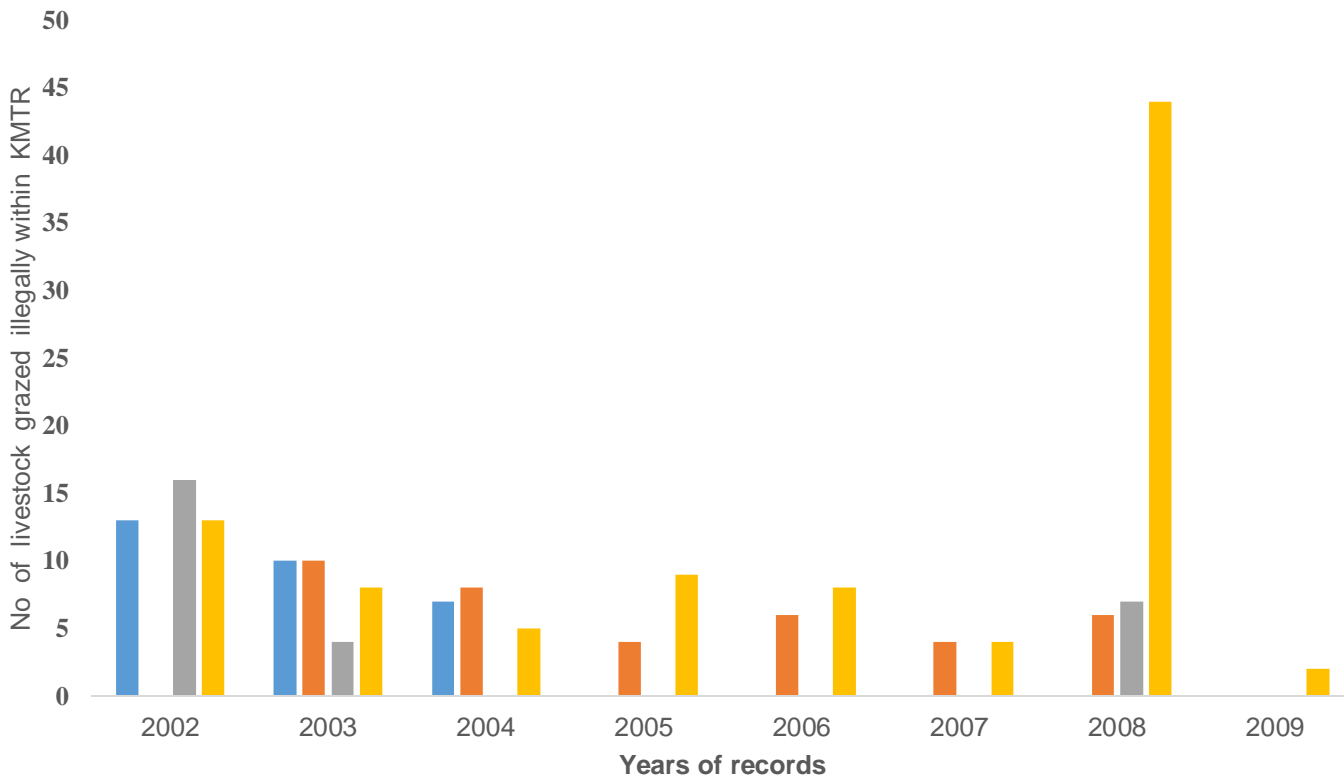


Figure 7.7: Change in number of livestock grazed within KMTR



7.3.14 Change in attitude

Traditionally participation was not the mandate of PA management. So there is a requirement to understand the level of acceptance of ecodevelopment as a participatory process of PA management by the forest staff who are considered as the main stakeholder and custodian of KMTR's natural resources. Simultaneously, it is also equally important to investigate whether local communities understood the basic objective of ecodevelopment, or for them it is another rural development exercise, this time conducted on behalf of forest department. The conservation link of ecodevelopment should be realized by forest dependent households in KMTR for whom the project was initiated. So, another part of attitude study was to find out the change of concept of local communities, if any, towards the importance of KMTR and its natural resources for the present and future generations in that area. It is important to analyse the level of improvement of mutual trust and interrelations between departmental staff and local communities, which ultimately may form the basis towards larger objective of joint management of KMTR. The results of attitude survey are discussed here.

7.3.14.1 Forest staff attitude survey

Forest staff attitude survey was performed on the basis of eighteen different parameters. During survey it was realized that actually such large scale program was executed by relatively fewer forest officials and NGO representatives. Involvement of different wings of the forest department was not visible. The whole program was actually run by a close network of individuals in a coordinated manner. It had its own positives and negatives.

The results revealed that in general there was high level of understanding about the technical details of ecodevelopment implementations among staffs associated with it, and there was high level of commitment and involvement towards ecodevelopment implementations among controlling and supervising officers, executive officers, frontline staffs and local NGO representatives (Table 7.10). Though 60% forest staffs (n=9) told of receiving some training in ecodevelopment, while rest (40%, n=6) did not receive any training in it. The envisioning of a novel strategy to reduce the dependency of fringe communities recognized as the major constraint in conserving the biodiversity of KMTR, and remaining committed to it speaks volumes about the first set of project leaders in KMTR (PEACE 2004). Simultaneously, a proper follow up action made possible due to committed staff executed the programmes, especially the alternative Income Generation Activities (IGAs). Among the staff involved in KMTR project, NGO representatives (n=52) commitment and involvement in various levels of implementations received maximum score (3.96) in staff attitude survey. The credible local NGO support to the program, and their perfect amalgamation with forest department staff created a new blend of institutional structure within KMTR management, and helped the management a lot in proper execution of economic development plans. But on the other side, staff attitude survey results showed that the impact of ecodevelopment on protection of wildlife, and in general on the conservation of biodiversity was low (attitude score 1.5 and 1.79 respectively in a scale of 0.1 – 4). This means, still lot of improvement in strategy and implementation is required to achieve the desired linkage between economic developments of dependent communities, and as a result, better conservation of KMTR's biodiversity, which also became evident during dependency and pressure study. The staff attitude score was

medium and high in 50% of the attitude survey parameters, and low to very low category in the rest 50% parameters. There was virtually no interconnection between regular rangers (ecodevelopment involvement score 0.5 only) assigned duties to protect the park from disturbances and specially deployed eco staff (eco rangers and foresters) for ecodevelopment. This division and complete separation of charges might hamper the linkage between economic development activities for forest dependents and protection of wildlife. The average staff attitude score was 2.26 (medium).

Forest staff was asked open ended questions regarding positive and negative aspects of KMTR ecodevelopment. Regarding positive aspects (Table 7.11), 25% staff mentioned about the increase in family income and living standard in fringe villages due to IGA scheme of ecodevelopment. 19% staff opined that skill development and capacity building like driving, computer, stitching and food processing training created some hope among local communities, and some of them applied it in real life. 19% staff mentioned that villagers' dependency on local money lenders significantly reduced after ecodevelopment due to availability of comparatively low interest loans through SHGs. 19% staff believed there was significant decrease in number of fuel wood head loaders, NTFP collectors and free grazing livestock within park after ecodevelopment. 13% opined that level of forest protection enhanced during ecodevelopment. 13% staff mentioned women empowerment in fringe villages due to successful functioning of large number of women Self-Help Groups (SHGs) during ecodevelopment, claiming it as first government initiative of this kind. Regarding negative aspects (Table 7.12) of KMTR ecodevelopment, 19% staff told lack of marketing skills among VFC members for the newly acquired skills or alternative enterprises. There was no arrangement of trainings programmes / workshops for

members regarding marketing skill development. 13% Staff warned about 'interest groups' in each VFCs trying to obstruct the economic help to the actual 'resource dependent' or 'red group' families by taking away more loans in their favour. 13% forest staff mentioned about large number of individual loan defaulters in some VFCs.

The forest staff made some very important observations, and accordingly gave remarks / suggestions for rectification of the existing modus operandi of KMTR ecodevelopment (Table 7.13). Suggestions like continuation of capacity building programmes by experts along with involvement of marketing specialists in training; continuation of scientific monitoring of various socio-economic and ecological parameters and necessary corrections for the coming 10-20 years to bring real economic and attitudinal change; giving more importance to conservation awareness generation; input of experts from the field of rural development and microfinancing; and networking between different government departments engaged in rural poverty eradication in the area keeping biodiversity conservation as central theme were proposed by staff. This shows the importance of both top to down and down to top approach in participatory management of biodiversity conservation in PAs of India. 53% (n=8) respondents had the opinion that local NGO representatives played the most significant role in program implementations. 20% (n=3) had the view that NGOs and eco foresters together contributed most in ecodevelopment field practices, while 13% respondents (n=2) wanted to give the credit to both NGOs and eco rangers.

Table 7.10: Attitude survey of the staff of KMTR

| Attitude survey parameters | Staff categories | | | |
|---|--------------------|------------------|---------------------|---------------|
| | Executive officers | Frontline staffs | NGO representatives | Overall score |
| Level of understanding ED | 3.25 | 3.67 | 3.75 | 3.56 |
| Level of participation in ED | 1.42 | 2.5 | 3.18 | 2.37 |
| General impact on conservation | 1.5 | 1.5 | 1.5 | 1.5 |
| Impact on protection of wildlife | 1.36 | 2.22 | 1.78 | 1.79 |
| Impact on staff people relationship | 1 | 1.33 | 0.95 | 1.09 |
| Connections with territorial & office staffs | 3.5 | 2.67 | 2.13 | 2.77 |
| Involvement of high officials in ED | 0.43 | 0.90 | 1.13 | 0.82 |
| Involvement of supervising officers in ED | 2.5 | 3.67 | 3.25 | 3.14 |
| Involvement of eco rangers in ED | 3.5 | 3.67 | 3.25 | 3.47 |
| Involvement of territorial rangers in ED | 1.5 | 0 | 0 | 0.5 |
| Involvement of eco foresters in ED | 3.75 | 4 | 3.25 | 3.67 |
| Involvement of forest guard in ED | 1.5 | 2 | 2.25 | 1.92 |
| Involvement of NGO representatives in ED | 4 | 4 | 3.88 | 3.96 |
| Involvement of office staffs in ED | 1 | 2.67 | 2.25 | 1.97 |
| Involvement of other rural institutions in ED | 0.8 | 1.25 | 0.83 | 0.96 |
| Involvement of media in ED | 3.25 | 3 | 2.63 | 2.96 |
| Involvement of other PA staff in ED | 3 | 2 | 2.63 | 2.54 |
| Involvement of other Government departments in ED | 1.25 | 1.67 | 1.88 | 1.60 |
| Average attitude score 2.26 | | | | |

Table: 7.11: Positive remarks made by staffs on KMTR ecodevelopment

| Remarks | Percentage (%) of respondent staff |
|--|------------------------------------|
| Increase in income level and standard of living in surrounding villages due to alternative livelihood options to villagers | 25 |
| Improvement in biodiversity conservation | 6 |
| TR surrounding communities started to understand linkage between community development & KMTR resource conservation | 6 |
| Skill development programmes like driving, computer training, food processing, stitching etc. generated hope amongst villagers and some real life application happened | 19 |
| Some small scale village enterprises like tea, idli, vegetable selling, cycle repairing succeeded and increased income | 6 |
| Significant decrease in number of fuel wood, NTFP collectors and grazing animals | 19 |
| Economic level and living standard of red group families (head loaders & grazers) had improved | 6 |
| Community awareness on wild life and biodiversity conservation had grown | 6 |
| Enthusiasm within village women was high regarding micro financing through Self-Help Group (SHG) formation. They willingly joined in the programme | 13 |
| Social relations between various caste and communities in villages improved by various interactions during ecodevelopment implementations | 6 |
| Programme objectives explained to villagers properly by higher and lower level staff and NGO representatives. Villagers reciprocated with high level of participation in ecodevelopment | 6 |
| Leadership and sincere involvement from policy and decision making officers (FD, EDO) and controlling and supervising officers (DD) were main ingredient of success | 6 |
| Level of territorial protection of KMTR had enhanced during and after ecodevelopment | 13 |
| Villagers cooperating with Department by providing information regarding occurrence of fire, helping in wild life rescue and informing illegal activities to forest guards | 6 |
| Human utilized forest habitat near boundary had improved during ecodevelopment | 6 |
| Villagers dependency on local money lenders significantly reduced after ecodevelopment implementations | 19 |
| In some scheduled caste and tribal villages ecodevelopment loan had been utilized for imparting education to children | 6 |
| Mutual trust built up between forest staff and villagers | 6 |
| Forest staff (Ranger, Forester) deployed in KMTR for ecodevelopment consciously appeared in plain dress during ecodevelopment job. It helped a lot in breaking the ice between 'staff' and 'villagers' | 6 |

Table 7.12: Negative remarks made by staff on KMTR ecodevelopment

| Remarks | Percentage (%) of respondent staff |
|---|------------------------------------|
| Villagers expected higher amount of loan for any off farm alternative livelihood | 6 |
| Lack of market opportunity regarding sustenance of various alternative livelihood options chosen and skills acquired by forest dependent community. Due to this, villagers were reluctant to take new ventures instead of more market secure fuel wood / MFP selling activities. | 19 |
| 'Interest groups' created within VFCs with a motive to squander government money pressing for individual loans instead of micro financing through women SHG formation. Some of them even took high amount of loan for many occasions flouting the VFC rule of 'one time loan to a dependent family'. Due to this, sufficient numbers of loan were not provided to 'Red Group' (KMTR dependent families) people. | 13 |
| Lesser 'field based learning' and 'ecodevelopment training' component in KMTR ecodevelopment in comparison to PTR or other places | 6 |
| Number of individual loan defaulters was high in some VFCs. It was very difficult to get back repayment from the defaulters. There was no legal bindings for individual loan acceptors in VFC before formation of SHG in the program | 13 |
| Very less amount given as loan to start even a small enterprise or business. | 6 |
| Comparatively less project investment in each VFC for implementation | 6 |
| Man-animal conflict intensified during ecodevelopment (crop damage by wild animal) due to habitat improvement. | 6 |
| Very less remuneration to NGO representatives(Rs. 2500 month ⁻¹ in 2010) for their job | 6 |
| Inter and intra community conflict mitigation strategies within VFC were not developed properly | 6 |

Table 7.13: Remarks / suggestions made by staff for KMTR Ecodevelopment

| Remarks | Percentage (%) of respondent staff |
|--|------------------------------------|
| Increase in loan amount in alternative livelihood programme | 6 |
| Locally suitable skill development / capacity building through technical training by experts. Some even suggested formation of cooperatives / small scale cottage industry run by consortium of VFCs in various locations. | 13 |
| A separate 'ecodevelopment wing' and 'Ecodevelopment Officer' (IFS Rank) for KMTR | 6 |
| Improvement in education level within communities living adjacent to KMTR as a strategy in ecodevelopment to reduce forest dependency in the long run | 6 |
| Continuation of ecodevelopment and constant monitoring of various implementations for the coming 10 – 20 years. | 6 |
| Training in financial management of alternative livelihood scheme for staff and NGOs involved in implementation | 6 |
| More thrust should be given in generating awareness regarding biodiversity conservation of KMTR | 6 |
| More quality interactions with dependent communities along with proper analysis of their real needs and expectations | 6 |
| Micro financing through formation of SHG should be undertaken by some NGOs / Government organization expert in that domain | 6 |
| Investment of money directly on poor and forest dependent families by construction of pakka house with toilet facility, etc. | 6 |
| Networking of social and government institutions in identification, flow of loans, and monitoring of progress in ecodevelopment. For example, all funds allocated for poverty alleviation in institutions like panchayat and different rural development departments can flow for ecodevelopment in KMTR with active participation and information sharing between panchayat, rural development units and VFC. | 6 |

7.3.14.2 Attitude survey of local communities

Open ended questions were asked to members in sample VFCs regarding the basic objective of KMTR ecodevelopment (Table 7.14). 80% of respondents remained as VFC member for more than five years. When asked, 56% members (43 households) did not have any clue why forest department is running ecodevelopment in surrounding villages of KMTR, and another 8% respondents (6 households) were not willing to answer this question. About 18% members (14 households) told wildlife conservation as the answer. 10% members (8 households) knew that department is implementing ecodevelopment to promote economic development in surrounding villages. Only 8% members (6 households) answered conservation oriented development in the fringe villages of KMTR as the objective of ecodevelopment.

Similarly, members were asked the main reason for which they joined Village Forest Committee (VFC). Maximum members (27%, 21 households) joined VFC to avail ecodevelopment loan. About 18% members (14 households) did not answer the question. 15% members (12 households) joined VFC after persuaded by VFC chairman or neighbours, while 13% (10 households) were persuaded by local NGO representatives. 9% (7 households) joined when forest executive like concerned eco ranger or forester asked them to join. 7% (5 households) joined with the hope that alternative enterprise would enhance their family income. Another 6% (5 households) joined when high official of the forest department like Field Director or Deputy Director appealed to join VFC. 3% (2 households) joined after persuaded by Ecodevelopment Officer (EDO). Only 2% members (2 households) joined after being informed about VFC through awareness programme conducted by forest department.

Respondents were also asked regarding their main source of livelihood if forest department withdraws support from ecodevelopment in future. 50% families (39 households) replied forest resource extraction activities as their livelihood in absence of departmental support. 42% families (32 households) believed they can live without extracting PA resources. 8% families (6 households) did not express their view on this question.

Respondent members (Table 7.15) were satisfied by the overall functioning, level of transparency, and an effort towards equitable distribution of benefits from forest department (attitude score 3.6). Fringe communities believed that human pressure on park reduced a lot in terms of fuel wood extraction and livestock grazing during ecodevelopment, but strategy is required to reduce increasing pressure from human settlements within park and local tourist spots (score 2.67). Respondents agreed that overall quality of life improved (score 3.33) during ecodevelopment, but did not give credit to alternative livelihood program (score 2). In fact, they felt that alternative income generation scheme should focus more on real forest dependent population. According to them the largest gain from KMTR ecodevelopment was the improved staff people relationship (score 4.5). When asked fixed response question most of the members were well aware about the issue of conservation, but it was not fully supported by other findings. For example, when asked regarding the demand of connecting Tirunelveli district of Tamil Nadu with state of Kerala by constructing a road through KMTR, almost 50% of the same respondents supported the idea as they would benefit economically. When asked whether conservation of wildlife is beneficial, most of them did not want to make any comment as they suffered heavy loss from crop damage by wildlife.

Most of the respondents viewed that forest protection improved during ecodevelopment. In response to open ended questions, members mentioned about availability of irrigation water, rainfall for rain fed agriculture, springs, falls and rivers as recreation, local tourists from various other places of Tamil Nadu as the benefits of having KMTR in their vicinity. Crop damage by wild animals, cattle lifting by wild carnivores, lack of access of fuel wood and other NTFP, and harassment by forest staff were attributed as negative impact of KMTR.

Table 7.14: Members awareness regarding objective of ecodevelopment and village forest committee (VFC) in sample villages

| Open ended questions | Percentage (%) of respondent | |
|--|------------------------------|----|
| | Households | % |
| Why forest department running ecodevelopment in surrounding Villages of KMTR? | | |
| Economic development in surrounding villages | 8 | 10 |
| Wildlife conservation | 14 | 18 |
| To implement conservation oriented development | 6 | 8 |
| No idea | 43 | 56 |
| Respondent not willing to answer the question | 6 | 8 |
| Why you have joined Village Forest Committee (VFC)? | | |
| To get loan | 21 | 27 |
| To opt for an alternative enterprise | 0 | 0 |
| Persuaded by NGO representative | 10 | 13 |
| Persuaded by eco ranger and forester | 7 | 9 |
| Persuaded by ecodevelopment officer (EDO) | 2 | 3 |
| Persuaded by Field Director / deputy director KMTR | 5 | 6 |
| Due to awareness programme regarding VFC | 2 | 2 |
| Persuaded by VFC chairman / other neighbours | 12 | 15 |
| To enhance family income | 5 | 7 |
| Respondent not willing to answer the question | 14 | 18 |

Table 7.15: Attitude survey of local communities

| Attitude survey parameters | Attitude score |
|--|-----------------------|
| Functioning of Village Forest Committees (VFCs) | 3.6 |
| Status of human pressure on KMTR after ecodevelopment | 2.67 |
| Conservation awareness within communities | 5 |
| Quality of life | 3.33 |
| Relationship with forest staff | 4.5 |
| Status of Income Generation Activities of ED | 2 |
| Women empowerment | 2.5 |

7.3.15 Change in Overall Socio Economic Conditions at VFC Level

Secondary data available in VFCs regarding various socio economic parameters were critically analysed to track changes. Table 7.16 compares the new PRA data (2010) with the 2004 survey data (KMTR ecodevelopment status report 2004) regarding changes in red, yellow and green group families in twenty five sample VFCs. Most of the records were obtained from Papanasam eco range office, which was controlling maximum number of VFCs (36 VFCs) among all the eco ranges especially created during ecodevelopment. The red group families decreased from 68% in 2004-05 to 41% in 2010-11 (27% decrease). This decrease in forest dependent families during post project period was statistically significant (both Wilcoxon signed rank and paired t test sig. 0.000). Similar increase was observed in less dependent yellow group families (21% increase, Wilcoxon sig. 0.000, and t test sig. 0.000) and green group families (5% increase, Wilcoxon sig. 0.009, and paired t test sig. 0.004).

Figure 7.8 shows project contribution till 2008 in 36 VFCs functioning under Papanasam eco range. 61% VFCs (n =22) in Papanasam eco range received project contribution within INR 1, 00,000 – 3, 00,000, 17% VFCs (n =6) received contribution within INR 3, 00,001 – 5, 00,000, and another 14% (n=5) received contribution within INR 5,00,001 – 7,00,000. It was observed that most of the VFCs that received project contributions higher than INR 5, 00,000 were big farming villages with relatively high family income and less PA dependent families in it, and majority of population belonged to high caste communities. It was discussed earlier that the above trend of providing ED loans for agriculture started from 2007 onwards, and many well to do farmers with large land holding started reaping the benefit. Among them, participation

of male members in ED was found extremely low in Moolachi VFC (received INR 6, 12,900 till 2008), and Ayan Singampatti (received a staggering amount of INR 10, 30,500 till 2008) was reported as not functioning well by KMTR forest staff. It shows that some rethinking regarding per capita project contribution is required in the next phase of program, otherwise a portion of monetary compensation which, otherwise can be utilized more on real forest dependent communities, may simply reach to some big villages that are actually less dependent on KMTR's resource. At the same time, it must be mentioned here that investment towards village ecodevelopment activities (51% of total investment) was one of the highest in KMTR ecodevelopment project compared to other IEDP sites in India, for example, neighbouring Periyar Tiger Reserve made only 35% of total investment in village ecodevelopment activities.

Table 7.16: Change in forest dependent families in twenty five sample VFCs

| VFCs | Percentage of VFC families | | | | | | | | |
|----------------------|----------------------------|----------------|-----------------------|----------------|----------------|----------------------|---------------|----------------|----------------------|
| | Red group | | Percentage Decreased | Yellow group | | Percentage increased | Green group | | Percentage Increased |
| | 2004-05 | 2010-11 | | 2004-05 | 2010-11 | | 2004-05 | 2010-11 | |
| K. Anna Nagar | 78 (90) | 76 (80) | 27 (P<0.05) | 17 (20) | 19 (20) | 21(P<0.05) | 5 (6) | 5 (5) | 5(P<0.05) |
| Sankarapandipuram | 74 (158) | 76 (161) | | 22 (48) | 19 (40) | | 4 (8) | 5 (10) | |
| Kondaipayanpattai | 70 (60) | 62 (70) | | 26 (22) | 35 (40) | | 5 (4) | 3 (3) | |
| Kamrajapuram | 77 (134) | 73 (62) | | 17 (30) | 27 (23) | | 6 (10) | 0 (0) | |
| Meenachipuram | 67 (91) | 44 (60) | | 27 (36) | 53 (72) | | 6 (8) | 2 (3) | |
| Ramalingapuram | 80 (140) | 53 (78) | | 13 (23) | 45 (66) | | 7 (13) | 2 (3) | |
| Kottavazhipatti | 76 (171) | 74 (172) | | 21 (46) | 22 (50) | | 3 (7) | 4 (10) | |
| Pasukadaivilai | 70 (190) | 69 (190) | | 19 (51) | 21 (59) | | 10 (28) | 10 (28) | |
| Pandrimadaswamykoil | 69 (137) | 54 (63) | | 25 (50) | 34 (40) | | 7 (13) | 11 (13) | |
| Thatanpattai | 82 (107) | 62 (70) | | 15 (19) | 35 (40) | | 3 (4) | 3 (3) | |
| Kondaipayanpattai | 70 (60) | 62 (47) | | 26 (22) | 30 (23) | | 5 (4) | 8 (6) | |
| Pulavanpatti | 60 (209) | 82 (203) | | 34 (117) | 16 (40) | | 6 (22) | 2 (4) | |
| Metuthangamankoil st | 91 (264) | 48 (87) | | 8(24) | 46 (83) | | 1 (2) | 6 (11) | |
| Thirupaniyapuram | 81(26) | 4(49) | | 16(5) | 80(39) | | 3(1) | 16(8) | |
| Kanayur | 19(11) | 14(20) | | 72(42) | 64(90) | | 9(5) | 21(30) | |
| Mandiyur | 48(27) | 8(20) | | 46(26) | 71(170) | | 5(3) | 21(50) | |
| Rajangapuram | 69(41) | 13(30) | | 12(7) | 66(152) | | 19(11) | 22(52) | |
| Neel Meghapuram | 63(36) | 20(25) | | 33(19) | 48(59) | | 4(2) | 32(40) | |
| Alahapuram | 46(61) | 9(30) | | 48(64) | 70(245) | | 7(9) | 21(75) | |
| Narayanswamy Koil st | 45(51) | 17(30) | | 54(61) | 72(130) | | 1(1) | 11(20) | |
| Mel Chettikulam | 67(85) | 14(38) | | 19(24) | 63(170) | | 13(17) | 22(60) | |
| Keel Chettikulam | 66(102) | 11(35) | | 28(43) | 72(235) | | 6(10) | 17(55) | |
| Bungla Kudiyiruppu | 60(54) | 11(23) | | 28(25) | 61(130) | | 12(11) | 28(60) | |
| Mettuthangaman Koil | 91(264) | 47(87) | | 8(24) | 45(83) | | 1(2) | 6(11) | |
| Georgepuram | 90(219) | 29(12) | | 9(22) | 71(29) | | 1(3) | 0(0) | |
| Mean ± SEM | 68±3.24 | 41±5.39 | | 26±3.09 | 47±4.11 | | 6±0.84 | 11±1.88 | |

Source: KMTR Eco Range offices record

Figure 7.8: Project contributions in 36 sampled VFCs in Papanasam Range till 2008

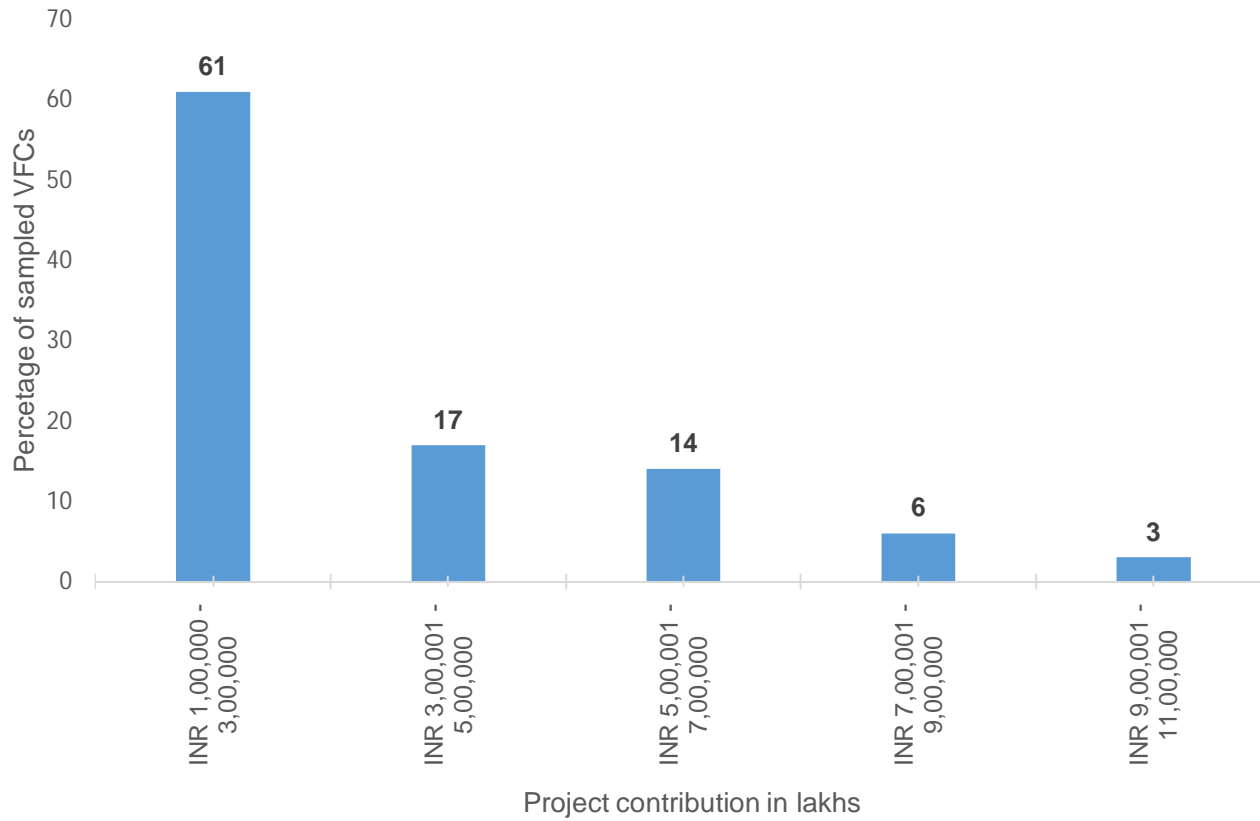
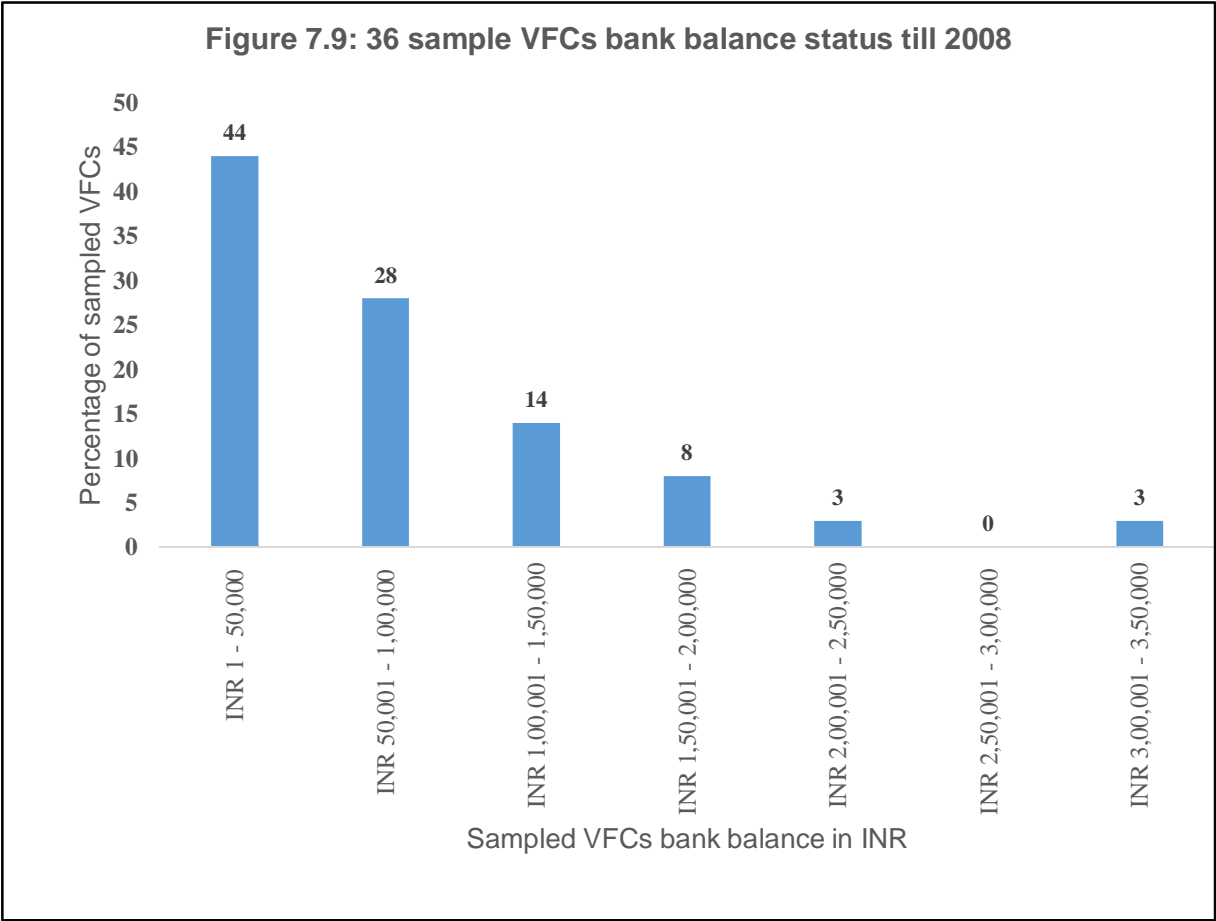
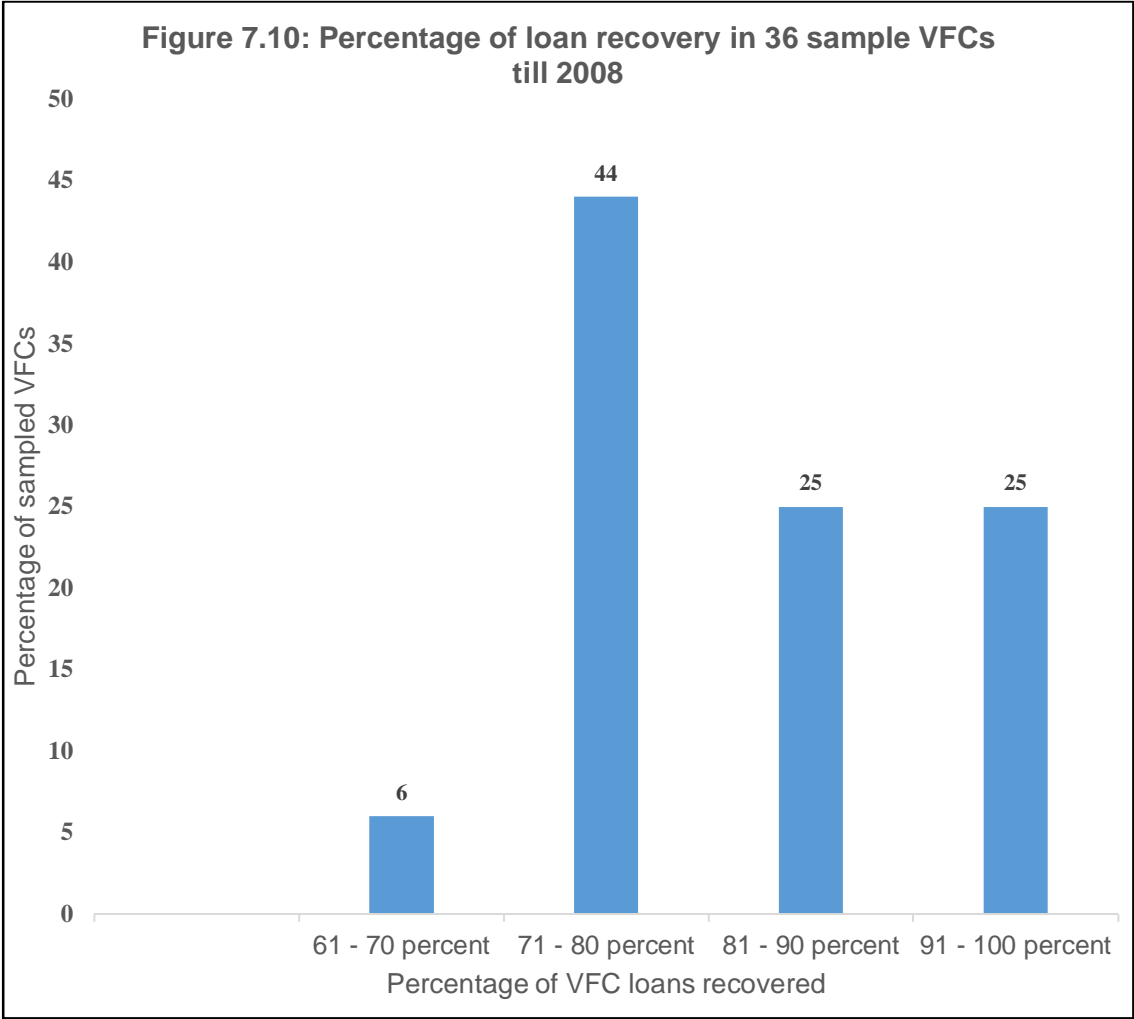


Figure 7.9 shows the bank balance status of 36 sampled VFCs in Papanasam eco range till 2008. 44% VFCs (n = 16) had bank balance up to INR 50,000. Bank balance developed from INR 50,000 to 1, 00,000 in 28% (n=10) VFCs. It was within INR 1, 00,001 to 1, 50,000 in another 14% (n=5) VFCs, and even grew from INR 3, 00,001 to 3, 50,000 in one of the sampled VFC. The income level increased in most of the VFCs during ecodevelopment, as already found for 11 sampled VFCs.

The percentage of loan recovery till 2008 in sampled VFCs is shown in figure 7.10. There was not a single VFC where percentage of loan recovery estimated to less than 60%. According to 2004 KMTR ecodevelopment status report also, among a total of 181 VFCs, only 13 VFCs had less than 60% loan recovery. Among 36 sampled VFCs in 2008, 44% (n=16) had 71 to 80 percent loan recovered, while the rate of recovery was 81 to 100 percent in another 50% (n=18) of the sampled VFCs. KMTR ecodevelopment project attained economic sustenance after successful introduction of numerous women Self Help Groups (SHGs) in place of individual alternative income loans to VFC members from 2002 onwards. For example, there were 194 women SHGs in the above mentioned 36 sampled VFCs till 2010-11, with a total number of 2919 women members.





7.4 DISCUSSION

Ecodevelopment has become a 'buzzword' in recent conservation movement in India, and every single Protected Area (PA) manager wants to have some kind of people's participation component in the upcoming projects for the park as it attracts international funding. Situation is almost same in other developing and underdeveloped countries where large percentage of fringe population depend on PAs natural resources for day to day survival. Even though all over the world, ICDPs have been implemented with the support of large international funding, literature suggests that the result of this approach have not been very encouraging as compared to the traditional policing approach (Kremen, Merenlender and Murphy, 1994). It is also argued that although the results of policing approach are immediate, ICDPs may show a greater impact over a long term. However, very few attempts have been made to test these arguments, and long term analysis to track ecological as well as socio-economic changes was never done like the present study did, though to some extent similar attempt had been made for Periyar Tiger Reserve in Kerala by Bhardwaj and Badola (2007).

In previous chapters, baseline studies (98-99) with respect to resource dependency, and subsequent human pressure on KMTR habitat was monitored during 04-05, and then during 10-11 to find significant changes. There was significant decrease of fuel wood head loaders and livestock grazing within park in the last decade when eco-development implemented in KMTR. KMTR eco-development project demonstrated some significant progress by reducing

number of Fuel wood head loaders and free grazing livestock within park during project tenure. But most of the reduction took place between 98-99 and 04-04, the first phase of evaluation when external aid of World Bank was at place. There was very little further progress in the last phase of ecodevelopment in terms of reduction in fuel wood head loaders and free grazing within park. Though fuel wood extraction didn't show any sign of increase, free grazing within park on the rise again which became evident by enhancement of weed percentage within transect. Despite initial success in reduction of forest dependency in fringe villages of KMTR, which very few PAs had demonstrated so far, very little progress towards it in the last phase of the programme (04-05 to 10-11) was a matter of concern regarding the long term sustainability of such reduction on PA resource dependency. In this chapter, all the socio-economic changes with respect to dependency and pressure in sample VFCs and in overall VFC level were analysed to determine the factors brought changes during ecodevelopment, and the initiatives which actually did not 'work' in the field.

7.4.1 Community Well-Being

In this study, overall community well-being of sample VFCs was studied for the first time. There is no reported work before inception of KMTR ecodevelopment which can be compared with 2010-11 well-being score to find any significant changes. Villages with more forest dependent families ranked as 'poor', and comparatively less forest dependent farming villages scored 'medium' to 'high medium'. Nearly 30% of sample VFCs were considered 'poor'

in terms of overall human well-being standard. So, there is a correlation between absolute forest resource dependency and overall 'poor' condition in life. With parameters like level of forest resource consumption in house construction or waste disposal in forest also being measured, it can be said that the standard of overall 'human development' was not been achieved after ecodevelopment.

7.4.2 Level of Participation in VFCs

It is evident from records of GB and EC meetings that the overall interest and initial enthusiasm towards ecodevelopment decreased within male and female members after 2004-05 though almost same amount of investment was made from Project Tiger Office in the post project phase. Most of the members failed to establish themselves in alternative microenterprises due to proper technical training and product marketing skills. Due to initial failure, in later phases members took alternative livelihood assistance of forest department merely as low interest loans to be utilized to fulfil immediate household requirements.

The period of lack of interest especially among male members coincided with the change of departmental policy in providing alternative livelihood loans through formation of SHGs instead of individual loans, and most of such SHGs were women groups. Male members started feeling left out from the program design of forest department, and continued in forest extraction activities in higher number than female head loaders.

It was also observed that in the last phase (04-05 to 10-11), maximum loans were given for improvement in agricultural productivity, and financially established farmers with large land holding started taking the benefit of it. Later on, a pressure group of them created in many VFCs to take maximum advantage from AIG program, and it became difficult for the executive staffs to keep things under control as many of them were not properly trained to tackle conflicts of interests between groups. As a result, real forest depended poor families were side lined from the process, and their initial hope and enthusiasm decreased substantially, and the same was reflected by high percentage of absentees in General Body (GB) meetings.

There were examples at the beginning of the project where socially marginalised communities were persuaded and convinced by the top management, and later on they participated after observing honest intention of the forest department to reach out towards real forest dependent families. Villagers did not find such enthusiasm and intention among project leaders in the last stage of ecodevelopment. Independent analysts of IEDP sites (PEACE 2004) mentioned PA level leadership as the most important ingredient of progress through ecodevelopment. Competent leadership remained one of the most important reason of initial progress in KMTR ecodevelopment. Even a separate IFS rank officer was deputed as 'ecodevelopment officer' to look about the overall functioning of VFCs, but the post was withdrawn after formal completion of World Bank Project.

7.4.3 Conservation Linkage of Alternative Livelihood

Critics of ecodevelopment view that alternative livelihood decided solely by forest dependent communities without further review by the department in some cases may destroy PA resources, instead of protecting it. 10% families in sample VFCs took loans for forest consumptive purposes which affirms the above observation of scientists. Very often the dependent families chose forest destructive alternatives or alternatives not linked with KMTR conservation, which is common in ICDPs across the world. Maximum families took eco loan to increase agricultural productivity, but it was hard to find any direct correlation between enhanced economic return from farms and reduction of head loads, since most of the loan receivers were established farmers having own land. Despite above deviations in later stage, most of the alternative non-forest income loans were directed toward fuel wood head loaders and grazers (red group) families at the beginning. It took a decade to find statistically significant decrease both in red group families in sample VFCs and percentage of fuel wood head loaders in sample forest trails. Significant change in dependency occurred due to socio-economic improvement of forest dependents after ecodevelopment, and better protection of PA by forest staff, but lost the momentum at the middle. That's why the initial change was not totally reflected in habitat improvement.

7.4.4 Status of VFC Funds

Unlike many other Ecodevelopment Projects in India, KMTR project maintained healthy fund both during World Bank project tenure, and post-World Bank period due to continuous investment from Project Tiger office, and proper fund management of women SHGs by the local NGO representatives, who were also mostly women. The project policies successfully blended women empowerment with project implementations in many different ways. Significant increase of investment towards SHGs between 04-05 and 10-11 proved this. However, insignificant increase of circulation fund in post project period indicated decrease of initial enthusiasm, especially among male members in VFCs.

7.4.5 Energy Requirements in VFCs

Despite 41% decrease in household fuel demand met from KMTR estimated in last decade (98-99 to 10-11), no significant change occurred in daily household fuel wood consumption rate (0.5 kg decrease household⁻¹ day⁻¹) in the same period. Due to strict forest protection, villagers were actually forced to collect low quality wood, dried sticks, stunted xerophytes from farmlands, fences, orchards and fallow lands located outside the park boundary to meet the requirement. Large scale conversion from wood to non-wood energy could not occur fast due to high price of alternative fuels, and lack of technical training for new energy and gadgets, along with environmental awareness within communities regarding health or time benefits of non-wood energy alternatives. In many cases though poor family members left fuel wood head loading from park after receiving alternative livelihood assistance, or due

to strict forest protection in recent time, but found reluctant to buy fuel and fodder from market as these were available free from PA.

VFC members were not received technical training about proper and safe use of fuel efficient gadgets and alternative energy sources. The on field efforts towards biomass regeneration at VFC level were also negligible. So the unsustainable practice of fuel wood collection from scanty xerophytes outside PA were continued during last half of the project. The initial reduction in livelihood dependency would only get stabilized if the high demand of fuel wood in villages partially get replaced by non-wood energy sources and fuel efficient gadgets, and another part from quality fuel wood species grown by VFCs following the model of Joint Forest Management (JFM) outside PA. The decade long habit of using fuel wood as domestic energy source is not going to diminish by overnight.

7.4.6 Change in Crop Damage Pattern

The reported increase in crop damage, statistically significant decrease in fuel wood extraction and free grazing in ten years, and significant presence of wildlife near boundary during 10-11 transect survey confirms that there was some improvement in forest habitat due to decrease in red group families in the KMTR fringe.

7.4.7 Forest Staff's Attitude

Change in attitude of forest staff towards acknowledging the importance of people's participation and cooperation in conservation on one hand, and people's understanding and awareness regarding the protection of park's ecosystem to sustain essential natural resources for generations on the other hand can be considered as the real step forward towards conservation through ecodevelopment. Most of the staff acknowledged the role of local NGOs in ecodevelopment implementations, and felt that proper coordination between staff and NGO representatives in execution of program was fundamental behind smooth running of the project, which is reportedly missing in many other India Ecodevelopment Project (IEDP) sites. Simultaneously, most of the staff felt that despite significant achievement in bringing socio-economic changes among forest dependents, the KMTR ED project is yet to bring significant habitat improvement. The linkage between socio-economic alternatives and their conservation outcome was missing in many occasions which might deter progress in improvement of forest habitat. Another flaw identified by ecodevelopment staff was complete alienation of regular territorial staff from the project activities and the resulting lack of communication between them and fringe communities. Territorial rangers and guards were not sensitized towards ecodevelopment, and this might create conflicts between forest department and fringe communities in future. Some ED staff warned about powerful 'interest groups' taking away the benefit of alternative livelihood loan from real forest dependents. All these opinions can be taken as guidance for the future policy refinements and necessary changes in management of ecodevelopment.

7.4.8 Community Attitude

There was lack of awareness among members about the objectives of ecodevelopment as more than fifty percent respondents were clueless regarding why forest department is running ecodevelopment in surrounding villages. Awareness generation programs in VFCs were superficial and infrequent in comparison to rigorous field exercises during ecodevelopment in parks like Gir in Gujrat and Periyar in Kerala. This can be considered as the weakest link in KMTR ecodevelopment. Maximum members joined VFC expecting low interest loan. The conservation link of alternative income scheme was not correctly transcribed to villagers, again due to weak awareness generation and environmental education among resource dependent population. As per the village communities the forest department played the dominant role as facilitator and mentor of ecodevelopment activities, and the role of communities was mainly restricted as passive participant. They were incapable of doing something without the help from staff or NGO representatives. Technical training and capacity building among communities regarding SHG functioning, VFC accounting etc. were required to build up confidence and self –sufficiency among members to run VFCs by their own. Community respondents recognized and appreciated the efforts towards equitable distribution of ecodevelopment benefits by forest department, but at the same time felt that it should be more focussed to the target group / real forest dependent families. The boundary communities observed reduction in human pressure from the buffer villages in last decade due to ecodevelopment, but felt that pressure from inner settlements had increased in the same period and needed to be controlled. Almost similar findings arose from final phase

transect study regarding human pressure on boundary and inner settlements. Same concerns were expressed in evaluation reports of Tiger Reserves in India (2006) about human pressure status in KMTR. Most of the community respondents agreed with the findings of present study that level of forest protection improved during ecodevelopment. But their biggest gain from ecodevelopment was improved park-people relationships. Awareness for biodiversity conservation was not high among communities. However community expectations from ecodevelopment grew very high, especially from alternative income generation activities, which might create difficulties for the department in future, if fund flowing dries up. Therefore a rethinking and revamping of program implementation is required for future sustenance.

7.4.9 Overall Socio-Economic Status of VFCs

Significant decrease in fuel wood head loaders and graziers (red group) and simultaneous similar increase in families not dependent on forest resource for daily living (yellow and green group) was found when large number of VFC records were analysed, confirming the earlier findings from eleven sample VFCs. All the sampled VFCs had healthy economic status with substantial bank balance during post project phase due to more than 60% loan recovery in all of them. The only matter of concern was the rise of powerful 'interest groups' getting more fund from ecodevelopment than the forest dependent marginal communities in some villages. This later trend, mentioned by forest staff and local communities as well needs to be curbed.

8

IMPORTANT FINDINGS AND MANAGEMENT RECOMMENDATIONS

8.1 INTRODUCTION

ICDPs or ecodevelopment projects are actually field experiments or action research using new methodologies in conservation and sustainable development to balance ecological security as well as local human needs. As such, these are not based on body of tested knowledge, but rather are the building blocks of theory and future efforts (Bhardwaj & Badola 2007). No one knows exactly what it should be. Appropriate methods must be learned through action. A key component of the learning process is 'action-research', consisting of actual tests in the field and community planning experiments, a willingness to learn from mistakes, and repeated returns to the drawing board (Cernea 1987). The 'product', the new methodology, will be a conceptual framework and a set of procedures, rules and approaches establishing interactions, field assessments and information exchanges between local people and outside experts (Wells 1994). The idea is to reconcile park management with local needs by emphasizing social and economic development among local communities (Bhardwaj & Badola 2007). As such ICDPs have managed to attract the lion's share of the funding for biodiversity worldwide. But so far the

results have not been very encouraging. Important unanswered questions remain, and there is still an on-going debate whether the ICDP's focus on development dilutes biodiversity conservation goals or the inward-looking protectionist alternative is doomed to failure (McShane & Wells 2004). As the struggle to balance conservation and development continues, the need to determine what works and what not becomes increasingly important (Bhardwaj & Badola 2007). If successful, these approaches may provide viable alternatives for sustainable development with equity, where the use of the ecosystem is truly sustainable and local people benefit equitably (Brown and Wyckoff – Baird 1992).

The hypothesis that Ecodevelopment can promote conservation of biodiversity in PAs remains virtually untested. There is no comprehensive study except that of Bhardwaj and Badola (2007) in Periyar Tiger Reserve that had analysed the impacts of project inputs and the desired conservation outputs. In this present study in Kalakad-Mundanthurai Tiger Reserve (KMTR), a serious attempt was made to investigate whether the inputs of KMTR ecodevelopment had actually resulted in reducing the dependency and hence benefited the Tiger Reserve by reducing anthropogenic pressures upon it. Here the overall inferences regarding change in resource dependency and biotic pressure on KMTR during initial, middle and final phase of ecodevelopment, and the driving factors of such changes are discussed to analyse the linkage between ecodevelopment inputs, and conservation outputs in KMTR. The research findings are as follows:

8.2 Reduction of Dependency on Fuel wood Extraction during Ecodevelopment

The main anthropogenic threat to KMTR habitat were large number of poor families (categorized as 'red' group during ecodevelopment) whose daily living was depended on extraction of fire wood from the reserve, and selling it in the locality. According to forest department's own estimation (Annamalai, 2004), there were 3215 fuel wood head loaders day⁻¹ collecting KMTR resource prior to ecodevelopment in 1995. This had created a completely degraded habitat for wildlife in the periphery of the reserve, and gradually inner areas also started getting affected by cutting pressure. When the authorities of KMTR tried to implement the policy of 'strict protection' in past, it resulted in great hostility between them and the local population. Due to the failure of purely 'protectionist' approach in preventing people from entering park for extraction whose daily living depended on forest extraction and selling, KMTR management decided to introduce ecodevelopment as the way of reducing people's livelihood dependency on Tiger Reserve, which eventually would reduce human pressure on eastern boundary. KMTR ecodevelopment started functioning from 1997 onwards to reduce PA dependency of 'red' group families in each fringe villages located within 5 km from PA by providing alternative non-forest enterprises loan to them.

Percentage of fuel wood head loaders visiting KMTR during initial stage (98-99) of ecodevelopment decreased significantly (39% decrease, $P < 0.05$, chapter 4) in the final stage of program (10-11). 41% decrease ($P < 0.05$) of most

PA dependent 'red group' families in sample Village Forest Committees (VFCs) in the same period (between 98-99 and 10-11), and their simultaneous upgradation to comparatively less PA depended group (categorized as 'yellow' group) confirmed the effect of ecodevelopment in reducing resource dependency of local communities. 76% increase of family income in sample VFCs was found between initial and final phase of ecodevelopment, and 73% respondent mentioned Alternative Income Generation (AIG) scheme of ecodevelopment as the main reason behind increase of family income during the mentioned period (chapter 7), which confirmed the linkage of 'alternative livelihood' offered to them and reduction of their dependency on reserve. On the other hand, according to the hypothesis of this study, if resource dependency and consequently human interference decrease near eastern boundary of KMTR, it will lead to the habitat improvement of PA. Overall 6% decrease in cutting pressure between 98-99 and 10-11 ($P > 0.05$, chapter 5) and proportionately higher recorded presence of wild herbivores and carnivores near PA boundary (69%, $P > 0.05$) than interior plateau region (63%) during 10-11 survey showed that some kind of habitat improvement near PA boundary took place between initial and final phase of ecodevelopment due to lesser human interference. Better PA protection by forest guards and migration of labour force from nearest township (Vickramsingapuram) of KMTR also contributed decrease in entry of people for fuel wood extraction. Overall, the linkage between ecodevelopment initiatives and reduction in dependency and pressure on PA established by the analysis.

8.2.1 Maximum Decrease of Fuel Wood Head Loaders during Initial Years

But why the decrease (6%) in cutting pressure between 98-99 and 10-11 near PA boundary was not that much high or statistically significant (Wilcoxon sig. 0.347, paired t sig. 0.355, chapter 5)? Most of the decrease (37%) in fuel wood head loaders from park took place in the initial phase of ecodevelopment (98-99 & 04-05), and then considerably slowed down in the last phase (only 3% decrease) of ecodevelopment (04-05 & 10-11). Similarly there was also a decreasing trend in fuel wood extraction offences till 2007, and then again rose in some forest beats on park boundary.

8.2.2 Lack of Interest and Enthusiasm among VFC Members in Last Phase

Lack of interest and enthusiasm within community about ecodevelopment reflected in significantly less General Body meetings of VFCs in later stages, drastic fall in both men and women memberships in VFCs, and overall decrease in members' attendance in GB meetings (chapter 7). Members' absence was significantly higher in last phase of ecodevelopment (10-11) in comparison to initial phase (98-99) even in Executive Committee (EC) meeting which consisted only seven core committee members including chairman. A drastic fall in male memberships in sample VFCs in the later phase (04-05 to 10-11) of ecodevelopment was noticed. What were the reasons behind members' indifferent attitude towards VFCs functioning in the last phase?

8.2.3 Male Fuel Wood Extractors Felt Left Out in Program Design

From the very beginning, KMTR ecodevelopment program was designed to incorporate women and poor as the largest beneficiaries of alternative livelihood initiatives (PEACE 2004). This can be considered as a path breaking step regarding ecodevelopment in India, as according to experts engaged in evaluation of ecodevelopment policies and planning, no other project recognized the need of formulation of gender sensitive strategies and employment opportunities from the very inception like KMTR. Successful functioning of 837 women Self Help Groups (SHGs) in KMTR ED till 2012 with 96% rate of loan recovery (chapter 7) helped to reduce comparatively more number of female fuel wood head loaders (decreased from 44% in 98-99 to 23% in 10-11) than the male counterparts (increased from 56% of head loaders in 98-99 to 77% of head loaders in 10-11). It means, comparatively more number of female fuel wood head loaders left head loading as they found economic alternatives through SHG loans, but male counterparts had not benefited to that extent by alternative livelihood program, and still went to forest for extraction. In fact, it was found from skill development training records of sample VFCs in 10-11, that most of the trainings imparted skills which were women oriented (66%), whereas skills training suitable for male members were very less (15-20%, chapter 6). At the beginning of the project, ratio of male and female head loaders were almost 50:50. After ecodevelopment, many women shifted from forest extraction as profession, but men remained in old profession due to lack of opportunity. Due to this, the rate of decrease of fuel wood head loaders slowed down considerably in the last phase of ecodevelopment.

8.2.4 Insufficient Training in Non-Forest Alternative Livelihood

At the beginning of ecodevelopment, 'real' forest dependent households were given priority in 'alternative livelihood' scheme in every VFC as a carefully chosen objective, and those members were given loans for microenterprises chosen by them. But due to insufficient skill training in new vocation, and in many cases lack of marketing skills and value addition of the product, many of such members failed to achieve profitable return from the microenterprises. It was found from sample survey (chapter 7), that only 5% of loan receiver were fully established in the new non-forest enterprise. Most of the successful entrepreneurs were women who received adequate professional training in vocations like tailoring, embroidery etc. organized by forest department. On the other hand, many women also failed to succeed in vocations like basket making, bag making, or food processing after getting trained in that due to lack of any experience in product marketing. In most VFCs, trainings in different skills and vocations were organized only once or twice in the last ten years, that also in the initial stage of program. So, in most cases it merely remained as a token exercise. After the failure in first chosen enterprise, members took loans in the name of some other microenterprise and used that money solely for household purposes which were discussed in detail in chapter 7. In this way, such households just tried to maximize total household income by periodically taking low interest eco loan in absence of any further scrutiny or monitoring of loan utilization by corresponding VFC. Such loan utilizations had no conservation linkage. During questionnaire survey in 10-11, most of the members told strict PA protection by staffs during ecodevelopment as more effective in reducing biomass extraction from PA than alternative income

generation program of VFCs. Some frontline staffs even mentioned about the necessity of organizing frequent training for communities by experts regarding financial management of 'Self Help Groups' (SHGs) like maintaining own accounts, loan ledgers, SHG accounts etc. which at present the NGO representatives were doing for them.

8.2.5 Creation of Pressure or Interest Groups within VFCs in Last Phase

KMTR management were praised by national and international experts at initial stage for the strong foundation of village level institutions (VFC) from the very beginning with a commitment at government level with clear government orders to give priority of benefiting the poor and weaker sections through ecodevelopment, which the first set of project leaders actually implemented in field. Initially, the on field presence of such leaders boosted the lower level staffs to work as a unit for the common cause of conservation through uplifting the living standards of poor, weaker and marginal sections of the community, who were also PA resource dependent. Later on, successful functioning of so many women SHGs under ecodevelopment not only stabilized the revolving fund, but revolved the initial project corpus three times. This showed that if opportunity is given and the system functions in a transparent way, so called poor, marginal and weaker sections can bring socio-economic changes by their own.

But from 2006-07 onwards KMTR management purposefully encouraged giving loan to improve agricultural productivity. Though there is no

explicit link between enhancement in agricultural productivity and less PA resource extraction, as most of the rural landless poor often engaged in PA resource extraction during slack labour period (Wells 1992), such loans actually benefitted farmers with large land holding, and gradually AIG programs were hijacked by the 'creamy layer' of society. During questionnaire survey executive staffs like eco rangers warned about such powerful 'interest groups' taking away the benefit of AIG loan from real forest dependent. It was found during sample survey that the percentage of loan repayment was lowest in villages of farmers with large land holding, who were otherwise socially and economically more powerful.

8.2.6 Still High Demand of Fuel Wood in PA Surroundings

Non-forest economic alternatives were provided to large number of 'real' resource dependent population through AIG program and forest staffs prevented human interferences within PA during ecodevelopment. Combining these factors, less number of people entered in PA for extraction. But daily fuel wood consumption per household remained almost same for the whole period (98-99 and 10-11) despite significant increase of the selling price (almost double) of fuel wood in the locality (chapter 7)! The household dependency on fuel wood was so high in the surrounding rural areas that due to strictness of forest staffs people were forced to collect inferior quality dried sticks, fallen branches and leaves as alternative to forest fuel wood. Still 26% fuel wood demand were met from PA in 10-11. Most of the households could not afford to pay for gas cylinders in every month. So, they kept LPG as supplementary to

fuel wood. Even economically somewhat better off families also kept minimum budget for fuel expenditure as they want to allocate more money for education, health, marriage etc. Fuel efficient chullah or stove provided through ecocodevelopment were not at all popular due to lack of training regarding proper use, and very few were actually distributed in VFCs. So the high demand of fuel wood need to be met from some other sources, and biomass regeneration in the buffer area is the only solution, till now which was not done properly through ecocodevelopment.

8.2.7 Some VFC Members Chose PA Destructive Economic Alternatives

Many management and development experts appreciated the fact that the needs and wants of 'poor' were listened with lot of sensitivity by the first set of project leaders in KMTR, and the beneficiaries themselves chose the IGA they wanted to take up (PEACE 2004). But in the absence of any scientific scrutiny and further monitoring of actual utilization of loan money some microenterprises chosen by VFC members as alternative livelihood were actually directly or indirectly forest exploitative. It was found that eco loans for fuel wood based tea stall or for repairing thatched house actually putting additional pressure for wood on PA. In fact, percentage of no conservation link and forest exploitative loans altogether were higher than pro conservation loans. 60% staffs received some training on ecocodevelopment, whereas 40% were working without any prior training. The frontline forest staffs and NGO representatives who were executing the program on field in various eco ranges, were seen only occupied in maintaining balance sheet and financial records of

eco loans. They were only oriented and trained regarding financial management aspect of each VFCs. They were not asked to scrutinize or check the purpose or ultimate utilization of loan by the beneficiaries.

8.3 Human Pressure on PA Habitat was more around Inner Settlements than PA Boundary

It was found during 10-11 transect survey that biotic pressure around Kani tribe and Electricity Board quarters located in Mundanthurai plateau within KMTR, the main habitat for wild carnivores, were even higher than PA boundary area surrounded by so many fringe villages. The anthropogenic pressure on plateau was found higher in terms of wood cutting, canopy opening and density of regenerating seedlings. Ecodevelopment was introduced from the very beginning in Kani settlements within park, but not at all functional due to lack of facilities to ferry the products from interior to fringe areas for marketing it. The forest staff – tribe relationship did not improve at all like it happened in boundary villages after ecodevelopment. On the other hand, Electricity Board Employees were allowed to keep cattle right on the center of Mundanthurai plateau. Free grazing cattle from EB settlements continuously damaged the habitat through browsing and trampling regenerating seedlings. Similarly, biotic pressure in terms of fuel wood extraction increased a lot in the forests surrounding Agasthiyar water falls due to pressure of local tourists especially in weekends in recent time. Some urgent steps are needed to be taken to prevent further destruction of PA habitat in plateau and surroundings of Agasthiyar falls.

8.4 Rising Grazing Pressure near Boundary in Last Phase

Significant increase (21%) of unpalatable weeds in forest floors near eastern boundary during ecodevelopment indicated again rise of grazing within park in the later phase of ecodevelopment. There was statistically significant decrease of cattle entry through park boundary in the initial stage (98-99 and 04-05) of ecodevelopment. 60% scrub cattle in eco villages being replaced by stall fed milking cow during ecodevelopment due to efforts by forest staffs and NGO representatives in persuading villagers to buy milking cow for a non-forest milk selling income instead of selling scrub cattle dung as manure where the owner purposefully send the herd to PA for free grazing. Villages located centrally near V K Puram township area were able to continue milk selling business due to the presence of large number of hotels and tea stalls nearby, and a well-run milk cooperative there. On the other hand, villagers from northern and southern end of park boundary were forced to sell their cow again due to less commercial demand in those areas, and absence of milk cooperative. Due to the above factors, selling of cow milk as alternative to selling of cow dung and subsequent free grazing in park, did not become successful in parts other than central zone outside PA. Fortunately, practice of keeping scrub cattle as dung machine also decreased a lot during same period mainly due to enhancement of inorganic fertilizer use in the locality and neighbouring areas. But still 40% scrub cattle were kept by fringe villagers which somehow required to be replaced by stall fed animals. On the other side, lopping of forest tree branches enhanced in later period as evident from transect survey in 10-11 as landless labourers who opted milk selling as

alternative to forest wood extraction were unwilling to buy fodder for the animal from market.

In combination of above factors, from 2006-07 onwards the popularity of getting eco loans for milking cow diminished a lot in large number of VFCs, and simultaneously forest department decided to help villagers then onwards on economic improvement through loans for agriculture purposes. Instead of finding a marketing solution for milk selling in every locality, and related infrastructure creation, department started giving agriculture loans in later stage of ecocodevelopment, which were not linked with PA conservation, and the task of reducing free grazing of cattle within park remained unfinished. Mostly established farmers with large land holding benefitted from eco loans in later stage of the program which even went against the stated objective of benefitting poor resource dependent population.

8.5 Change in Staffs and Community Attitude during Ecodevelopment

One of the biggest gain from KMTR ecocodevelopment was far improved staff-community relationship during the program when in past both the stakeholders were at constant conflict with each other. It happened due to initial 'breaking of ice' by the proactive first set of leaders in KMTR management, and subsequent 'trust building' community development activities at the beginning in complete synergy with local NGO representatives. Lack of communication and mutual trust between NGOs and forest department became hindrance for the success of participatory projects in many other PAs. KMTR was an

exception where local NGO representatives were in constant touch with executive staffs like eco rangers and foresters, and NGOs merely became the 'torch bearer' of the project. NGO representatives (52 during 10-11 survey) bridged between department and people, and VFC record maintenance and financial management were done by them. Forest staffs highly acknowledged the major role which local NGO representatives played in ecodevelopment implementations, and community respondents talked about much improved park-people relationships during project. Despite of improved relationships between staffs involved in ecodevelopment and local communities, regular territorial rangers, foresters and guards were not sensitized at all towards the value of community engagement in PA protection, and according to many staff respondents might jeopardize the whole effort put in building up good relations with local communities. During informal discussions with territorial rangers it became evident that they still had the old 'authoritarian' outlook in terms of their interactions and handling of local communities, and were not trained to adopt the new concept of co-management with the cooperation of local communities.

8.5.1 Staffs View Regarding Change in Dependency and Pressure

Almost in line with the present research findings, most of the respondent staffs opined that the significant socio economic change which the current ecodevelopment program brought in the life of resource dependent population, was not totally reflected in corresponding habitat improvement of PA. Forest staffs were also aware of the fact of no conservation linkage of many alternative enterprises chosen by local communities. All these opinions can be taken as

guidance for the future policy refinements and necessary changes in management of ecodevelopment.

8.5.2 Community Awareness Regarding Conservation Linkage of KMTR Ecodevelopment

More than fifty percent community respondents were clueless about why forest department is running ecodevelopment in surrounding villages. Environmental education and biodiversity awareness generation programs in KMTR ecodevelopment was not intensive like what took place in Gir National Park and Periyar Tiger Reserve. Most awareness programs took place in the initial years (1998 to 2000) when VFCs were forming under first set of project leaders of park management. There was no follow-up of the same in later years, so many next generation members were clueless about the conservation lineage of alternative livelihood offered to the dependent households. This can be considered as the weakest link in KMTR ecodevelopment initiatives, and need to be planned again differently for effective results. In later years, maximum members joined VFC expecting low interest loan. It became evident during attitude survey that the role of communities was mainly restricted as passive participant. They require constant guidance and hand holding of department staffs and NGO representatives for every aspects of VFC functioning. 50% respondent members opined to return back to forest extraction again in absence of departmental assistance to ecodevelopment. Capacity building training for VFCs self-sustainability remained incomplete again due to lack of follow ups in later stage of ecodevelopment.

The honest effort of KMTR management regarding equitable distribution of eco loans to all sections of society, especially the poor and marginal families were appreciated by local communities, but they warned about recent rise of 'pressure groups' in VFCs. Members felt that biotic pressure on KMTR reduced during ecodevelopment, but similar like research findings talked about rise in human pressure surrounding within park settlements and tourist and religious spots within park. When fixed response questions were asked, respondent members gave more priority to their immediate economic benefits over long term sustainability in terms of forest resource conservation.

8.6 MANAGEMENT RECOMMENDATIONS

KMTR ecodevelopment program had many positives and it was able to reduce number of fuel wood extractors and free grazing livestock within PA over a decade which was the main conservation problem prior to ecodevelopment. Maximum project benefits were targeted to poor and weaker sections of the community according to the basic principle of ecodevelopment. From the overall analysis it became clear that the only problem was the inability to maintain the initial thrust and focus towards the conservation of PA in the later stage of the program which require some adaptive changes in policy, strategy, implementations, and further strengthening of village level institution (VFC). Based on the decade long ecological and socio-economic assessment of changes in PA dependency and human pressure on KMTR, the following recommendations were suggested for better management of the park:

8.6.1 Biomass Generation in Fringe Areas of KMTR by VFCs

At present, fuel wood is the main source of energy for nearly 70% households in the villages' located near eastern boundary of park. The livelihood dependency on park fuel wood decreased significantly through provision of alternative livelihood, but the other two major areas of implementations – energy conservation and biomass generation outside park, were almost neglected in real field application. Now it is the time to concentrate more on these two aspects to complete the cycle of activities taken up at the beginning. As household fuel wood consumption is still very high, forest extraction cannot be stopped completely by only diverting fuel wood extractors to other economic alternatives. In addition to provision of alternative livelihood for extractors, growing quality fuel wood species in barren and fallow land in village surroundings is necessary to meet the fuel wood demand of villages. Some deciduous forest species were preferred more by communities as fuel wood. Nearly 8% of land around fringe villages of KMTR is of barren and fallow category. These lands can be taken up by respective VFCs for plantation of preferred fuel wood species which will be used as fuel after maturity, and distributed equally among each households like the model of Joint Forest Management (JFM) outside PA. Male and female still found engaged in fuel wood extraction in each VFC can be given employment to look after the trees, and the activities can be run as an extension of current ecodevelopment. Among the species, the fast growing one can be selected for plantation. Even the social forestry wing of Tamil Nadu forest department can be asked to plant such species along sides of roads and irrigation canals in the locality, and the product can be distributed equally among VFCs.

The most practical approach is to create a unified Buffer Zone (BZ) taking together the plateau and foothills within park along with all the impact zone villages of ecodevelopment, where forestry operations can go on around village buffers (Wells and Brandon, 1993) to meet the resource demand outside PA. KMTR management is already thinking in this line for a buffer zone creation which includes impact zone villages like what is already being done in Kanha Tiger Reserve in Madhya Pradesh.

8.6.2 Help Milkmen to Sell Milk to Milk Cooperatives in the Locality

Tamil Nadu Forest Department can coordinate with State Dairy Development Board to establish more milk societies in Kadaiyam (north), Ambasamudram (central) and Kalakadu (south) block in Tirunelveli district located near boundary of Tiger Reserve, so that families taking milk selling as alternate profession can get proper value of the product. By this, department can reformulate the strategy of replacing remaining scrub cattle from the locality instead of diverting to non-linked loans for agriculture which was helping established farmers more.

8.6.3 Popularize Fuel Efficient Chullah and Solar Cooker to Reduce Fuel Wood Consumption

Nearly 25% families in the fringe villages used LPG, and 11% of them used it as an additional source of energy along with fuel wood. Many families in the locality received free LPG connection from another government scheme simultaneously ran with ecodevelopment. Still rest of the families depended on

fuel wood as household energy. It became evident that the household dependency on fuel wood in the surrounding locality of park will only decrease in phase by phase manner, and simultaneous use of smokeless fuel efficient chullah and solar cooker need to be encouraged. Only 8% families received smokeless chullah through ecocodevelopment, and most of them abandoned it due to lack of training regarding its proper use, and solar cooker was not even tried in ecocodevelopment. Forest department can encourage VFC members to use these alternatives with prior technical training for proper use in next phase of implementations.

8.6.4 Alternative Livelihood for Male Fuel Wood Extractors

Due to overemphasis on women members' economic self-sufficiency, very few men SHGs were formed, and male members felt left out from economic development plan of VFCs. As a result they continued to extract forest resources in far larger numbers than female counterparts. Some of them can be appointed as fire and anti-poaching watchers by VFCs to help regular guards in forest protection, which was already experimented in some forest beats. It is better to train them in some economic alternatives which are similar to their past experience or which is familiar in the locality. They can be given technical training to grow medicinal plants in nurseries outside PA, along with the skill training in marketing and value addition of the product. Capacity building in male oriented vocations like fisheries or poultry animals will be useful for them, and till now very less number were trained in it. They can also be involved in biomass generation activities outside PA by VFCs.

8.6.5 Technical Training in Product Development, Marketing, and Value Addition

Both male and female loan recipients require to be trained by marketing experts and professionals in final product development, value addition, packaging and marketing skills. Constant interactions with the field experts in all levels of activities are needed to get financial success in the newly acquired alternative enterprises. The training sessions require to be organized in much higher frequencies than what was happening in recent past. It will improve the success rate in new enterprises many times than before.

8.6.6 Community Capacity Building to Run Village Level Institution by Own

Direct and meaningful participation of local communities in the program is expected which ultimately may lead to co-management of PAs in future. But in most of the cases, the role of communities in ecodevelopment restricted to passive actors and heavily dependent on forest department's instruction for every actions and implementations. In spite of initial success in improving relations with local communities, and establishment of functional VFCs in every fringe villages, the KMTR management still remain far away from building capacity within communities to run these VFCs by their own. The program was unable to bring up 'community leaders in VFCs who might take the lead to propagate conservation agenda to other fellow members. At present, VFCs are totally dependent on local NGO representatives for each and every activity. Organization of regular training programs, field workshops and trips to other PAs for members is required to learn collective decision-making, VFC

operations, financial and conflict management. Even some selected VFC presidents and executive members can be trained for short period on the above aspects in institutions like Wildlife Institute of India (WII) or Centre for Environment Education (CEE) like what had been done in Gir Conservation Area (PEACE, 2004). Regular territorial field staffs of KMTR are also required to be sensitized regarding the value of community participation in conservation of PA, and how to deal communities in a changing scenario like this.

The initial thrust on conservation awareness generation among local communities in the initial stage (1998 to 2000) faded away in absence of proper follow up program in middle and final stage of ecodevelopment. Members who joined VFCs after 2000 joined in expectation to avail low interest eco loan, the conservation linkage was not transcribed to them. There should be intensive awareness generation program in all stages of the project like which was done in much better manner in Gir and Periyar Tiger Reserve. Along with communities, there should be systematic awareness generation program in local schools and colleges about the unique biodiversity of KMTR, and the watershed value of the forest ecosystem which is crucial for agriculture productivity of the vast land area surrounding KMTR. Department should try to engage trained local schools and college students in spreading the biodiversity value of KMTR among surrounding rural communities.

8.6.7 Employ Kani's as Tourist Guides for Tourist Spots Located within PA

Alternative livelihood program completely failed in Kani settlements located within park due to unavailability of transport and market facilities. These

settlements should be separately categorized as ecotourism related professional VFCs, and Kani youths should be employed as tourist guides and operators to accompany local tourists to the falls, dam sites and other areas (religious sites) where tourists are allowed to visit. Kani VFCs within park should look after the whole aspect of tourism within buffer zone, and the revenue earnings can be shared proportionately. Prior to that, they require to be trained by professionals in the aspects of ecotourism.

Management of Periyar Tiger Reserve (PTR) successfully categorized village level institutions on the basis of occupations, geographical settings, and level of dependency (PEACE 2004) at the initial stage of ecodevelopment, and it proved to be beneficial in long terms.

8.6.8 Relocate Electricity Board Employees Housings outside KMTR

Electricity Board Employees kept cattle right in the center of Mundanthurai Plateau within park. These cattle used to graze freely within plateau for days together. Free grazing in plateau did tremendous harm to the natural regeneration of important species, and gradually transforming the area into a secondary forest. EB Employees are not at all depended on PA resources for livelihood. They are simply taking advantage of the situation, and doing rampant utilization of forest resources available free of cost. The large EB housing colonies should be relocated outside the park, and essential operation, maintenance, and security personnel can be transported in shifts from outside PA to work in the sites within the park.

8.6.9 Periodic Socio-Economic Monitoring of Processes and Impacts According to Monitoring Protocol

Mishra and Gupta (2000) prepared monitoring protocol for various processes and impacts of the project at the initial stage of ecodevelopment which the management did not follow or implement. Otherwise, department could easily keep a track on the number of resource extractors and free grazing animals in each villages by monitoring village entry/exit points during peak season of resource demand, or could identify the households that utilized eco loans in not-linked to conservation act and PA extractive activities. Even now, management can do periodical socio-economic monitoring of all the processes in each VFCs by engaging local youths and NGOs to get necessary feedback of the system functioning.

8.6.10 Bring Back the Post of Ecodevelopment Officer

A separate high level officer (IFS Cadre) was deputed to spearhead the whole program in KMTR as ecodevelopment officer at initial level of implementation, but abolished now after the formal withdrawal of World Bank support from the project. Competent and committed officers at the early stage of the project played a major role in overall integration of departmental and community level activities and brought an on field synergy between them. It is required to appoint one such high level officer who will be overall in charge of ecodevelopment activities.

8.7 Future Scope of Research

Ecological and socio-economic monitoring of Ecodevelopment Projects is an essential task to find out whether inputs of ecodevelopment actually reducing PA resource dependency of local communities, and henceforth reducing biotic pressure on park. Despite of it's enormous importance, very few attempts like Kremen *et al.*1994, Mishra and Gupta 2000, and Bhardwaj and Badola 2007 had been made till today to test whether such integrated conservation and development projects (ICDPs) are actually able to reduce resource dependency and human pressure on PA. Even in the works cited above, one mainly concentrated on socio-economic monitoring, and the other one did the ecological part. No one had done both the socio-economic and ecological assessment of any ecodevelopment project like the present study. The study developed methods for quantification of resource dependency and anthropogenic pressure on PA which will be useful for future researchers, and can be developed further. Ecological parameters were chosen carefully which are quantifiable and changes over time can be measured. The methods are kept as simple as possible, so that even forest staffs and community members with some scientific training, able to make gross measurement of changes. Innovative ideas were used in socio-economic studies like quantifying qualitative aspects such as level of community well-being, VFC members' level of participation, change in forest dependency and change in stakeholders' attitude after the completion of project. All these methods of measurements and analysis will be useful for future researchers engaged in extensive ecological and socio-economic baseline studies during ICDP implementation, and further changes can be measured to find out whether the project actually brought

positive changes regarding resource dependency and human pressure on park. Ideally, the quantification of resource dependency and pressure on PA should be done before ecodevelopment, and then at equal time gaps during project implementation to get a better idea about impact of the program in biodiversity conservation, which could not be done for KMTR project due to official delay. Establishing linkage between rural development activities and desired conservation outcome is the most important aspect of such projects, whether for a particular Protected Area or a landscape level initiative. It became clear during the study that integrating development and conservation is a dynamic aspect, and change in management policies and tactics based on periodical assessment of ecological and socio-economic changes on field is the key to success in linking local economic development with the goal of conservation.

For the first time, the impact of ecodevelopment in reducing PA resource dependency and consequent reduction of anthropogenic pressure on park was thoroughly analyzed by integrating ecological and socio-economic monitoring. This overall assessment of dependency and pressure on KMTR during ecodevelopment could serve as a feedback mechanism to promote better integration of conservation and development in future. Overall learnings from this study can be effectively used for necessary policy framing and process adjustments in projects dealing with similar type of conservation problems.

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APPENDIX I

List of User Villages

| SI No | Name of the Village | Fuelwood Collection | | Livestock Grazing | Other Biomass Collection |
|-------|-----------------------------------|---------------------|---------|-------------------|--------------------------|
| | | Own use | Selling | | |
| 1.* | Nannagaram | | √ | | |
| 2.* | Kadaiyam | | √ | √ | √ |
| 3. | Kanavoor | | √ | √ | √ |
| 4.* | Mettur | | √ | √ | √ |
| 5. | Pethanpillai kudiyruppu | | | √ | √ |
| 6. | Sambankulam | | √ | √ (1) | √ |
| 7. | Azhagappapuram | | √ | √ | √ |
| 8. | Kalyanipuram | | √ | √ (1) | √ |
| 9.* | Pottal Pudur | | √ | | |
| 10.* | Veikalpetti | | √ | | |
| 11. | Muduliyarpetti | | √ | √ | |
| 12. | Vadamalaisamudram | | | √ (1) | |
| 13. | Agasthiyapuram | | √ | √ | |
| 14. | Pottaivilaipetti | | √ | √ | |
| 15.* | Valakudi street | | √ | | √ |
| 16. | Pasukudaivilai | | √ | | √ |
| 17.* | Karuthiyapuram | | √ | | √ |
| 18. | Anavankudiyruppu | | √ | √ (1) | √ |
| 19. | Dana | | √ | √ (2) | √ |
| 20. | Pothigaidi | | | √ | √ |
| 21. | Adivaram | | | | √ |
| 22. | V.K.Puram | | √ | √ | √ |
| 23. | Sankarapandipuram | | √ | | |
| 24. | Arunachalapuram | | √ | | |
| 25. | N.St.V.K.Puram | | √ | | |
| 26.* | Vaithilingapuram | | √ | | |
| 27. | Kottaram | | √ | | |
| 28. | Kaskipuratoppu | | | √ | |
| 29. | Adivaram | | √ | √ | |
| 30.* | Kattapaitheru | | √ | | |
| 31. | Lower dam (within PA) | | √ | | |
| 32.* | Ramalingapuram | | √ | | |
| 33. | Kattapali street | | √ | | |
| 34.* | Thirupadiapuram | | | √ | |
| 35. | Near Santhanamariam Koil / Temple | | √ | | |
| 36.* | Meenakshipuram | | √ | | |
| 37. | Chettimedu | √ | | √ (2) | √ |

| | | | | | |
|-------|------------------------------|---|---|-------|---|
| 38. | Srilankan Tamil Refugee camp | | | √ (1) | |
| 39. | Koraiyarkulam | √ | | √ (1) | |
| 40. | Vembiyapuram | √ | | | √ |
| 41. | Ambasamudram | | √ | | |
| 42. * | Kallidaikuricchi | | √ | √ | √ |
| 43. * | Korankulam | √ | | | |
| 44. | Aladiyur | √ | | | |
| 45. | Manimuthar | | √ | √ | √ |
| 46. * | Zamin Singampetti | | √ | √ | |
| 47. | Aermalpuram | √ | | √ | |
| 48. | Therku Papangulam | | √ | √ (1) | √ |
| 49. | Ulupadiparai | | | √ (2) | |
| 50. | Ian Singampetti | | | √ (1) | |
| 51. | Pottal | √ | | √ (3) | √ |
| 52. | Kakan Nagar | | | √ | |
| 53. | Neduvilai | | | √ (2) | |
| 54. | Theyanallur | | | √ (1) | |
| 55. | Padmaneri | | | √ (6) | √ |
| 56. | Vadagarai | | | √ (3) | |
| 57. | Manjovilai | | √ | √ (8) | √ |
| 58. | Kamrajapuram | | √ | √ (1) | |
| 59. | Pulavankudiyiruppu | | √ | √ (2) | |
| 60. | Shivapuram | | √ | √ | √ |
| 61. | Palliyarkulam | | √ | √ | |
| 62. | Angigramam | | | √ | |
| 63. * | Malaiyadipudur | √ | | √ | |
| 64. | Chidambarapuram | √ | | √ (4) | |
| 65. | Salaipudur | | | √ (1) | |
| 66. | Thoppur | | | √ | |
| 67. | Mavadi | | | √ | |
| 68. | Thirukurangudi | | √ | √ | |
| 69. | Levangipuram | | √ | √ | |
| 70. * | Rajapuram | | √ | | |
| 71. | Rosmalpuram | | | √ | |
| 72. | Kanyakumari district | √ | √ | | |
| 73. * | Karuvelankulam | | | √ (2) | |
| 74. * | Patthai | | | √ (7) | |

*Name of user villages marked with * are situated outside the 5 kilometer radial distance zone. Values in the parenthesis refer to the number of herdsman collectively employed by the villagers to take their livestock for grazing into the protected area.*

APPENDIX II

Questionnaire for survey of Households of sampled VFCs

VFC:

Date:

Questionnaire no.:

GPS reading:

1. Group: Red/Yellow/Green
2. Name of head of the family:
3. Name, Age and Education of the Members and Non-members in the family:

| Members | | | | | |
|---------------|------|-----|-----------|-----------------|----------------|
| Members | Name | Age | Education | Main Occupation | Marital status |
| Male | | | | | |
| Female | | | | | |
| Non - Members | | | | | |
| Male | 1. | | | | |
| | 2. | | | | |
| | 3. | | | | |
| | 4. | | | | |
| Female | 1. | | | | |
| | 2. | | | | |
| | 3. | | | | |
| | 4. | | | | |

*1. Illiterate 2. Primary 3. Secondary 4. Degree 5. PG and above

** 1. Agriculture 2. Wage labour 3. Head loader 4. Grazer 5. MFP collection 6. Animal husbandry 7. Bidi making 8. Service 9. Business 10. Others

*** 1. Married 2. Un married 3. Widowed/Divorced

4. House and Economy details of household observed by interviewers

| | | | | | | |
|--|----------------|----------------|------------------------|----------------------|-------------------------|-----------|
| House roof | Thatched 1 | Tiled 2 | Concrete 3 | Concrete and tiled 4 | Concrete and asbestos 5 | Others OT |
| Walls | Mud 1 | Concrete 2 | Leaves and poles 3 | Stones 4 | Bricks 5 | Others OT |
| Amenities | Radio 1 | TV 2 | Cable TV 3 | CD 4 | Electricity 5 | Phone 6 |
| Vehicles | Cycle 1 | Bike 2 | Car 3 | Auto 4 | | |
| Toilets | Yes 1 | No 2 | | | | |
| Waste disposal | Bin 1 | Forests 2 | Around home 3 | Compost pits 4 | Burn 5 | |
| Status | Poor 1 | Middle class 2 | Rich 3 | | | |
| Use of forest products in construction | Very high 1 | High 2 | Neither high nor low 3 | Low 4 | Very low 5 | Nil 0 |
| Agricultural assets | Bullock cart 1 | Tractor 2 | | | | |

5. Cattle holding and fuel-record for household survey

| No. and Type of Livestock | | | | | | Type of Fuel Used | | | | | | | Cooking Device Use | | | | |
|---------------------------|----|---------|----|--------------|----|-------------------|---|---|---|---|---|---|--------------------|---|---|---|---|
| Cattle | | Buffalo | | Sheep / Goat | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 1 | 2 | 3 | 4 | 5 |
| SF | FG | SF | FG | SF | FG | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | |

SF & FG refers to number of stall fed and free grazing animal

Fuel Type: 1= Fuelwood, 2 = Lopped branches, 3 =Saw dust, 4 = Kerosene, 5 = LPG, 6 = Electricity, 7=Others (please note)

Cooking device: 1=Conventional wood stove (Chullah), 2=Fuel efficient chullah, 3=Hot point kerosene stove, 4=Pressure cooker, 5=others (Please note)

**Milking cow procured from VFC loan*

*** Fuel and fuel efficient devices procured from VFC (loan/free of cost)*

10. Main occupation before and after becoming a member of VFC:

| 98-99 | | 04-05 | | 08-09 | |
|------------------------------------|--------|------------------------------------|--------|------------------------------------|--------|
| Employee of forest department | 1 | Employee of forest department | 1 | Employee of forest department | 1 |
| Temporary job in Forest Department | 2 | Temporary job in Forest Department | 2 | Temporary job in Forest Department | 2 |
| Employed in other places | 3 | Employed in other places | 3 | Employed in other places | 3 |
| Hotel employee | 4 | Hotel employee | 4 | Hotel employee | 4 |
| No job(Instigate) | 5 | No job(Instigate) | 5 | No job(Instigate) | 5 |
| Agriculture | 6 | Agriculture | 6 | Agriculture | 6 |
| Fuel wood collection | 7 | Fuel wood collection | 7 | Fuel wood collection | 7 |
| Grazer and milk production | 8 | Grazer and milk production | 8 | Grazer and milk production | 8 |
| Goat rearing for meat | 9 | Goat rearing for meat | 9 | Goat rearing for meat | 9 |
| Bidi making | 10 | Bidi making | 10 | Bidi making | 10 |
| Tea stall | 11 | Tea stall | 11 | Tea stall | 11 |
| Vegetable selling | 12 | Vegetable selling | 12 | Vegetable selling | 12 |
| Utensils selling | 13 | Utensils selling | 13 | Utensils selling | 13 |
| Tailoring | 14 | Tailoring | 14 | Tailoring | 14 |
| NTFP collection | 15 | NTFP collection | 15 | NTFP collection | 15 |
| Medicinal plant collection | 16 | Medicinal plant collection | 16 | Medicinal plant collection | 16 |
| Wage labourer | 17 | Wage labourer | 17 | Wage labourer | 17 |
| Forest offences | 18 | Forest offences | 18 | Forest offences | 18 |
| Business | 19 | Business | 19 | Business | 19 |
| Others(specify) | O T | Others(specify) | O T | Others(specify) | O T |
| Cant tell | CT | Cant tell | CT | Cant tell | CT |

11. If he/she changed the job probable reasons?

12. What is most important in your daily life and your main livelihood?

| Livelihood | Agriculture | Animal Husbandry | Fuel wood collection | Daily wage labourer | Bidi making | NTFP | Service | Business | Others |
|----------------------|-------------|------------------|----------------------|---------------------|-------------|------|---------|----------|--------|
| Income (Rs.) / Month | | | | | | | | | |

13. Kindly tell your monthly family income:

| 98-99(Rs.) | 04-05(Rs.) | 08-09(Rs.) |
|------------|------------|------------|
| | | |

14. Whether your monthly family income increased due to any of the project input of ecodevelopment? Yes / No

15. If Yes, then when, which project input, and how much/month increased? Whether still you are getting the same benefit?

16. What you and your family would do if the support of ecodevelopment programme is stopped by KMTR management?

| Alternative activity | Worth Rs. per month |
|----------------------|---------------------|
| 1. | |
| 2. | |
| 3. | |

17. Why forest department is running ecodevelopment in the surrounding villages of KMTR?

18. VFC awareness:

| Name of VFC | Year of joining VFC | Reason of joining | CT |
|-------------|---------------------|-------------------|----|
| | | | |

APPENDIX III

Staff Attitude Survey

Ecodevelopment Project KMTR

2010-11

1. What is your designation?

| Eco - Range Officer | Forester | Forest Guard | Ministerial staff | Contract staff (NGO) | Other staff |
|---------------------|----------|--------------|-------------------|----------------------|-------------|
| | | | | | |

2. Under which office you are/ were working in KMTR?

| Eco-range | Territorial Range | FD office / other offices |
|-----------|-------------------|---------------------------|
| | | |

3. How long you have worked in KMTR?

| <1Yr. | 1-3 Yrs. | 3-5 Yrs. | > 5 Yrs. |
|-------|----------|----------|----------|
| | | | |

4. Where you are working now? In KMTR Outside

5. If in KMTR, where?

| Tourism zone | Buffer zone | Core area | Office |
|--------------|-------------|-----------|--------|
| | | | |

6. Have you received any training in Ecodevelopment/ PRA? Yes / No

7. How much is your understanding about Village Ecodevelopment?

| Very high | Medium | Less | Nil |
|-----------|--------|------|-----|
| | | | |

8. Have you been involved in village ecodevelopment programme? Yes / No

9. If yes, in what way? What in your opinion had been your participation in the programme?

| Sl. No. | Component | Your participation | | | | No opinion |
|---------|--------------------------------|--------------------|--------|-----|-----|------------|
| | | High | Medium | Low | Nil | |
| 1 | PRA/ Micro planning | | | | | |
| 2 | Programme implementation | | | | | |
| 3 | VFC meetings | | | | | |
| 4 | VFC field visits / Discussions | | | | | |

10. What in your opinion is the objective of Ecodevelopment programme?

| Park conservation | Livelihoods for local people | Development of local people | Others | Not aware |
|-------------------|------------------------------|-----------------------------|--------|-----------|
| | | | | |

11. What in your opinion has happened good due to the implementation of this new programme?

12. What in your opinion has happened bad due to the implementation of this new programme?

13. Any other remarks:

14. To what extent, in your opinion, ecodevelopment programme has been able to benefit KMTR conservation?

| Sl. No. | Component | Level of benefits | | | | No opinion |
|---------|---|-------------------|--------|-----|-----|------------|
| | | High | Medium | Low | Nil | |
| 1 | Facilities to the staff | | | | | |
| 2 | Conservation awareness | | | | | |
| 3 | Research and monitoring | | | | | |
| 4 | Livelihoods to KMTR dependent people | | | | | |
| 5 | Reduction in forest resource dependencies of local people | | | | | |
| 6 | Relation between park staff and local people | | | | | |
| 7 | Support of local people in Park protection through: <ul style="list-style-type: none"> a. Providing information b. Active patrolling c. Apprehending offenders d. Fire protection | | | | | |
| 8 | Mutual relation between the field staff, office staff and other technical staff | | | | | |

15. In your experience what has been the involvement of different levels of staff and other peoples in the programme?

| Sl. No. | Staff/ people | Level of involvement | | | | No opinion |
|---------|--------------------------------|----------------------|--------|-----|-----|------------|
| | | High | Medium | Low | Nil | |
| 1 | CCF | | | | | |
| 2 | FD | | | | | |
| 3 | DFOs | | | | | |
| 4 | EDO | | | | | |
| 5 | Deputy Director | | | | | |
| 6 | Wildlife assistant | | | | | |
| 7 | Range officers | | | | | |
| 8 | Foresters | | | | | |
| 9 | Forest Guards | | | | | |
| 10 | NGOs | | | | | |
| 11 | Contract staffs | | | | | |
| 12 | Office staff | | | | | |
| 13 | Panchayat | | | | | |
| 14 | Political leaders | | | | | |
| 15 | Media | | | | | |
| 16 | Staff / Officials outside KMTR | | | | | |
| 17 | Other Departments | | | | | |

16. Do you think you need some training in Ecodevelopment? Yes / No

17. Who in your opinion should be the most important for field implementation of ecodevelopment programme?

| DFO/EDO/Deputy Director | Eco Ranger | Eco Forester | VFC executive members | Forest guards | NGO |
|-------------------------|------------|--------------|-----------------------|---------------|-----|
| | | | | | |

Date:

Name (optional)

APPENDIX IV

List of tree species found to be cut by local people for different purposes

| Scientific name | Family | Local Uses |
|---------------------------------|--------------|--|
| <i>Acacia arabica</i> | Leguminosae | Medicinal, dye, and fodder |
| <i>Acacia planifrons</i> | Leguminosae | Implements, fuel wood |
| <i>Acorus calamus</i> | Aroideae | Medicinal, fuel wood |
| <i>Acrocarpus fraxinifolius</i> | Leguminosae | Furniture, fuel wood |
| <i>Acronychia laurifolia</i> | Rutaceae | Fuel wood |
| <i>Adina cordifolia</i> | Rubiaceae | Furniture, agriculture implements, house poles and fuel wood |
| <i>Albizzia amara</i> | Leguminosae | Wooden beams, carts, agriculture implements, fuel wood, gum and leaves as green manure |
| <i>Albizzia lebbeck</i> | Leguminosae | Building wood, agriculture & fuel wood |
| <i>Albizzia odoratissima</i> | Leguminosae | Wood for wheels, furniture & buildings, leaves & twigs as fodder. As fuel wood |
| <i>Albizzia procera</i> | Leguminosae | Wood used for carts, furniture, & house-building. Wood yields fine charcoal. Used as fuel |
| <i>Albizzia stipulata</i> | Leguminosae | Furniture and fuel wood |
| <i>Amarantus spinosus</i> | Amarantaceae | Medicinal. Antidote to snake-poison. Extracted essence of plant given to clean bowels & to improve digestion |
| <i>Amoora rohituka</i> | Meliaceae | Fuel wood |

| Scientific name | Family | Local Uses |
|--------------------------------|-----------------|---|
| <i>Anogeissus latifolia</i> | Combretaceae | For axe-handles, house poles, furniture, agriculture implements, fuel wood & charcoal. Leaves used for tanning |
| <i>Artocarpus integrifolia</i> | Moraceae | Jack fruit tree. Used for carpentry |
| <i>Averrhoa carambola</i> | Geraniaceae | Medicinal. Fruits used in curry |
| <i>Bassia malabarica</i> | Sapotaceae | Fuel wood |
| <i>Bauhinia racemosa</i> | Caesalpinoideae | Fuel wood |
| <i>Cajanus indicus</i> | Leguminosae | Fodder, dried stem makes good fuel & charcoal |
| <i>Careya arborea</i> | Lecythidaceae | Bark as fibre, fruit eaten by cattle and wildlife |
| <i>Caryota urens</i> | Palmae | Wood used for hut-building, agriculture implements & fencing. Fibre used for fishing lines. Toddy (desi wine) obtained. |
| <i>Cassia fistula</i> | Leguminosae | Used for posts, agriculture implements & as fuel |
| <i>Casuarina equisetifolia</i> | Casuarinaceae | As pole. Excellent fuel wood |
| <i>Chloroxylon swietenia</i> | Meliaceae | Valuable for furniture & turnery. Used as fuel |
| <i>Coffea travancorensis</i> | Rubiaceae | Medicinal. Roots used in preparation of Aiyurvedic medicine |
| <i>Commiphora caudata</i> | Burseraceae | Fuel wood |
| <i>Dalbergia latifolia</i> | Leguminosae | Used for furniture, cart-wheel & agricultural implements. |
| <i>Dichrostachys cinerea</i> | Leguminosae | Very good fuel |

| Scientific name | Family | Local Uses |
|-------------------------------|------------------|--|
| <i>Diospyros assimilis</i> | Ebenaceae | Hard wood fuel |
| <i>Diospyros bourdilloni</i> | Ebenaceae | Medicinal plant |
| <i>Diospyros melanoxylon</i> | Ebenaceae | Leaves are used as wrappers of tobacco to produce bidi. Off-cuts of leaves are burned and the ash is used in tooth powder. |
| <i>Diospyros montana</i> | Ebenaceae | Woods used for furniture, leaves used as fodder |
| <i>Dodonaea viscosa</i> | Sapindaceae | Dried leaves extensively used as green manure. Moist paddy is covered with leaves to accelerate germination before sowing. Leaves used as fodder. Hard stem useful as walking sticks |
| <i>Dolichos biflorus</i> | Leguminosae | Stem & leaves used as fodder |
| <i>Elaeocarpus serratus</i> | Elaeocarpaceae | Edible fruit Also as fuel wood |
| <i>Emblica officinalis</i> | Euphorbiaceae | Fleshy edible fruit Useful for poles |
| <i>Flacourtia indica</i> | Bixaceae | Fuel wood |
| <i>Garcinia echinocarpa</i> | Guttiferae | As fuel |
| <i>Givotia rottleriformis</i> | Euphorbiaceae | Used for carved images, toys etc. Seeds give an oil |
| <i>Grewia tiliaefolia</i> | Tiliaceae | Used for shafts of carts, for axe-handles, fishing-rods & in house building. Also as fuel |
| <i>Hopea parviflora</i> | Dipterocarpaceae | Valuable timber |
| <i>Isonandra candolleana</i> | Sapotaceae | Used as fuel |
| <i>Justicia gendarussa</i> | Acanthaceae | Medicinal Leaves used for medicinal purposes |

| Scientific name | Family | Local Uses |
|---------------------------------|----------------|--|
| <i>Lagerstroemia lanceolata</i> | Lythraceae | Useful for building, boat-building, furniture & as fuel |
| <i>Lannea coromandelica</i> | Anacardiaceae | Fuel wood |
| <i>Maba buxifolia</i> | Ebenaceae | As timber and fuel |
| <i>Macaranga peltata</i> | | Red gum extracted from the tree As fuel |
| <i>Madhuca indica</i> | Sapotaceae | As fuel |
| <i>Mesua ferrea</i> | Guttiferae | As fuel |
| <i>Mitragyna parvifolia</i> | Rubiaceae | Woods used for furniture. As fuel |
| <i>Morinda citrifolia</i> | Rubiaceae | Roots give a red dye |
| <i>Mundulea suberosa</i> | Leguminosae | Fuel wood |
| <i>Oroxylum indicum</i> | Bignoniaceae | As fuel |
| <i>Pavetta indica</i> | Caprifoliaceae | Fuel wood & green manure |
| <i>Phoenix humilis</i> | Palmaceae | Used in making mats |
| <i>Plectronia didyma</i> | Rubiaceae | Wood as timber & fuel |
| <i>Pseudarthria viscida</i> | Leguminosae | Medicinal. Powdery form of root materials applied in several ailment |
| <i>Pterocarpus marsupium</i> | Leguminosae | Wood used for building, furniture & agricultural implements. Medicinal. It gives a red gum resin 'kino' used in medicine. Leaves used as fodder. |
| <i>Schleichera trijuga</i> | Sapindaceae | Used as fuel, rice-pounders & for carts. Best lac produced on its twigs |
| <i>Streblus asper</i> | Moraceae | Cut as fuel. Rough leaves used to polish wood |

| Scientific name | Family | Local Uses |
|--------------------------------|---------------|--|
| <i>Syzygium jambolanum</i> | Myrtaceae | Purple edible tasty fruit. Wood useful for building & agricultural implements. |
| <i>Tamarindus indica</i> | Leguminosae | Tamarind Fruit. Wood used for rice-pounders, as charcoal & as fuel |
| <i>Tectona grandis</i> | Verbenaceae | Principal timber in India. |
| <i>Terminalia bellerica</i> | Combretaceae | Wood useful if carefully seasoned Fruit used in tanning |
| <i>Ventilago maderaspatana</i> | Rhamnaceae | Climber used as ropes to tie bundles of fuel wood and fodder |
| <i>Weightia tinctoria</i> | Apocynaceae | As Fuel |
| <i>Zizyphus rugosa</i> | Rhamnaceae | As fuel |
| <i>Zizyphus xylopyrus</i> | Rhamnaceae | As fuel |

Plate 1: Group of women head loaders in KMTR



Plate 2: Fuel wood seller taking mature stumps and branches out from the PA



Plate 3: Trail monitoring team accompanying fuel wood extractors to find the exact location of extraction



Plate 4: Fuel wood sellers sharpening wood cutter instrument (arubal in Tamil) on the sides of forest trail



Plate 5: Recent phenomenon of cycle load of fuel wood from the eastern side of KMTR



Plate 6: Free grazing buffaloes owned by human settlements in Mundanthurai plateau



Plate 7: Paid herdsman returning to the village in the dusk



Plate 8: Village women with broom grass load (*Phoenix pusilla*) from the forest



Plate 9: Collection of fodder through forest trail located on eastern boundary



Plate 10: Roots of *Coffea travancorica* collected from KMTR to be transported to Kerala as raw material of Aiyurvedic medicine



Plate 11: Farmer applying leaves of *Dodonea viscosa* collected from KMTR as green manure



Plate 12: Kani tribals within PA collected woody climbers as rope



Plate 13: Soil erosion in certain locations of Mundanthurai plateau subjected to heavy wood cutting and grazing pressure in the past



Plate 14: Electric fencing on eastern boundary of KMTR to prevent wild animals from entering nearby agricultural fields and orchards



Plate 15: Researcher engaged in transect study within boundary forest to quantify human pressure



Plate 16: Transect study to quantify pressure on park



Plate 17: Fresh Lopped and chopped branches within transect line during quantification of pressure



Plate 18: Informal interview and group discussion with executive members of Sambankulam VFC in Kadaiyam Range



Plate 19: Women Self-help Group (SHG) members engaged in interactions in Papanasam eco-range office



Plate 20: PRA exercise during initiation of ecodevelopment in the fringe villages of KMTR



Plate 21: Stitching and tailoring training for the women VFC members in Mundanthurai



Plate 22: Vocational training for women SHG members by NGOs during KMTR ecodevelopment



Plate 23: Milking cow as alternative income for forest dependent families



Plate 24: Vaccination camp for domestic animals organized by forest department in KMTR



Plate 25: Health camp for villagers during KMTR ecodevelopment



Plate 26: Street plays to generate awareness about biodiversity of KMTR



Plate 27: Village woman collecting dry sticks from the scrub jungle located in the buffer zone of KMTR due to strict protection during ecodevelopment



Plate 28: Reforestation through plantation of *Acacia arabica* by VFC members in KMTR ecodevelopment

