

**Tiger habitats and Integrated Conservation and Development Projects:
A case study from Periyar Tiger Reserve, India**



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Sanjay Gubbi

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Durrell Institute for Conservation and Ecology
University of Kent

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Abstract

Protected areas (PAs) in India are mostly managed through protectionist approaches by government agencies. Since the past two decades the focus of biodiversity conservation has shifted to new models such as Integrated Conservation and Development Projects (ICDP) due to increasing population pressures around and within the PAs, and the escalating conflict between wildlife managers and local communities. The India Eco-Development Project (IEDP) was implemented to reduce impacts of local communities on the PAs, and vice versa. Among the seven sites, the IEDP at Periyar Tiger Reserve (PTR) is generally recognised as a success and the communities are believed to have positive attitudes towards PTR and wildlife due to the implementation of the IEDP. However, previous studies did not base the results either on pre-project surveys or compare them to non-beneficiaries to evaluate attitudes, nor were statistical methodologies included. Longer-term evaluation of community benefits provided under the IEDP would provide an understanding of the role of these benefits in influencing community attitudes towards biodiversity conservation. Furthermore, because six of the seven PAs supported under the IEDP have tigers as their flagship species, an assessment and documentation of PTR-IEDP could also be of importance to set priorities for guiding future investments in tiger conservation.

Most (71.1%) of the IEDP beneficiaries were aware of the project objectives that the incentives were provided to reduce local community threats on PTR and build extensive local support for PTR. Provision of household benefits, community benefits, access rights to natural resources or alternative livelihoods did not influence conservation attitudes nor did they influence the perceptions of respondents towards the IEDP. Community benefits were provided under the IEDP in consultation with focal communities. However, the majority (66%) of community benefits were not used or maintained. This questionnaire survey showed that there was no difference in conservation attitudes between IEDP beneficiaries and non-beneficiaries. However, conservation attitudes were related to formal education, human-wildlife conflicts and professions.

The PTR-IEDP addressed several concerns and issues raised by ICDP critics, however, despite addressing these concerns, it has made little impact as a rural development project, while evidence is entirely lacking to determine its impact as a conservation project. Without biological evaluation of the success of previous investments, and with the equivocal evaluation of the results of the rural development aspects of the project documented in this study, it remains unclear whether or not it is worthwhile to implement similar ventures. Otherwise, however well-intentioned these projects are, they may fail to deliver their primary objective of providing incentives for wildlife conservation, while at the same time providing a major burden to the Indian taxpayer for the years over which loans have to be repaid.

Key words: Periyar Tiger Reserve, India Eco-Development Project, Integrated Conservation Development Projects, conservation attitude, community benefits.

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Acronyms and abbreviations

DES – Department of Economics and Statistics
EDC – Eco-Development Committee
FAO – Food and Agriculture Organisation
GEF – Global Environment Facility
GO – Government Order
GOI – Government of India
GOK – Government of Kerala
GOT – Government of Tamilnadu
ICDP – Integrated Conservation and Development Project
IEDP - India Eco-Development Project
JFM – Joint Forest Management
KFD – Kerala Forest Department
LPG – Liquefied Petroleum Gas
MOEF – Ministry of Environment and Forests
MSL – Mean Sea Level
NGO – Non-Governmental Organisation
NTFP – Non Timber Forest Produce
PA – Protected Area
PRA – Participatory Rural Appraisal
PTR – Periyar Tiger Reserve
Rs. – Indian Rupees
SAPP EDC - Swami Ayyappa Poongavana Punarudharana Eco-Development Committee
Sq km – Square kilometre
US \$ - American Dollars
WB – World Bank
WCS – Wildlife Conservation Society
WII – Wildlife Institute of India
WLPA – Wildlife Protection Act 1972
WWF – World Wide Fund for Nature

Currency equivalents

US\$ 1 = Rs.44
Rs. 1 = US\$ 0.023 (World Bank 2004)

Chapter 1

General introduction



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Habitat destruction & fragmentation is a serious threat to wildlife

Introduction

1.1 Protected areas and changing conservation paradigms

Protected areas (PAs) are central to most national policies to conserve wildlife the world over (Terborgh & van Schaik 1997; Chape *et al.*, 2005). However, PAs are usually surrounded by local communities who use or depend on PAs natural resources for their livelihood, additional income or subsistence. Furthermore, many species of wildlife usually range beyond PA boundaries causing conflicts between wildlife and people, resulting in economic loss to local communities. In turn, this can lead to loss of support for wildlife conservation as local communities are rarely adequately compensated. Hence Community-based Conservation (CBC) has emerged as a solution to offset the costs of living with wildlife (Wells, Brandon & Hannah 1992; Hackel 1999; Salafsky & Wollenberg 2000)

Initiatives such as the Communal Areas Management Program for Indigenous Resources (CAMPFIRE) in Zimbabwe, Administrative Management Design (ADMADE) in Zambia and the Joint Forest Management (JFM) in India have emerged as examples of such CBC programmes (Barrett & Arcese 1995; Child 1996; Lewis & Alpert 1997; Murombedzi 1999; Kothari, Pathak & Vania 2000). However, CBC projects were often designed and implemented to function independent of neighbouring PAs, thereby creating lacunae between PAs and local communities (Murombedzi 1999; Alexander & McGregor 2000). In turn, this has led to a newer paradigm of Integrated Conservation and Development Projects (ICDP) that seek to link PA management with CBC. In India, high population pressures and rich biodiversity make the integration of PAs and CBC particularly relevant.

1.2 Wildlife conservation in India

India is rich in biodiversity and is one of the 12 mega-diversity countries in the world (McNeely *et al.*, 1990). It hosts three of the world's 34 biodiversity hotspots (Myers *et al.*, 2000, Conservation International 2006). The country harbours 7.6% of world's mammal species, 2.6% of its bird species, 6.2% of its reptile, 4.4% of its amphibian, 11.7% of its fish, 6.1% of its invertebrates and 6.0% of its floral species (WII 2006).

By 2005, India had established 95 national parks and 500 wildlife sanctuaries that covered 4.74% of the country's total land area (WII 2006). These PAs harbour several flagship, umbrella and ecologically fragile species, including the Indian tiger *Panthera tigris tigris*, Asiatic lion *Panthera leo persica*, snow leopard *Uncia uncia*, Asiatic wild dog *Cuon alpinus*, Asian elephant *Elephas maximus*, greater one-horned rhinoceros *Rhinoceros unicornis*, Asiatic water buffalo *Bubalus bubalis*, Nilgiri tahr *Hemitragus hylocrius*, lion-tailed macaque *Macaca silenus*, great hornbill *Buceros bicornis*, great Indian bustard *Ardeotis nigriceps* and gharial *Gavialis gangeticus*. Among these, tigers are the most prominent flagship species for the country's wildlife (Leader-Williams & Dublin 2000) and receive considerable national and international attention. Tigers have been used to raise large-scale conservation funding, both in India and in several other Asian countries, both by government and non-

government agencies (World Bank 1996; Seidensticker, Christie & Jackson 1999; Karanth *et al.*, 2002; WWF 2006, WCS 2006; 21st Century Tiger 2006; Project Tiger Directorate 2006; STF 2006; WWF-India 2006; Dalton 2006).

1.3 Tiger conservation in India

In 1973, the Indian government with support from international conservation organisations started the ‘Project Tiger’, thereby committing itself to protecting tigers, their prey and habitats, which were facing serious threats at that time. A total of nine tiger reserves were set up across India, and this total has since increased to 28 tiger reserves spread over 37,761 sq km in 17 states (GOI 2005).

1.4 Tigers in human-dominated landscapes

Despite all the conservation efforts focussed on them, tigers remain threatened by overhunting of their prey species, by large-scale habitat destruction and fragmentation, by direct persecution for trade purposes or as a pest and other community pressures on their habitats (Karanth 2001; Damania *et al.*, 2003; Chengappa 2005; Phatarphekar 2005; Check 2006; Dalton 2006).

A burgeoning human population of over 1 billion in India, industrial advancement, developmental projects and aspirations of both urban and rural communities has placed enormous pressures on wildlife habitats and on tiger habitats in particular. Despite these problems, India still has 350,000–400,000 sq km of potential tiger habitat (Wikramanayake *et al.*, 1998), although the current range where tigers are actually reproducing could be limited to only 40,000 sq km within Indian PAs (Karanth 2001). Nevertheless some of the Indian PAs have the potential to support up to 22 tigers/100 sq km (Karanth 2003).

1.5 Shifting scenario of conservation; Integrated Conservation Development Projects

In India PAs are mostly managed through protectionist approaches implemented solely by government agencies at a federal or at state level. Over the past two decades, the focus of biodiversity conservation has shifted from the ‘parks’ and ‘species protection’ approaches to ‘sustainable development’ and ‘equitable resource sharing’ approaches. Under this new approach, India seeks to better integrate PAs into the development process through sustainable use of their natural resources (World Bank 2002). Increasing population pressures around and within Indian PAs, and the escalating conflict between wildlife managers and local communities have been among the core reasons for shifting the focus of PA management (Kothari *et al.*, 2000). In response to these conflicts India has started to follow other models such as ICDPs that have been tried in other parts of the world (Wells *et al.*, 1992; MacKinnon, Mishra & Mott 1999), notably in Africa (Kiss 1990; Gibson & Marks 1995; Newmark & Hough 2000).

ICDPs are defined as projects that link biodiversity conservation in PAs with local socio-economic development (Wells *et al.*, 1992). ICDPs are promoted as an answer to mitigating the pressures of human exploitation on traditional PAs, and to solving the problems of human-wildlife conflicts both within and outside PAs. In India and elsewhere, ICDPs are broadly categorised as projects that (1) give

direct incentives for conservation of biodiversity through harvest of plant and animal resources found inside PAs; and (2) provide access to alternative or better resources outside the PAs (Kremen, Merenlender & Murphy 1994).

Policies of several multilateral donor agencies now emphasise their focus on ICDPs (Newmark & Hough 2000; MacKinnon 2001; World Bank 2002). The fundamental recognition that rural communities bear the costs of conservation, and that they should therefore be afforded the right to benefit from conservation, has driven this change in attitude among many institutional stakeholders (Rodgers *et al.*, 2003).

A main component of ICDPs is eco-development which has two main thrusts: improvement of PA management and the involvement of local people in that management (World Bank 1996). The development of an eco-development strategy aims to conserve biodiversity by addressing both the impact of local people on PAs and the impact of PAs on local people (*Ibid*).

1.6 India Eco-Development Project (IEDP)

India had already experimented with eco-development options and benefits for villages adjoining reserved forests in the 1980's (Bhatt & Kothari 1997; Kothari *et. al.*, 2000). In the mid 1990s, India sought to extend such efforts to those living within and around PAs. Therefore the Indian government requested World Bank assistance to implement a major series of ICDPs in 1994. This request was supported by the Global Environment Facility (GEF) and the World Bank and was known as the India Eco-Development Project (IEDP).

Though the IEDP was initially estimated to cost US\$67 million, the budget was restructured during the mid term review to US\$61.02 million. Furthermore, more than half of the total project budget (US\$32.75 million) was allocated for village eco-development activities, aimed at reducing negative impacts of local communities on biodiversity and increase their participation in conservation (World Bank 2004, Table 1.1).

The IEDP had five specific objectives (World Bank, 1996). They were to:

- improve the capacity of PA managers to conserve biodiversity and increase opportunities for local participation in PA management activities and decisions;
- reduce negative impacts of local people on biodiversity and of PAs on local people and increase collaboration of local people in conservation efforts;
- develop more effective and extensive support for eco-development of PAs;
- ensure effective management of this project; and
- prepare future biodiversity projects¹.

¹ This objective was dropped during the mid-term review of the project (World Bank 2004).

The project implementing agencies were the Ministry of Environment and Forests (MOEF) and state forestry departments, while the respective PAs implemented all the community conservation and education activities through the formation of Eco-Development Committees (EDCs). The project aimed to implement different components (Table 1.1) across seven sites (Figure 1.1).

Table 1.1: Different components of India Eco-Development Project, and their associated costs

(World Bank 1996, 2004)

Project components	% of costs	Amount in US\$
Improved PA management	25.4	15.49
Village eco-development	53.7	32.75
Education and awareness and impact monitoring and research	4.5	2.77
Overall project management	15.3	9.35
Preparation of future biodiversity projects	1.0	0.61
Reimbursement of the project preparation facility	0.1	0.05
Total	100	61.02



Figure 1.1: The seven India Eco-Development Project sites

The IEDP was started as a 5-year pilot project to run from October 1996 to June 2002² and to cover seven PAs (Figure 1.1), covering both the PAs and the peripheral villages within a 2 km radius of each PA boundary (Kothari *et al.*, 2000, Sharma *et al.*, 2004). The PAs were located in different biogeographic regions: Ranthambore in Rajasthan, Pench in Madhya Pradesh, Periyar in Kerala, Palmau in Jharkhand³ and Buxa in West Bengal all of which are tiger reserves, and Gir in Gujarat and Nagarahole in Karnataka which are both national parks. Tigers were the flagship species in all project areas except in Gir National Park, which supports the only surviving wild populations of Asiatic lions, and which served as the flagship species in place of tigers.

1.6.1 IEDP at Periyar Tiger Reserve (PTR)

The PTR-IEDP ran from 1996 to 2004 at a total cost of US\$ 5.97 million (JPS Associates 2004). The PA authorities and project planners had initially identified 225,000 villagers as the target population, but this was later reduced to 58,144 villagers (World Bank 1996; Sharma *et al.*, 2004), representing

² Due to a delay in the launch of the project, two one-year extensions were agreed on and the project ended in June 2004 (World Bank 2004)

³ Palmau Tiger Reserve was in the state of Bihar during the initial implementation of the project.

less than one third of the estimated population living within the 2 km periphery of PTR (MacKinnon *et al.*, 1999).

A total of 72 EDCs (Table 1.2) were formed around PTR, based on resource use patterns and social structure, to implement village eco-development and other activities (Uniyal & Zacharias 2001; KFD 2001; Sharma *et al.*, 2004). The EDCs were classified as follows

- *Neighbourhood-based EDCs*: these comprised villages, settlements and hamlets consisting of 31-138 households. The project emphasis was on building community infrastructure and individual benefits to improve local livelihood opportunities;
- *User group-based EDCs*: these comprised members who were dependent on PTR for a particular resource, such as grazing, fuelwood or thatching grass as a source of livelihood. The focus of these EDCs was to provide community groups with alternative livelihoods to decrease their dependency on PTR. Currently, they are permitted to graze livestock, and to harvest fuelwood, thatching grass and some Non-Timber Forest Produce (NTFP) species within PTR;
- *Professional group based EDCs*: these comprised of (i) professionals who were previously involved in illegal activities such as collection of cinnamon bark (*Cinnamomum malabattrum*), timber smuggling and poaching; and (ii) forest dwelling communities who were relocated from the interiors of PTR (between 1930s and 1984), and who are currently carrying out agriculture and other professions, and are living in the periphery of PTR. These groups were formed as two separate EDCs consisting of 43 members who were trained to carry out eco-tourism and reserve protection activities;
- *Pilgrim management EDCs*: these comprised seasonally active members who ran business activities within PTR during the Sabarimala pilgrimage months of November to January. Some members of these EDCs were members of the Neighbourhood EDCs.
- *Staff EDCs*: these comprised members of government departments and included staff of forest, irrigation and tourism departments who resided within and around PTR.

Table 1.2: Numbers of different Eco-Development Committees and the total number of households in each EDC

EDC category	Number of EDCs	Total no of households
Professional EDCs	2	43
User group EDCs	3	213
Neighbourhood EDCs	58	4706
Pilgrim management EDCs	6	390
Staff EDCs	3	188
Total	72	5540

During the implementation of the IEDP, a household was considered as an EDC member and the basic unit for all project benefits and activities. Each household was entitled to a total benefit of US\$ 329.5 under the project for the entire project period (KFD 2002; KFD 2003a). The EDC consisted of an executive committee headed by an elected chairman, while a Deputy Ranger acted as the ex-officio secretary. The eco-development activities within each EDC were planned based on recommendations of micro-plans that were drawn up through PRA exercises in the targeted villages or communities (KFD 2003a; Sharma *et al.*, 2004).

1.7 Need for this study

Evaluation of the success of conservation projects is critical to enable an audit of how conservation funds are spent, and to determine the conservation impacts of spending those funds (Sanjayan, Shen & Jansen 1997). ICDPs are large and multi-million dollar conservation projects, the success of which it is critical to evaluate for their cost-effectiveness and sustainability. In order to understand if such projects leave a sustainable legacy, it is also critical that such impacts should be measured over different time horizons, from short- to long-term. Consequently, it was important to revisit the IEDP at PTR several years after it had ended to undertake an objective, field-based evaluation that seeks to analyse different components of the project for their sustainability beyond the IEDP lifespan. Equally, ongoing monitoring of project success that documents the sustainability of conservation interventions is a key component of any CBC or ICDP project.

Of the seven IEDP reserves, only the project at PTR is generally recognised as a success through several reports and documents (Uniyal & Zacharias 2001; Ohrling 2001; Arun, Jayashankar & Abraham 2001; World Bank 2002; Kothari 2003; Sharma *et al.*, 2004; Kutty & Nair 2005; Griffiths 2005; Thampi 2005; Bhardwaj, Krishnan & Geetha, 2006). Indeed, it has been deemed as one of the best forest management practices in Asia by the FAO (Kutty & Nair 2005). There have been several positive reports published in the popular media (Bagla 2000, 2003; Padmanabhan 2004; Kozhisseri 2005; Pillai 2005). Nevertheless, previous literature and evaluation documents have been based on studies carried out during the implementation phase of the IEDP (Uniyal & Zacharias 2001; Ohrling 2001; World Bank 2002; Kothari 2003; Sharma *et al.*, 2004) and some of the published reports have

been based on short trips to the area, rather than on detailed field surveys (Ohrling 2001; Bagla 2000, 2003; Kutty & Nair 2005; Thampi 2005). Hence an objective, process-based trend analysis, carried out by an external investigator seeking to determine project success, could be highly beneficial to assess the longer-term impacts of the IEDP at PTR, which in turn would provide inputs for future ICDP projects that are planned to be implemented in India. Furthermore, because six of the seven PAs supported under the IEDP have tigers as their flagship species, an assessment and documentation of PTR-IEDP could also be of importance to set priorities for guiding future investments in tiger conservation.

For this study, it was necessary to adopt a degree of analytical rigour that has been lacking in the previous evaluation reports of project success (KFD 2003a; Sharma *et al.*, 2004; JPS Associates 2004). All previous reports and evaluations suggest that local communities hold positive attitudes, towards PTR and wildlife conservation in general, following the implementation of the IEDP (Pillai 2001; KFD 2003; JPS Associates 2004; Sharma *et al.* 2004). Nevertheless, benchmark data are unavailable to compare any possible changes in conservation attitudes of beneficiaries, nor have the attitudes of beneficiaries been compared with those of non-beneficiaries, who have an impact on PTR and satisfy all eligibility criteria but were not covered under the project (KFD 2003a; KFD 2003b; Sharma *et al.*, 2004; JPS Associates 2004). Moreover, the success or otherwise of community-based conservation in changing behaviour of local communities has not been independently evaluated in India (Arjunan *et al.*, 2006). Therefore, an evaluation of the success of projects such as the IEDP, should help others determine how to engender more positive attitudes among communities towards the PAs and wildlife conservation in general.

One of the major assumptions of ICDPs is that certain incentives will influence communities to participate in biodiversity conservation through direct and indirect investments, such as providing infrastructure to reduce human-wildlife conflicts, income generating infrastructure and so on (Sanjayan *et al.*, 1997; World Bank 1996). This assumption that has not been fully tested (Sanjayan *et al.*, 1997). Finally, it would be beneficial to revisit and evaluate the longer-term sustainability of community benefits such as crop protection measures, income generation benefits and so on, that were determined and prioritised by the communities through micro-plans, as most of the previous reports do not evaluate their performance, current condition or usability (KFD 2003a; Sharma *et al.*, 2004; JPS Associates 2004; World Bank 2004). There have been conflicting opinions about the use of community benefits. One study attributes the electric fencing provided under the IEDP as a useful tool in minimising crop damage by wildlife (KFD 2002, JPS Associates 2004), while another study mentions the performance of electric fences as not beneficial (Gurukkal 2003).

Under the PTR-IEDP benefits targeted at communities as a whole were used to assist communities through provision of community infrastructure and assets to increase their income and to build local support for PTR. A total of 53.7% of the IEDP budget was spent on village eco-development activities

(World Bank 2004) and at PTR a sum of US\$ 2.71 million, or 43.22% of the total project budget had been invested on these activities (*Ibid*).

1.8 Aims of this study

The overarching question that this case study at PTR seeks to address is whether or not conservation benefits provided through an ICDP have affected attitudes towards conservation. This overarching question is addressed using a questionnaire survey that compares the benefits received by, and conservation attitudes of, IEDP and non-IEDP beneficiaries. Specifically this study aimed to assess:

- i) linkage between development tools and biodiversity conservation;
- ii) the problems and solutions of communities living in and around PTR;
- iii) the perceptions of beneficiaries towards the IEDP;
- iv) sustainability and impacts of household, access rights to natural resources, community benefits and alternative livelihood provided under the IEDP;
- v) assess the impact of the IEDP towards influencing conservation attitudes of the communities;
- vi) determine the role of incentives provided under the IEDP in influencing attitudes towards PTR and wildlife conservation; and
- vii) compare the conservation attitudes of IEDP beneficiaries and non-beneficiaries towards PTR and wildlife conservation.

1.9 Structure of the dissertation

The dissertation is divided into seven chapters:

Chapter 1 has already explained how the different conservation paradigms followed in India and elsewhere have resulted in present day ICDPs, and the aims of this study which seeks to analyse the success or otherwise of one such ICDP at PTR. **Chapter 2** describes the history and biological importance of the study site, including the flora and fauna of PTR. **Chapter 3** explains the field and statistical methods used for collection and analysis of the data. **Chapter 4** describes the main results of the study, including the socio-economic and demographic profiles of respondents, and the factors that determine their attitudes to conservation, to the linkages between development tools and conservation. **Chapter 5** discusses some of the major findings of the study and outlines the strengths and weaknesses of the IEDP at PTR. **Chapter 6** describes recommendations and a set of evaluation criteria to measure longer-term gains of ICDPs that could provide management inputs for implementation and furthering of the project at PTR. **Chapter 7** has concluding remarks about IEDP and similar projects to be implemented in India.

Chapter 2

Study site



© Sanjay Gubbi

Grassland 'shola' forests of Periyar Tiger Reserve

Study site

2.1 The Periyar Tiger Reserve

PTR is located in the Idukki and Pathanamthitta districts of Kerala state in southern India (9° 16' to 9° 40' N and 76° 55' to 77° 25' 55 E) (Figure 2.1), and forms part of the Western Ghats, which is recognised as a biodiversity hotspot (Myers *et al.*, 2000, Conservation International 2006). The town of Kumili borders the PTR and its development has been linked to the growth of tourism activities at PTR. Indeed the economy of Kumili is now largely dependent on PTR.

Historically the area now encompassed within PTR was under the administrative control of the erstwhile State of Travancore. An area of 600 sq km was declared as the Periyar Lake Reserved Forest in 1899. More areas were added in subsequent years and the present wildlife sanctuary of 777 sq km was established in 1950. The core area of 350 sq km within the wildlife sanctuary was declared as a national park in 1982.

PTR was designated as one of India's Tiger Reserves in 1978 (GOI 2005) and was declared as an Elephant Reserve in 1991 (KFD 2001). PTR forms part of a contiguous and compact forest block of 3,000 sq km in the southern Western Ghats. The large forest block of PTR and its surrounding area are designated as Tiger Conservation Landscape TCL 64 of regional importance (Sanderson *et al.*, 2006).

2.2 Zonation and administration

PTR has a total boundary length of 220 km, and shares an interstate boundary of 90 km bordering the State of Tamilnadu (KFD 2001). The reserve is divided into core (350 sq km), buffer (427 sq km) and tourism zones (50 sq km) (*Ibid*) and is headed by a Field Director and two Deputy Directors. PTR has two divisions (Periyar east division and Periyar west division), each managed by a Deputy Director and has five administrative ranges each managed by a Range Officer.

2.3 Elevation

The reserve is spread over a variety of elevations but mostly lies between 750–1500 m asl (KFD 2001). Kottamala is the highest point in PTR at 2019 msl, and Pamba Valley is the lowest at 100 msl (*Ibid*).

2.4 Climate and rainfall

The area receives both the southwest (June-September) and northeast (October-December) monsoons. However most rain falls during the southwest monsoon with the maximum rainfall in July. The average rainfall within PTR is 2500 mm with average humidity varying between 60-85%. The temperatures vary between 15°C and 31°C (KFD 2003).

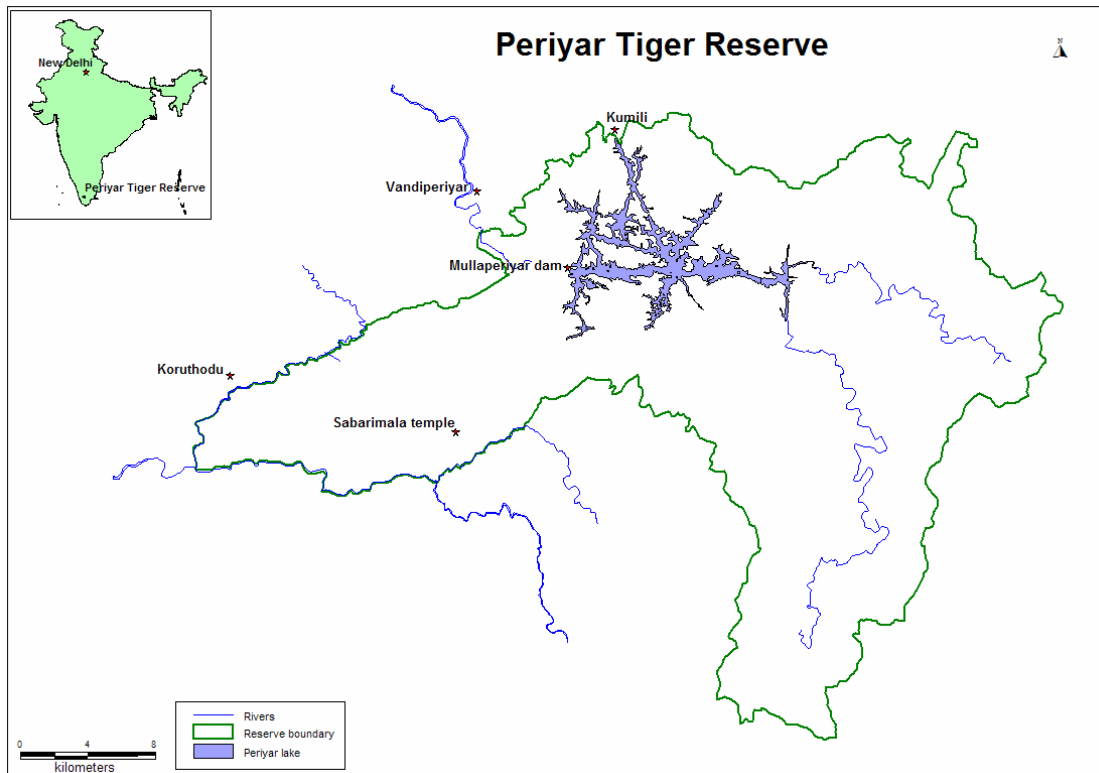


Figure 2.1: Periyar Tiger Reserve and its location within India

2.5 Biological importance

2.5.1 Flora and vegetational characteristics⁴

A total of 1965 species of flowering plants, from 823 genera and 159 families, have been documented in PTR (Sasidharan 1998), and 26% of these species are endemic to the Western Ghats. The main forest types in PTR are tropical evergreen and semi-evergreen (74.6%) and moist deciduous forests (12.7%). Eucalyptus *Eucalyptus grandis* plantations occupy about 7.1% and the Periyar Lake, a man-made reservoir built in 1895, forms 3.5% of PTR area.

2.5.2 Fauna⁵

PTR supports a high animal diversity with 63 species of mammals, 323 species of avifauna, 72 species of herpetofauna, 38 species of fishes and 119 species of butterflies. PTR supports some globally threatened wildlife species, including the tiger *P. tigris tigris* (EN), Asiatic wild dog *C. alpinus* (EN), Indian elephant *E. maximus* (EN), lion-tailed macaque *M. silenus* (EN), Nilgiri tahr *H. hylocrius* (EN), Salim Ali's fruit bat *Latidens salimalii* (EN), slender loris *Loris tardigradus* (EN), great hornbill *B. bicornis* (EN) and king cobra *Ophiophagus hannah* (EN) (IUCN 2006).

⁴ Information on vegetation and floral species of PTR was extracted from KFD 2001 and KFD 2003a.

⁵ Information on the faunal species of PTR was extracted from KFD 2001 and KFD 2003a

2.6 Ecological value

PTR acts as a catchment for the Mullayar, Periyar, Pamba and Azutha rivers. The Mullayar and Periyar rivers join to become the Mullaperiyar River that has been dammed to form the Periyar Lake. The Periyar Lake irrigates about 680 sq km of agricultural land in Theni, Ramanad and Dindigul districts, lying within the neighbouring State of Tamilnadu (KFD 2003). Water from the Periyar Lake is also used for hydro-power generation in Tamilnadu.

2.7 Threats to PTR⁶

PTR has a human population of 225,000 living within 2 km from the radius of the reserve who either partially or completely depend on its natural resources (World Bank 1996; KFD 2003a; Sharma *et al.*, 2004). This high human density has put severe pressures on PTR and some of the important threats to PTR's natural resources and biodiversity are listed below

2.7.1 Tourism and pilgrimage

Nearly 400,000 tourists visit PTR annually (KFD 2001; KFD 2003a) leading to extensive direct and indirect pressures on PTR. The Ayyappa temple at Sabarimala situated in the south west part of PTR attracts about 5 million pilgrims annually (KFD 2001; KFD 2003a; Sharma *et al.*, 2004). This pilgrimage poses a serious threat on PTR's resources in terms of timber and fuelwood. Fire and litter disposed by pilgrims are serious consequences of this high-volume pilgrimage.

2.7.2 Mullaperiyar dam

The lease for the Mullaperiyar dam, which was built prior to the declaration of the wildlife sanctuary, runs for a period of 999 years. The water level in the dam was set at 152 feet in the original lease agreement, but the water level is currently maintained at 136 feet, based on safety considerations. Nevertheless, the Tamilnadu government who maintain the dam have been trying to increase the water level to the originally prescribed level of 152 feet. However, any further increases in water level will submerge critical wildlife habitats, especially for the common otter *Lutra lutra* (NT) and smooth-coated otters *Lutrogale perspicillata* (VU) (IUCN 2006) and will pose threat to the only habitat of the endemic ground orchid *H. periyarensis* and to the endangered *Taeniophyllum scaberulum*, an orchid that was recently rediscovered after a gap of 140 years (KFD 2003a).

2.7.3 Non-Timber Forest Products (NTFP)

NTFP's harvested across PTR for commercial and subsistence purposes include: black damar *Canarium strictum*, nutmeg *Myristica* spp., giant honey *Apis dorsata*, Asiatic honey *Apis cerana indica*, cinnamon *Cinnamomum malabatrum*, reed bamboo *Ochlandra travancorica*, thatching grass *Amaranthus spinosus* and *Themida cymbaria*, and mahsheer *Tor khudree* (Appendix 1).

⁶ Threats have been described and prioritised based on KFD 2001, KFD 2003a and on the authors' observations in the field during this study.

2.7.4 Poaching

Several wildlife species are hunted for both local meat consumption and commercial trade, including: wild boar *Sus scrofa*, sambar *Cervus unicolor*, gaur *Bos gaurus*, mouse deer *Moschiola meminna*, Indian giant squirrel *Ratufa indica indica*, Indian flying squirrel *Petaurista philippensis*, black-naped hare *Lepus nigricollis*, common monitor *Varanus bengalensis* and grey jungle fowl *Gallus sonneratii* (Appendix 2). Poaching of herbivores could be a limiting factor for the predator density of PTR. The main hunting methods used are scavenging wild dog kills, guns, snares and hunting dogs.

2.7.5 Timber smuggling

Illegal felling of timber both for local consumption and commercial trade poses a threat to the northern and south-western parts of PTR. Commercially viable, but threatened, tree species are illegally felled, including sandal *Santalum album* (VU), Indian rose wood *Dalbergia latifolia* (VU) and teak *Tectona grandis*. Species such as *Allophylus cobbe*, *Macaranga peltata* are extensively extracted as poles. Large-scale felling of timber in the south-western part of PTR increases during the Sabarimala pilgrimage season from November - February.

2.7.6 Livestock grazing

Livestock grazing is observed in all areas of PTR except where the terrain is inaccessible. Disease transmission from domestic animals to wildlife, such as foot-and-mouth disease is recorded and has resulted in the death of wildlife. It is estimated that over 2000 domestic livestock graze in the tourism zone alone (KFD 2003) and grazing competition with livestock could consequently be a limiting factor for wild herbivore densities.

2.7.7 Narcotic cultivation

Illegal cultivation of cannabis is carried out in some evergreen patches of PTR. Cultivation of cannabis involves forest clearance and these workers are often also involved in wildlife poaching.

2.7.8 Fire

Forest fires in PTR are mainly caused by human disturbances (KFD 2003a). The fires in natural grasslands have affected PTR's small population of Nilgiri tahr and have seriously impacted upon ground vegetation. Pilgrims are one of the main causes of fire in PTR.

Chapter 3

Methods



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Questionnaire surveys were administered to assess conservation attitudes and resource use

Methods

3.1 Questionnaire survey

Survey data were collected between May and July 2006 through questionnaires that were administered to IEDP and non-IEDP respondents, and that included a mixture of open and fixed response questions. Sampling was conducted at the household level, both because this constitutes the basic unit of shared economic production and resource utilisation within the study area, and because this was considered as the unit for EDC membership within the IEDP. The household head whether husband or wife was interviewed, based on their availability. If the interviewees were not available on a minimum of three repeated attempts, or because they had died or moved from the area, the next person on the members list of another household was selected to be interviewed.

A list of IEDP members who belonged to various EDCs was obtained from micro-plans that were developed during the IEDP. However two classes of EDCs were excluded from this study, as follows:

- households that were part of the pilgrim management, SAPP EDCs, because they were either members of other neighbourhood EDCs, or did not fall within 2 km of PTR, or did not depend on PTR resources;
- households exclusively formed for the staff of the Forest Department (Periyar Tiger Samrakshan and Vallakadavu Watchers EDC), both because their source of livelihood did not depend on PTR resources and they did not permanently reside either within or on the periphery of PTR, and because they were project administrators and beneficiaries and could express biases towards the project.

From those remaining on this list, a sample of 90 respondents was randomly chosen using PopTools ver 2.6.7 a free non-commercial MSExcel add-in (CSIRO, Canberra). This resulted in sampling household heads from 38.8% of the 72 EDCs that were established under the IEDP (Table 3.1), and 1.6% of 5,540 families covered under the IEDP. Hereafter, these respondents are termed as 'IEDP respondents'.

Table 3.1: Various eco-development committee categories sampled under this study

EDC category	Total No of EDCs	No of EDCs sampled	Percentage sampled
Professional EDCs	2	2	100
User group EDCs	3	3	100
Village EDCs	58	23	39.7
SAPP EDCs	6	0	0
Staff EDCs	3	0	0
Total	72	28	38.8

A random sample of 90 households that were not included in the IEDP was also selected to compare attitudes between IEDP beneficiaries and non-beneficiaries. These respondents were chosen through local contacts or based on the author's observations of their dependency on PTR. These households were opportunistically selected for interview, based on their dependence on PTR resources including NTFPs, timber, hunting, fuelwood, grazing, thatching grass for their livelihoods, additional income or subsistence. Hereafter, these respondents are termed as 'non-IEDP respondents'.

The locations of the houses of IEDP and non-IEDP respondents were recorded using a 12 XL Garmin global positioning system (Garmin Corp., Olathe, KS), as shown in Figure 3.1. Distances of their houses to the PTR boundary were extracted within the geographical information system MapInfo, using boundary data derived from Survey of India maps of 1:50,000 scale. Locations of NTFP harvest points were obtained from respondents and triangulated through other informants, through forest department sources, or based on field observations and plotted on toposheets. Maps were prepared using MapInfo Professional version 6.0.

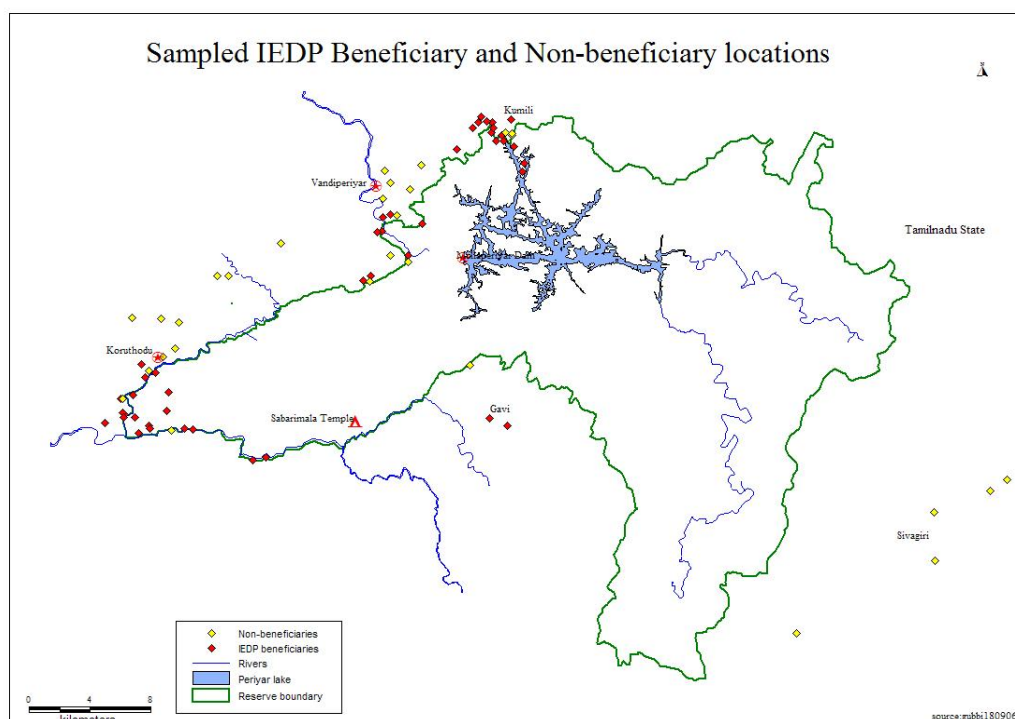


Figure 3.1: Locations of sampled India Eco-Development Project and non-India Eco-Development Project respondents

Prior to the administration of the questionnaires, the interviewees were informed of that the study was part of an academic research project from which no financial benefits would accrue, rather than a Kerala Forest Department or a conservation NGO project. All interviews were conducted with the full willingness of the respondents. The respondents were assured of anonymity in order to increase the

chances that respondents would give genuine answers (Henerson, Morris & Fitz-Gibbon 1987). Questionnaires were administered orally in local language *Malayalam* and in *Tamil* for those from the neighbouring state of Tamilnadu, with the help of an interpreter who was aware of conservation issues. Interviews took between 20 and 40 minutes. Some of the questions were indirectly repeated to triangulate responses.

Two questionnaires were designed, one for the IEDP and another for the non-IEDP respondents. The questionnaires contained many of the same questions to allow for direct comparisons. However, respective questionnaires also contained questions that were pertinent to whether or not a respondent participated in the IEDP (Appendix 3 and Appendix 4). For example, in place of questions in the IEDP section, non-IEDP respondents were asked about their willingness to participate in a project like the IEDP, the reasons, their requirements if a similar project was to be implemented, and their perceptions towards the IEDP.

A pilot study (n=10) was conducted to check for validity and clarity of the questions. Questions were modified and altered based on this pre-test before the final survey.

The questionnaire was divided into seven sections:

- Socio-economic and household demographics;
- Reasons for, and dependency on, PTR;
- Development tools and biodiversity conservation linkages;
- IEDP benefits and perceptions;
- IEDP and conservation education;
- Conservation attitudes; and
- Problems and solutions.

3.1.1. Socio-economic and household demographics

All respondents were asked a series of questions on household demographics and socio-economic information, including gender and age, origin, occupational details, land holding, systems of tenure and agricultural practises. The origin of respondents whose first language was not *Malayalam*, the local language, who or whose parents had migrated from other states, were categorised as migrants. All such respondents were of *Tamil* speaking origin. The ages of respondents were categorised as shown in Table 3.2 while their occupations were categorised as shown in Table 3.3.

Table 3.2: Categorisation of age groups of respondents

Category	Age group in years
1	18-25
2	26-35
3	36-45
4	46-55
5	56+

Table 3.3: Categorisation of occupations of respondents

Category	Occupations
Professionals	Timber smuggler, NTFP collector and hunter
User group	Fuelwood, thatching grass collector and traders/businessmen dealing with NTFP
Neighbourhood	Agriculturists, labour, private employees, house wife and business
Eco-tourism guides	Eco-tourist guides employed in EDCs formed under the IEDP

3.1.2 Dependency on PTR

Furthermore, all respondents were asked a series of questions to determine their extent of resource use in and dependency on PTR, the reasons for such dependency, types of dependency, NTFP species harvested, frequency and methods of harvest, and wildlife species hunted and methods of hunting. Field guides (Grimmet, Inskip & Inskip 2002; Prater 2005) with colour photographs were used to identify the wildlife species hunted.

3.2 Views on PTR**3.2.1 Why was PTR established?**

All respondents were asked 'why was PTR established'. These answers were categorised as being a 'correct' (coded as '1') or an 'incorrect' ('0') answer based on their match with the true reason for PTR establishment (KFD 2001, GOI 2005) which was for wildlife and habitat preservation, and especially for tigers and elephants.

3.2.2 Problems and solutions

All respondents were asked to rank the worst three problems they faced by living near PTR, although respondents could list less than three, and their proposed solutions to these problems.

3.2.3 Does PTR provide you any benefits?

The questionnaire survey also aimed to understand IEDP beneficiaries and non-beneficiaries knowledge about the tangible, intangible or aesthetic benefits they received from PTR. All respondents were asked if PTR provided them with any tangible, intangible or aesthetic benefits. Benefits received

from PTR were coded for statistical analysis as '0' for responses who said that they received no benefits from PTR and '1' for respondents who said that they received benefits from PTR.

3.3 Development tools and biodiversity conservation linkages

To assess whether beneficiaries understood the primary project objectives of the IEDP, two questions were administered to IEDP respondents only, to determine their understanding of the linkages with the socio-economic development tools used to achieve the conservation objectives of IEDP.

- Why were you given benefits under IEDP?
- What community benefit(s) has your EDC received and what is their utility and usage?

Responses to 'why were you given benefits under IEDP?' were categorised as 'correct' (coded as '1') and 'incorrect' (coded as '0') answers based on their match with the objectives of the IEDP (World Bank 1996). Responses that were not entirely correct, but still consistent with the IEDP objectives were also categorised as 'correct'.

Benefits received under the IEDP were placed in four categories: a 'household benefit' that was restricted to the household level; a 'community benefit' that was useful to the entire community; an 'access rights benefit' when access was granted to harvest natural resources from PTR; and an 'alternative livelihood benefit' when livelihood initiatives were supported under the IEDP (Table 3.4). Furthermore, IEDP respondents were asked to list all the community benefits received by their village/community under the IEDP. These benefits were further categorised as community utility benefits, crop protection benefits and income generation benefits (Table 3.5)

Table 3.4: Categorisation of benefits different received under the India Eco-Development Project

Category	Type of benefit
Household benefit	Micro-credit, LPG stove and cylinder
Community benefit	Community hall, crop damage prevention measures, drinking water well or storage tanks, awareness centre, EDC office building, solar street lighting, community income generation assets such as co-operative agricultural produce or milk marketing, provision stores, souvenir shops, solar light marketing, cardamom drying unit, bottle washing unit and shops to rent
Access rights benefit	Permission to collect fuelwood, thatching grass, NTFPs and grazing rights
Alternative livelihood	Eco-tourism guide, livestock, small business supported under the IEDP

Table 3.5: Further categorisation of various community benefits provided under the India Eco-Development Project

Community benefit category	Benefit type
Community utility benefits	Provision store Drinking water well or storage tank Solar street light EDC office building Awareness centre Community hall
Crop protection benefits	Barbed wire fencing Electric fencing Elephant proof trench
Income generation benefits	Souvenir shop Toilets for tourists Community milk co-operative store Community store for farm produce marketing Solar light marketing unit Shops to rent Cardamom drying unit Bottle washing unit

An attempt was made to triangulate the questionnaire survey responses and a field assessment of community benefits provided under the IEDP. Furthermore, this survey aimed to serve as an indicator of community participation in the longer-term, by gaining an idea of whether EDC members had managed and maintained community infrastructure provided under the IEDP project three years after the project had ended. In locations where IEDP respondents acknowledged having received community benefits (n=36), these benefits were visited to assess their usage and state of repair. Benefits such as electric fences, barbed wire fences and elephant proof trenches were surveyed by walking between 500-2000 metres along the infrastructure at various locations to assess their present usage (used, not used) and state of repair (maintained, not maintained). Some benefits where the questionnaire survey was not administered were also opportunistically visited (n=11) to make similar assessments.

3.3.1 Perceptions of IEDP respondents towards the IEDP

Among IEDP respondents, an open-ended question about their perceptions towards the IEDP was categorised as being either positive (coded as '1') or negative ('0'). Respondents who did not have an opinion towards the IEDP (n=2) due to a lack of knowledge about the IEDP were excluded from this analysis.

3.3.2 Willingness of non-IEDP respondents to participate in an ICDP

Non-IEDP respondents were asked about their willingness to participate in a project like the IEDP, the reasons, their requirements if a similar project was to be implemented, and their perceptions towards the IEDP.

3.3.3 Perceptions of non-IEDP respondents towards the IEDP

Among non-IEDP respondents, an open-ended question about their perceptions towards the IEDP was categorised as being either positive or negative.

3.3.4 Conservation attitudes

All respondents were presented with four positive and four negative statements about natural resource or species conservation in PTR (Table 3.6). The respondents were asked whether they ‘agreed’, ‘disagreed’ or ‘do not know’. Agreeing to: a positive statement received +1 point; agreeing to a negative statement received -1 point; and, vice versa for disagreeing to these statements. A ‘do not know’ to either type of statement received zero points. The points from these eight questions were then totalled into a single additive score termed as ‘conservation attitude score’. Thus, the most positive conservation attitude score was +8 points, whereas the most negative conservation attitude was -8 points.

Table 3.6: Fixed response statements to assess conservation attitudes

Statement	Yes	No	Don't know
It is important to protect wildlife inside PTR ⁺			
PTR is important for my children ⁺			
People should be allowed to graze livestock inside PTR ⁻			
PTR should be abolished ⁻			
People should not be allowed to hunt wild animals for food inside PTR ⁺			
Wild animals from PTR that cause crop-damage should be exterminated ⁻			
Wild animals from PTR are important as a source of tourism revenue ⁺			
People should be allowed to carry out agriculture inside PTR ⁻			

⁺ = positive statement

⁻ = negative statement

3.4 Statistical analysis

The data were imported to SPSS version 14.0 statistical software (SPSS Inc., Chicago) to determine effects of different explanatory variables in determining responses.

3.4.1 Views on PTR

3.4.1.1 Why was PTR established?

Preliminary bivariate tests were conducted separately to compare the responses of the beneficiaries with a range of explanatory variables, comprising: i) gender; ii) origin of the respondent, whether local or migrant; iii) age category (Table 3.2); iv) level of formal education; v) current occupation (Table 3.3); vi) occupational dependency on PTR; vii) whether that occupation was legal or illegal; viii) whether or not possessed agricultural land; ix) distance of the respondents house to PTR boundary; x) whether or not affected by human-wildlife conflict; and xi) whether IEDP beneficiary and non-beneficiary.

A binary logistic regression analysis was then performed to determine which explanatory variables best explained whether the respondents answer was consistent with the true reason for PTR establishment. The performance of the model was evaluated by calculating the area under the curve (AUC) of the receiver operating characteristics plot (Manel, Williams & Ormerod 1999; Pearce and Ferrier 2000; Osbourne, Alonso & Bryant 2001). These values range from 0.5 to 1.0, and those above 0.7 indicate an accurate model fit, while those above 0.9 indicate a highly accurate model (Swets 1988).

3.4.1.2 Does PTR provide you any benefits?

Responses under this category were divided as 'yes' (coded as '1') and 'no' ('0') answers. Preliminary bivariate tests were conducted separately to compare the responses of the beneficiaries with a range of explanatory variables, comprising: i) gender; ii) origin of the respondent, whether local or migrant; iii) age category (Table 3.2); iv) level of formal education; v) current occupation (Table 3.3); vi) occupational dependency on PTR; vii) whether that occupation was legal or illegal; viii) whether or not possessed agricultural land; ix) distance of the respondents house to PTR boundary; x) whether or not affected by human-wildlife conflict; and xi) whether IEDP beneficiary and non-beneficiary.

A binary logistic regression analysis was then performed to determine which explanatory variables best explained the respondents understanding of receiving benefits from PTR. The performance of the model was evaluated by calculating the area under the curve (AUC) of the receiver operating characteristics plot.

3.5 Development tools and biodiversity conservation linkages

3.5.1 Why were you given benefits under IEDP?

Preliminary bivariate tests were conducted separately to compare the responses of the beneficiaries with a range of explanatory variables, comprising: i) gender; ii) origin of the respondent, whether local or migrant; iii) age category (Table 3.2); iv) level of formal education; v) current occupation (Table

3.3); vi) occupational dependency on PTR; vii) whether or not possessed agricultural land; viii) distance of the respondents house to PTR boundary; ix) whether or not affected by human-wildlife conflict; x) office bearer of EDC or not; xi) household benefit received; xii) community benefit received; xiii) received access rights benefits to PTR resources; and xiv) alternative livelihood provided under the IEDP were compared with respondents understanding of the IEDP objectives.

A binary logistic regression analysis was then performed to determine which explanatory variables best explained whether the respondents answer was consistent with original objectives of the IEDP. The performance of the model was evaluated by calculating the area under the curve (AUC) of the receiver operating characteristics plot.

3.5.2 Perception of IEDP respondents towards the IEDP

Preliminary bivariate tests were conducted separately to compare the responses of the beneficiaries with a range of explanatory variables, comprising: i) gender; ii) origin of the respondent, whether local or migrant; iii) age category (Table 3.2); iv) level of formal education; v) current occupation (Table 3.3); vi) occupational dependency on PTR; vii) whether or not possessed agricultural land; viii) distance of the respondents house to PTR boundary; ix) whether or not affected by human-wildlife conflict; x) benefits (tangible, intangible, aesthetic) derived from PTR; xi) office bearer of EDC or not; xii) household benefit received; xiii) community benefit received; xiv) received access rights to PTR resources; xv) alternative livelihood provided under the IEDP; and xvi) the total number of benefits received by the beneficiary under the IEDP were compared with respondents perceptions towards the IEDP.

A binary logistic regression analysis was then performed to determine which explanatory variables best explained the respondents' perceptions towards the IEDP. The performance of the model was evaluated by calculating the area under the curve (AUC) of the receiver operating characteristics plot.

3.5.3 Conservation attitude score

The conservation attitude scores of respondents were imported to SPSS version 14.0 statistical software (SPSS Inc., Chicago) to determine the effect of different explanatory variables in determining these scores. None of the datasets was normally distributed, so non-parametric statistical tests were chosen for subsequent analyses.

Preliminary bivariate tests were conducted separately to compare the conservation attitude scores with a range of explanatory variables comprising: i) gender; ii) origin of the respondent, whether local or migrant; iii) age category (Table 3.2); iv) level of formal education; v) current occupation (Table 3.3); vi) occupational dependency on PTR; vii) whether the occupation was legal or illegal; viii) personal experience of hunting wildlife in PTR; ix) whether or not possessed agricultural land; x) distance of the respondents house to PTR boundary; xi) whether or not affected by human-wildlife conflict; xii) whether or not experienced conflicts with Forest Department; xiii) benefits (tangible, intangible, aesthetic) derived from PTR; and xiv) whether IEDP beneficiary and non-beneficiary.

Positive (0 to +8) and negative (-1 to -8) conservation attitude scores were recoded either as '1' or '0', respectively. This produced two disparate groups, with 32 samples receiving '0' and '148 samples receiving '1'. Therefore, to compare an equal number of samples between the two groups, the conservation attitude scores of all respondents were ranked and the middle scores (+3 and +4) removed, leaving 67 samples from the most positive respondents (mean score = 6.52, S.D. = 1.09) and 67 samples from the most negative respondents (mean score = 0.14, S.D. = 2.06). A binary logistic regression analysis was then performed to determine which socio-economic variables explained whether a respondent held a positive or negative conservation attitude score. The addition and removal of independent variables from the regression model was controlled by the Wald statistic with respective *P*-values of 0.05 and 0.1. The performance of the model was evaluated by calculating the area under the curve (AUC) of the receiver operating characteristics plot.

Chapter 4

Results



©Killi Vallavan

Semi-evergreen forests on the shores of the Periyar Lake

Results

4.1 Response rate

There was a very high (98.39%) response rate to the questionnaire survey. A total of 187 people were contacted for questionnaire survey, and only four people declined to take part in the survey, and of the remaining 184 questionnaires four were not used due to incomplete data forms.

4.2 Socio-economic and household demographics

Demographic and socio-economic profiles of respondents were analysed separately for 90 IEDP, and 90 non-IEDP, respondents. Of the IEDP respondents, 36.6% were female and 63.3% were male, while 28.8% of non-IEDP respondents were female and 71.1% were male. Almost all IEDP respondents were locals (91.1%) while 48.8% of non-IEDP respondents were migrants (Figure 4.1), either having migrated from the neighbouring State of Tamilnadu (n=46) or from Sri Lanka (n=8).

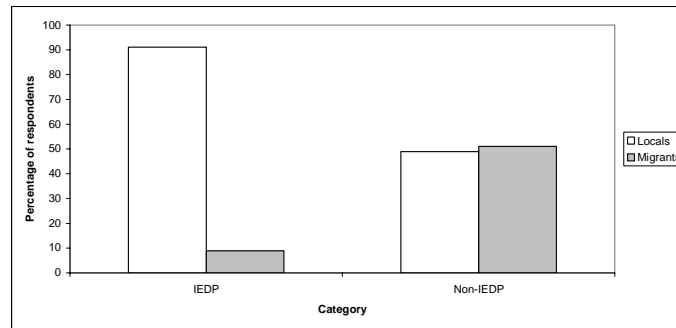


Figure 4.1: Origin of respondents

The average age of IEDP respondents was 44.22 years (range 25 to 85, SD =12.48), while the average age of non-IEDP respondents was 41.93 years (range 18 to 70, SD = 11.69) (Figure 4.2).

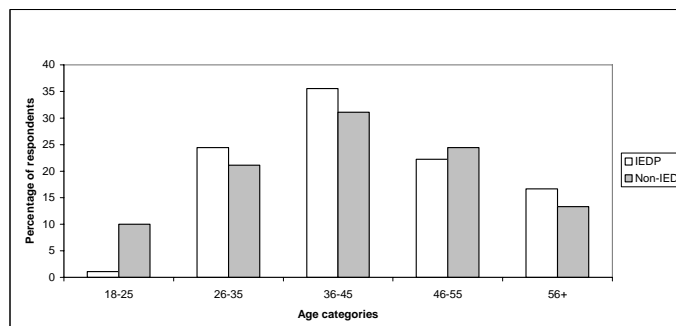


Figure 4.2: Age categories of respondents

Almost all IEDP respondents had attained some level of formal education (89.9%) but very few (8.8%) had attained beyond high school (Figure 4.3). Many (68.8%) of non-IEDP respondents had formal education, but only 1.1% had reached beyond high school (Figure 4.3).

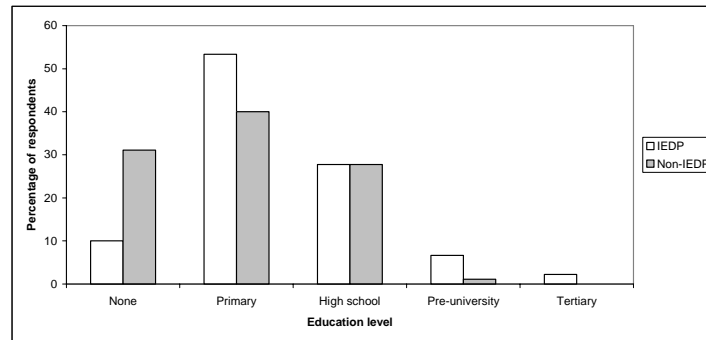


Figure 4.3: Highest level of formal education among respondents

The average household size among the IEDP respondents was 4.6 people (range 1 to 10, SD=1.47), while it was 4.5 people among non-IEDP respondents (range 1 to 9, SD=1.67) (Figure 4.4).

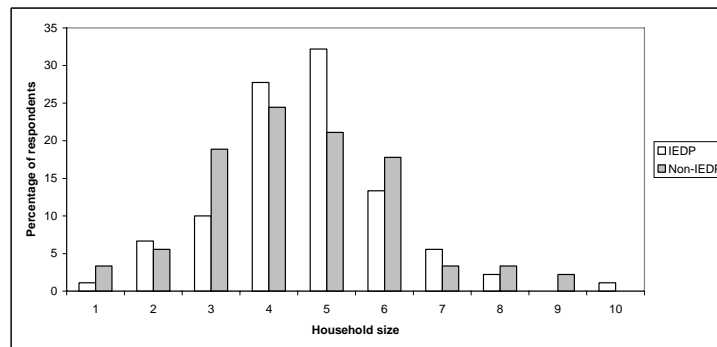


Figure 4.4: Household size of respondents

4.2.1 Occupations of respondents

Among IEDP respondents the major primary occupation was eco-tourism guide (33.3%), fuelwood collector (22.2%), agricultural labour (17.7%) and agriculture (15.5%) (Figure 4.5). Furthermore, many (64.4%) IEDP respondents had secondary occupations, while few (16.6%) had tertiary occupations. In contrast, among non-IEDP respondents, agricultural labour (40%) was the most important primary occupation, while NTFP collection (25.5%) and fuelwood collection (12.2%) were the other major occupations (Figure 4.6). A total of 47.7% and 7.7% of the non-IEDP respondents had secondary and tertiary occupations.

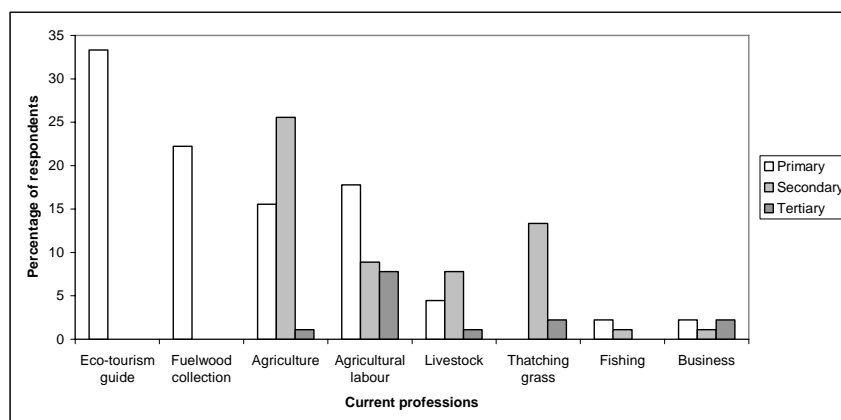


Figure 4.5: Occupations practised by India Eco-Development Project respondents, classified by their relative importance to respondents

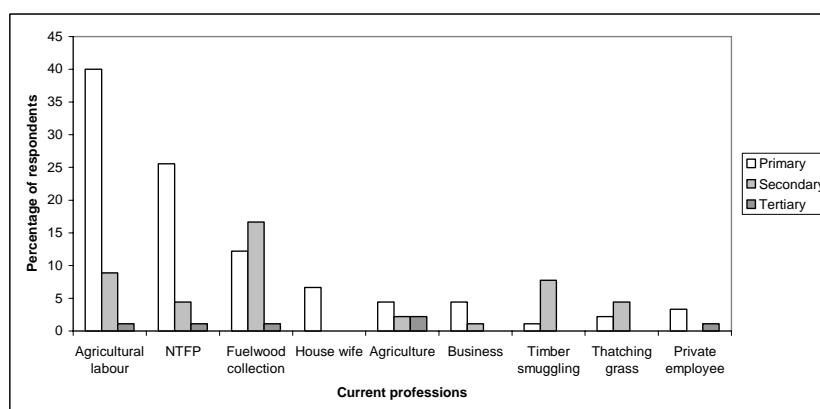


Figure 4.6: Occupations practised by non-beneficiaries of India Eco-Development Project respondents, classified by their relative importance to respondents

4.2.2 Land holding and agricultural crops

Many (57.7%) IEDP respondents owned agricultural land and 69.2% of the 52 respondents held this with land title while 30.7% had no land title (Figure 4.7). On average, these respondents held 0.71 acres (range 0.05 - 4.0 acres, SD = 0.89). In contrast few (20%) non-IEDP respondents owned agricultural land and 44.4% of the 18 respondents held this with land title while 55.5% had no land title (Figure 4.7). On average, these respondents held 1.65 acres (range 0.06 - 12.0 acres, SD = 2.92). Among IEDP respondents, 37.7% resided and carried out agriculture within PTR, while 20% carried out agriculture outside PTR.

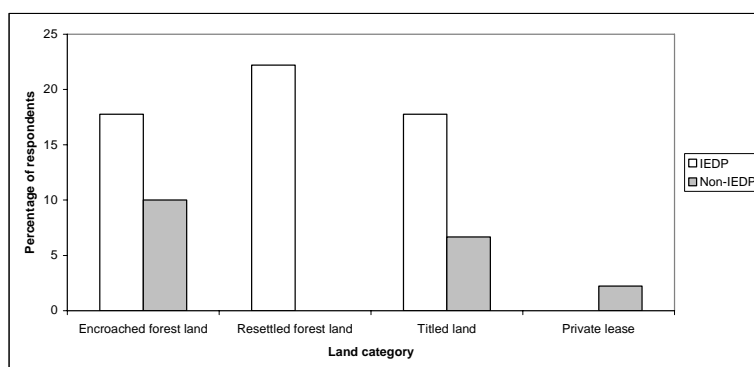


Figure 4.7: Land categories of India Eco-Development Project beneficiaries and non-beneficiaries of India Eco-Development Project respondents

Both IEDP and non-IEDP agricultural landholders cultivated crops for both commercial and subsistence purposes. The main commercial crops grown were pepper *Pipper nigrum* (64.2%), rubber *Hevea* spp. (34.2%), coffee *Coffea arabica*, *C. robusta* (31.4%), cocoa *Theobroma cacao* (21.4%) and plantain *Musa* spp. (20%) (Figure 4.8). The main subsistence crops grown were tapioca *Manihot esculenta* (8.5%), yam *Dioscorea* spp. (7.1%) and beans *Phaseolus* spp. (4.2%).

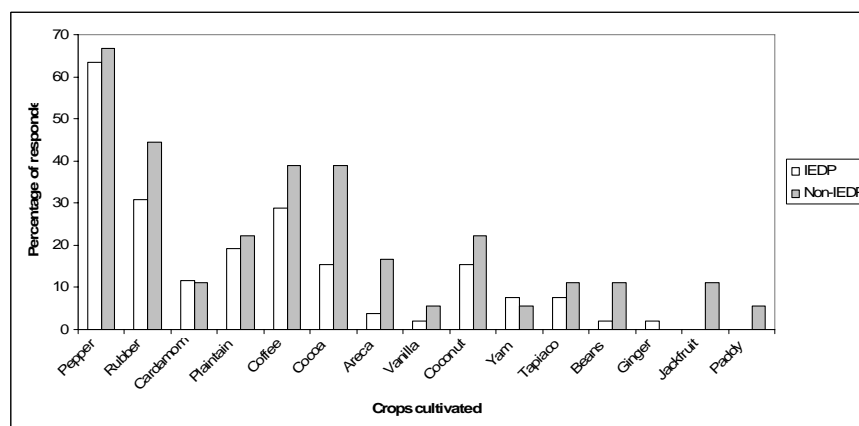


Figure 4.8: Agricultural crops cultivated by respondents

4.3 Dependency on PTR

Both IEDP and non-IEDP respondents were dependent on PTR for their livelihoods, additional income and subsistence use. Among IEDP respondents, a total of 82.2%, 32.2% and 13.3% of primary, secondary and tertiary occupations, respectively, were directly dependent on PTR. In contrast 41.1%, 34.4% and 3.3% of primary, secondary and tertiary occupations of the non-IEDP respondents, respectively, were directly dependent on PTR.

Since all the IEPD beneficiaries were issued verbal permits to harvest specific resources from PTR their occupations were all legal. In contrast, 70% of non-IEDP respondents were directly dependent on PTR for illegal activities, including timber smuggling, NTFP collection, fuelwood collection, thatching grass collection and hunting.

4.3.1 Use of non-timber forest produce

Both IEDP and non-IEDP respondents were heavily dependent on PTR for the harvest of NTFPs. Collectively, the IEDP and non-IEDP respondents reported, that they collected a combined total of 33 NTFP species for their livelihood or primary occupation, additional income and/or subsistence use (Appendix 3). Among IEDP respondents, thatching grass *A. spinosus* was the most commonly collected NTFP (64.7%). In contrast among the non-IEDP respondents, the resin black damar from the tree *C. strictum*, was the most commonly collected NTFP for use in varnish and perfume industry (52.5%). The average price earned and average quantity collected of some of the important NTFP species are shown in Table 4.1 and Table 4.2 respectively.

A total of 74 NTFP collectors spent an average of 7.5 days per trip on NTFP collection during their forays into PTR (range 1 to 20, SD=4.86). On average, these NTFP collectors travelled distance of 11.40 km per foray (range 0.48 to 38.11 km, SD=8.95) (Figure 4.9). However, the length of trip in part depended on the location of their houses. NTFP collectors coming from the neighbouring State of Tamilnadu devoted the most days per trip and covered the greatest distances (20 days, 38.11 km).

Table 4.1: Average price of non-timber forest produce earned by collectors for produce of good quality

Species	Price/kg in US \$
Black damar	0.90
Cardamom	5.45
Nutmeg	2.79
Giant honey	0.97/L
Asiatic honey	4.09/L
Malabar tamarind	0.61
Cinnamon	1.13
Indian gooseberry	0.09
Pepper	0.34
Thatching grass	1.59/100 stalks
Reed bamboo	1.13/100 reeds
Soapnut	0.22
Inja	0.22
Ginger	0.22

Table 4.2: Average quantity of different non-timber forest produce species collected per trip by collectors

Species	Average quantity collected/collection trip
Black damar	27 kg
Cardamom	6.2 kg
Nutmeg	9.5 kg
Giant honey	8.75 L
Asiatic honey	5 L
Malabar tamarind	15 kg
Cinnamon	40 kg
Indian goose berry	30 kg
Pepper	7.5 kg
Thatching grass	150 stalks
Bamboo reed	100 reeds
Soapnut	7.5 kg
Inja	5 kg
Ginger	7.5 kg

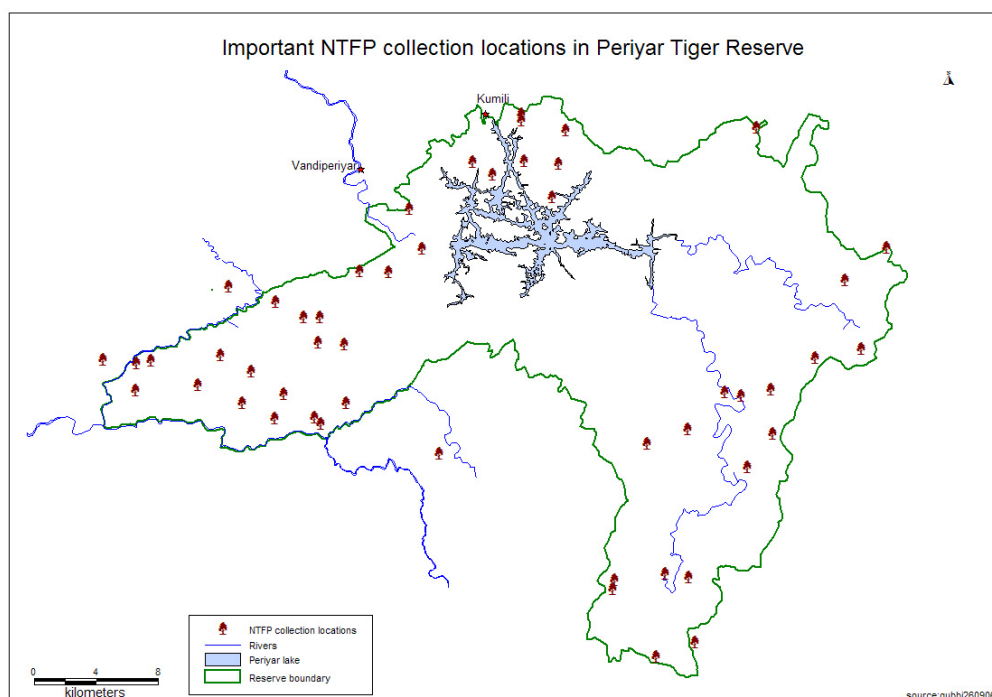


Figure 4.9: Important collection locations of non-timber forest produce in Periyar Tiger Reserve as reported by questionnaire survey respondents and triangulated by forest department sources and field observations

4.3.2 Hunting and methods

Among IEDP respondents, 35.5% admitted to having hunted in the past, while 15.6% had picked eggs from bird nests and 1.1% had picked chicks from the nests. In contrast, among non-IEDP respondents, 25.6% admitted to having hunted, but none admitted to having picked eggs or chicks.

At least eighteen species of mammals, four species of birds, and two species of reptiles (Appendix 4) were reported as having been hunted, mostly for local consumption and local meat sales. One respondent admitted to having paid somebody to hunt one leopard (*Panthera pardus*) and one elephant (*E. maximus*) for trade. Wild boar (*S. scrofa*) were hunted for local consumption and as a guarding strategy to reduce this species of crop pest.

Malabar parakeet (*Psittacula columboides*), blossom headed parakeet (*Psittacula roseate*), hill myna (*Gracula religiosa*), common myna (*Acridotheres tristis*), barbets (*Megalaima* spp.), sunbirds (*Nectarinia* spp.) and bulbuls (*Pycnonotus* spp.) were caught as pets.

Collectively, both IEDP and non-IEDP respondents reported 20 different hunting methods (Appendix 4). Among the IEDP respondents, scavenging wild dog (*C. alpinus*) kills was the most (40.6%) common way to obtain wild meat, followed by the use of guns (37.5%) and snares (21.8%). In contrast, among the non-IEDP respondents, the use of hunting dogs (47.6%), snares (42.8%) and guns

(23.8%) were the most common methods of obtaining wild meat. Some methods, such as hunting dogs, snares, guns and catapults were used to hunt a variety of species, while some methods were very species-specific. For examples, thorns were specifically used to catch Indian flying fox (*Pteropus giganteus*), while Nilgiri tahr (*H. hylocrius*) were circled and scared down a cliff to fall to their death.

4.4 Views on PTR

4.4.1 Why was PTR established?

Among IEDP respondents, 49.9% correctly stated why PTR was established, while 32.2% did not know and the remaining 17.8% were incorrect. Among those 16 respondents who were incorrect 75% thought it was established for tourism purposes, while other less common responses included 'to support local economy', 'to help the rich', 'to support local people' and 'for forest department'.

Among non-IEDP respondents, 28.8% correctly stated why PTR was established, while 45.5% did not know and the remaining 25.6% were incorrect. Among those 23 respondents who were incorrect 47.8% thought it was established for tourism purposes, while other less common responses included 'to protect sandalwood', 'to support local people', 'for forest department' and 'to support local economy'.

When considered singly, the understanding of reasons for establishment of PTR was affected by a range of explanatory variables, including education (Kruskal-Wallis $\chi^2=9.042$, $df=2$, $P=0.011$), occupation (Kruskal-Wallis $\chi^2=18.966$, $df=3$, $P<0.001$) and distance to PTR boundary (Table 4.3).

A comparison of the effect of different levels of education on the understanding of reasons for establishment of PTR showed a difference between having no education and a high school and above level of education, but no difference between having no education and primary level of education. Therefore the education variable was recoded to include those respondents who had received no education or a primary level of education (0), and those who had received a high school and above level of education (1). A comparison of effect of different occupations on the understanding of reasons for establishment of PTR showed a difference between professional groups with eco-tourism guides, user groups with eco-tourism guides and neighbourhood groups with eco-tourism guides. Therefore different occupations remained separately coded in subsequent analyses. Overall, respondents appeared more likely to have a correct reason for why PTR was established if they were male, of local origin, had high school and above level of education, were from user groups, neighbourhood groups, eco-tourism guides, possessed agricultural land, carried out legal occupations within PTR, living closer to PTR boundary, had not been affected by human-wildlife conflicts and were IEDP beneficiaries.

Table 4.3: Comparison of reasons given by respondents about establishment of Periyar Tiger Reserve with a range of explanatory variables, each tested singly with a Mann-Whitney *U* test and Kruskal-Wallis test

Variable	Mann-Whitney <i>U</i>	<i>Z</i>	<i>P</i>
Gender	2525.5	-3.749	<0.001
Origin	2627.5	-2.730	0.006
Education			
No education vs. primary	1279.5	-1.884	0.060
No education vs. high school	754.0	-2.987	0.003
Primary vs. high school	2149.5	-1.564	0.118
Occupation			
Professionals vs. user groups	358.5	-0.795	0.427
Professionals vs. neighbourhood	928.5	-1.540	0.123
Professionals vs. eco-tourism guides	171.0	-3.798	<0.001
User vs. neighbourhood	1422.0	-0.752	0.452
User vs. eco-tourism guides	282.0	-3.385	0.001
Neighbourhood vs. eco-tourism guides	897.0	-3.396	0.001
Occupational dependency on PTR	3708.0	-0.189	0.850
Legality of occupation	3037.5	-2.290	0.022
Agricultural land holding	2860.0	-3.423	0.001
Distance to PTR boundary	3108.5	-2.463	0.014
Human-wildlife conflicts	2970.0	-2.253	0.001
IEDP beneficiary or non-beneficiary	3150.0	-3.304	0.002
	χ^2	d.f.	<i>P</i>
Age	6.985	4	0.137
Education	9.042	2	0.011
Occupation	18.966	3	<0.001

When considered in combination, the understanding of respondents about establishment of PTR were best explained by three explanatory variables, comprising gender, origin and IEDP beneficiary status. (Table 4.4, Figures 4.10, 4.11, 4.12), but with no effect from education, occupation, legality of occupation, agricultural land holding, distance to PTR boundary and human-wildlife conflicts. Respondents with a better understanding about why PTR was established tended to be males, locals and IEDP beneficiaries. The final regression model explained 70.0% of the original observations and had an AUC value of 0.728 indicating an accurate fit of the model.

Table 4.4: Best logistic regression model explaining the relationship between respondents understanding of establishment of Periyar Tiger Reserve and a combination of explanatory variables among communities in and around Periyar Tiger Reserve

Variable	Coefficient(β) \pm S.E.	Wald	df	P
Gender				
Female	(included in constant)			
Male	1.664 \pm 0.398	17.480	1	<0.001
Origin				
Local	(included in constant)			
Migrant	-0.910 \pm 0.422	4.652	1	0.031
Beneficiary status				
IEDP beneficiary	(included in constant)			
Non-IEDP	-0.839 \pm 0.368	5.214	1	0.022
Constant	-0.939 \pm 0.345	7.413	1	0.006

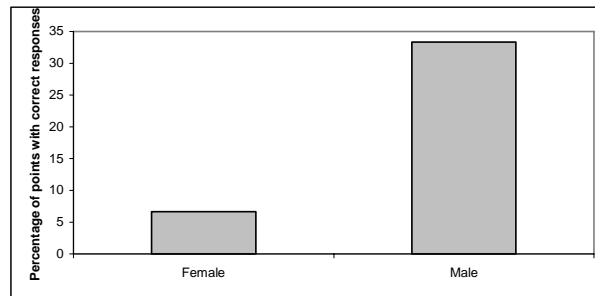


Figure 4.10: Percentage of points found within respondents who correctly identified the reasons for the establishment of Periyar Tiger Reserve and their gender

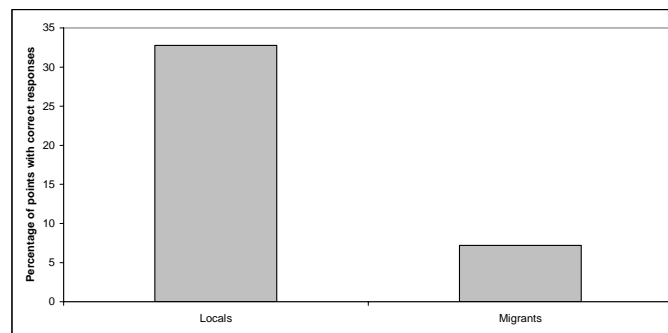


Figure 4.11: Percentage of points found within respondents who correctly identified the reasons for the establishment of Periyar Tiger Reserve and whether they are local or not

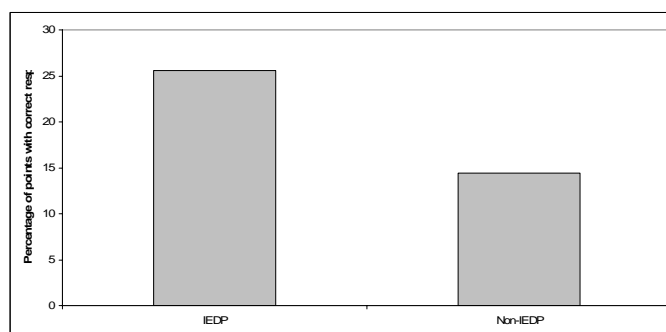


Figure 4.12: Percentage of points found within respondents who correctly identified the reason for the establishment of Periyar Tiger Reserve and whether India Eco-Development Project beneficiaries or non-beneficiaries

4.4.2 Problems and solutions living near PTR

Among IEDP respondents nearly half (45.5%) stated that they did not face any problems living next to PTR. Of the 49 respondents who faced problems, most (75.5%) stated crop damage by wildlife as the primary problem they faced living next to PTR, while other less common problems included fear of elephants (8.1%) and lack of basic amenities (6.1%).

Among the non-IEDP respondents over half (54.5%) stated that they did not face any problems living next to PTR. Of the 41 respondents who faced problems, crop damage by wildlife (34.9%), restricted access to natural resources (30.2%) and conflicts with the Forest Department (23.2%) were the main problems they faced living next to PTR.

Among the problem animals, the respondents prioritised wild boar *S.scrofa* as the most destructive primary crop raiding pest (79.1%), followed by elephant *E.maximus* (8.3%) and bonnet macaque *M. radiata* (6.25%) (Figure 4.13). The secondary destructive crop raiding pests were Sambar *C. unicolor* (25.0%), elephant (14.5%) and then wild boar (14.5%). Of the 52 respondents who faced crop raiding as a problem 26.8% suggested electric fence, 15.3% suggested electric fence and trench and 11.5% suggested trenches to mitigate crop raiding problems. Among the 15 respondents who cited restricted access to PTR as the main problem, 62.5% suggested that they should be allowed to harvest natural resources from PTR.

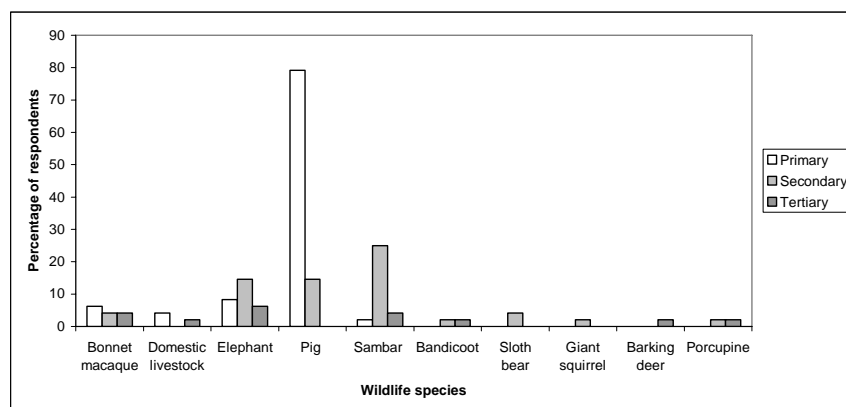


Figure 4.13: Wildlife species causing crop damage in and around Periyar Tiger Reserve as reported by respondents.

4.4.3 Does PTR provide you any benefits?

Among IEDP respondents, 65.9% said that they had received no benefits from PTR, while the remaining 34.1% acknowledged that they had (Figure 4.14). In contrast, among non-IEDP respondents, 64.4% said that they received benefits from PTR, while the remaining 35.6% said that they had no benefits.

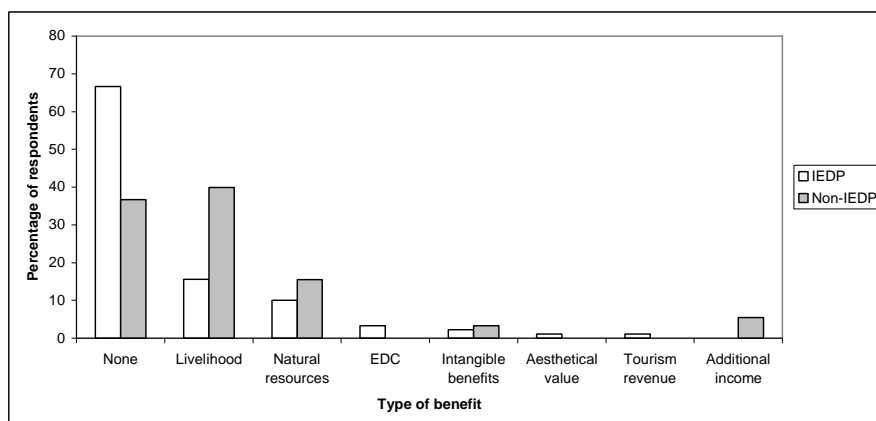


Figure 4.14: Type of benefits respondents received from Periyar Tiger Reserve

When considering singly, the responses about deriving benefits from PTR was affected by a range of explanatory variables, including origin, occupation (Kruskal-Wallis $\chi^2=12.059$, $df=3$, $P=0.007$), occupational dependency on PTR, legality of occupation, distance from PTR boundary and being IEDP beneficiary or non-beneficiary (Table 4.5).

A comparison of the effect of different occupations on the responses about deriving benefits from PTR showed a difference between professional groups with neighbourhood groups, professional groups with eco-tourism guides and user groups with eco-tourism guides. Overall, respondents appeared more likely to derive benefits from PTR if they were migrants, were from professional, user and

neighbourhood groups, were dependent on PTR for occupation, carried out illegal occupation within PTR, lived closer to PTR boundary and were non-IEDP beneficiary (Table 4.5).

Table 4.5: Comparison of responses about deriving benefits from Periyar Tiger Reserve with a range of explanatory variables, each tested singly with a Mann-Whitney *U* test and Kruskal-Wallis test

Variable	Mann-Whitney <i>U</i>	<i>Z</i>	<i>P</i>
Gender	3254.0	-0.698	0.485
Origin	2529.5	-2.876	0.004
Occupation			
Professionals vs. user groups	339.0	-1.128	0.259
Professionals vs. neighbourhood	753.0	-2.694	0.007
Professionals vs. eco-tourism guides	210.0	-3.017	0.003
User vs. neighbourhood	1251.5	-1.633	0.102
User vs. eco-tourism guides	360.0	-2.147	0.032
Neighbourhood vs. eco-tourism guides	1220.0	-1.020	0.308
Occupational dependency on PTR	2968.0	-2.380	0.017
Legality of occupation	2211.5	-4.956	<0.001
Agricultural land holding	3329.0	-1.421	0.155
Distance to PTR boundary	2817.0	-3.373	0.001
Human-wildlife conflicts	3392.0	-0.526	0.599
IEDP beneficiary or non-beneficiary	2758.0	-4.038	<0.001
	χ^2	df	<i>P</i>
Age	9.287	4	0.054
Education	2.404	2	0.301

When considered in combination, the understanding of benefits derived from PTR were best explained by the explanatory variable, legality of occupation (Table 4.6, Figures 4.15), but with no effect from age, origin, occupation, occupational dependency on PTR, agricultural land holding, distance to PTR boundary, human-wildlife conflicts and being IEDP beneficiary or non-beneficiary. Respondents who stated that they received benefits from PTR were more likely to conduct illegal activities within PTR. The final regression model explained 68.0% of the original observations and had an AUC value of 0.678 that was close to an accurate fit.

Table 4.6: Best logistic regression model explaining the relationship between respondents deriving benefits from Periyar Tiger Reserve and of explanatory variables

Variable	Coefficient(β) \pm S.E.	Wald	df	P
Legality of occupation				
Illegal occupation	(included in constant)			
Legal occupation	-1.668 \pm 0.349	22.866	1	<0.001
Constant	1.078 \pm 0.289	13.869	1	<0.001

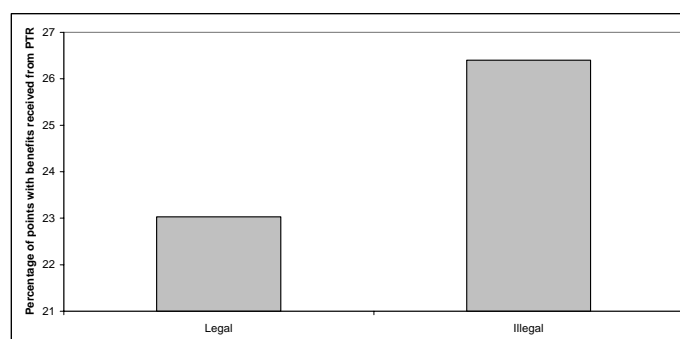


Figure 4.15: Percentage of points found within respondents deriving benefits from Periyar Tiger Reserve and whose occupations was legal or illegal within Periyar Tiger Reserve

4.5 Development tools and biodiversity conservation linkages

4.5.1 Why were you given benefits under IEDP?

Among IEDP respondents, 47.7% had received household benefits alone, 7.7% had received alternative livelihoods alone, 47.7% had received both household and alternative livelihood benefits, and 1.1% were unsure if they had received any benefits. Most (71.1%) IEDP respondents understood that they were given benefits to reduce negative impacts of local people on PTR.

When considered singly, the understanding among respondents of ‘Why were you given benefits under IEDP?’ was affected by a range of explanatory variables, including gender, education (Kruskal-Wallis $\chi^2=7.228$, $df=2$, $P=0.027$), occupation (Kruskal-Wallis $\chi^2=14.242$, $df=2$, $P=0.001$), occupational dependency on PTR and alternative livelihood provided under the IEDP (Table 4.7).

A comparison of the effect of different levels of education on understanding of reasons for having given benefits under the IEDP showed a difference between having a primary level and a high school level of education, but no difference between having no education and primary level of education. A comparison of effect between different occupations on the understanding of reasons for having received benefits under the IEDP showed a difference between user groups with eco-tourism guides and neighbourhood groups with eco-tourism guides. Overall, respondents appeared more likely to give a correct response to ‘why were IEDP benefits given?’ if they were male, had high school and above level of education, were eco-tourism guides, from user groups and neighbourhood groups, their

occupations were dependent on PTR, and were provided alternative livelihoods under the IEDP (Table 4.7).

Table 4.7: Comparison of respondents understanding of ‘Why were you given benefits under India Eco-Development Project?’ with a range of explanatory variables, each tested singly with a Mann-Whitney *U* test and Kruskal-Wallis test

Variable	Mann-Whitney <i>U</i>	<i>Z</i>	<i>P</i>
Gender	694.5	-2.624	0.009
Origin	252.0	-1.372	0.170
Education			
None vs. primary	201.0	-0.389	0.697
None vs. high school and above	100.5	-2.163	0.143
Primary vs. high school and above	591.0	-2.508	0.012
Occupation			
User vs. neighbourhood	363.0	-0.283	0.777
User vs. eco-tourism guides	174.0	-3.166	0.002
Neighbourhood vs. eco-tourism guides	381.0	-3.725	<0.001
Occupational dependency on PTR	781.5	-2.209	0.027
Agricultural land holding	899.0	-0.926	0.354
Distance to PTR boundary	812.0	-0.195	0.845
Human-wildlife conflicts	954.0	-0.596	0.551
EDC office bearer	575.0	-1.545	0.122
Household benefit received	165.0	-0.175	0.902
Community benefit received	969.0	-0.402	0.688
Access rights benefit to PTR resources	954.5	-0.189	0.850
Alternative livelihood received	774.0	-2.447	0.014
	χ^2	df	<i>P</i>
Age	8.965	4	0.062

When considered in combination, the understanding among respondents of ‘why were IEDP benefits given?’ were best explained by the explanatory variable, occupation (Table 4.8, Figure 4.16) but, with no effect from gender, formal education level, occupational dependency on PTR and alternative livelihood provided under the IEDP. Respondents with the best understanding of why they were given benefits under the IEDP tended to be working as eco-tourism guides. The final regression model explained 71.1% of the original observations and had an AUC value of 0.716, indicating an accurate fit of the model.

Table 4.8: Best logistic regression model explaining the relationship between respondents understanding of ‘Why were you given benefits under India Eco-Development Project?’, and a combination of explanatory variables

Variable	Coefficient(β) \pm S.E.	Wald	df	P
Occupation				
Eco-tourism guide	(included in constant)			
User	-2.915 \pm 1.126	6.701	1	0.010
Neighbourhood	-3.080 \pm 1.064	8.380	1	0.004
Constant	3.367 \pm 1.017	10.961	1	0.001

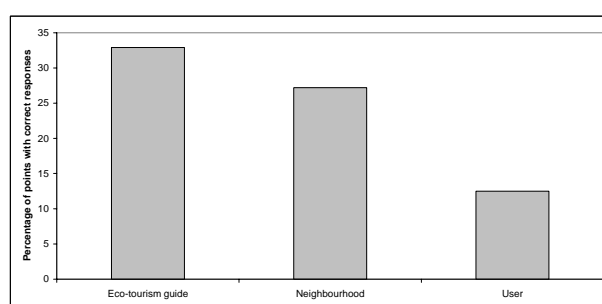


Figure 4.16: Percentage of points found within respondents who correctly identified the reason to ‘Why were you given benefits under India Eco-Development Project?’ and their occupations.

4.5.2 Liquefied Petroleum Gas and stove as household benefit

Among IEDP respondents, 26.6% had received a LPG cylinder and stove as an individual household benefit, either as an incentive or as a loan to reduce demand for fuelwood. Three to four years after receiving this benefit, only 41.6% of these 24 respondents were still using their LPG cylinder and stove regularly or occasionally, whilst the remaining 58.4% had stopped using this benefit as it was too expensive (58.3%), too difficult to transport (12.5%), fuelwood was too easily available in their estate (12.5%) or it was too difficult to use LPG (12.5%).

4.5.3 Usage of community benefits

Among IEDP respondents, nearly half (46.7%) were not aware of the type of community benefit that their community or village had received under the IEDP. Of the 48 respondents who were aware of the community benefit they had received, 37.7% said that they found the community benefit useful, whilst 10% did not find it useful and 5.6% had no opinion. Furthermore, among these 48 respondents, 43.9% often used the community benefit, 27.0% respondents used it occasionally, 16.6% rarely used it and 10.4% did not use it.

The community benefits introduced by the IEDP (n=47) were broadly classified as ‘community utility benefits’, ‘crop protection benefits’ and ‘income generating benefits’. Overall, the majority of these

benefits were not now used or maintained (66%). In particular, none of the crop protection benefits (n=18) were now being used or maintained. In contrast 50% of the community utility benefits (n=18) were still used and maintained, while many (63.6%) of the income generation benefits (n=11) were still used and maintained.

4.5.4 Perceptions of the IEDP respondents towards the IEDP

Among IEDP respondents, the great majority (97.7%) were aware of the project and of these 88 respondents, 42.2% held a positive perception towards the IEDP while 55.6% held a negative perception.

When considered singly, the perceptions towards the IEDP was affected by a range of explanatory variables, including distance to PTR boundary, human-wildlife conflicts and access rights to PTR resources (Table 4.9). Overall, respondents appeared more likely to have a positive perception towards the IEDP if they lived closer to PTR boundary, had not been affected by human-wildlife conflicts and did not have access right benefits to PTR natural resources.

Table 4.9: Comparison of respondent perceptions towards the India Eco-Development project with a range of explanatory variables, tested singly with a Mann-Whitney *U* test and Kruskal-Wallis test

Variable	Mann-Whitney <i>U</i>	<i>Z</i>	<i>P</i>
Gender	856.5	-0.275	0.783
Origin	296.0	-0.406	0.685
Agricultural land holding	836.0	-1.119	0.263
Access rights to PTR resources	596.0	-3.216	0.001
Occupational dependency on PTR	836.0	-1.119	0.263
Human-wildlife conflict	678.5	-2.812	0.005
Distance to PTR boundary	724.0	-1.977	0.048
Benefits derived from PTR	789.5	-0.396	0.692
EDC office bearer	576.0	-1.207	0.227
Household benefits received under IEDP	114.5	-0.348	0.778
Community benefits received under IEDP	948.0	-0.117	0.907
Alternative livelihood provided or not under the IEDP	916.0	-0.478	0.626
Number of benefits received under IEDP	942.5	-0.243	0.808
	χ^2	d.f.	<i>P</i>
Age	4.432	4	0.351
Education	0.015	2	0.993
Occupation	2.168	2	0.338

When considered in combination, the perceptions of respondents towards IEDP were best explained by two explanatory variables, comprising access rights benefit to PTR resources and whether or not respondents had been affected by human-wildlife conflicts (Table 4.10, Figures 4.17, 4.18), but with no effect from distance to PTR boundary. Respondents with a more positive perception towards the IEDP did not rely on access rights to PTR and to have not been affected by human-wildlife conflicts. The final regression model explained 69.3% of the original observations and had an AUC value of 0.747 indicating an accurate fit of the model.

Table 4.10: Best logistic regression model explaining the relationship between perceptions towards the India Eco-Development Project and a combination of explanatory variables among project beneficiaries in and around Periyar Tiger Reserve

Variable	Coefficient(β) \pm S.E.	Wald	df	P
Human-wildlife conflict				
Conflict	(included in constant)			
No conflicts	1.382 \pm 0.508	7.403	1	0.007
Access rights to PTR resources				
Access	(included in constant)			
No access	1.758 \pm 0.543	10.492	1	0.001
Constant	-1.509 \pm 0.427	12.473	1	<0.001

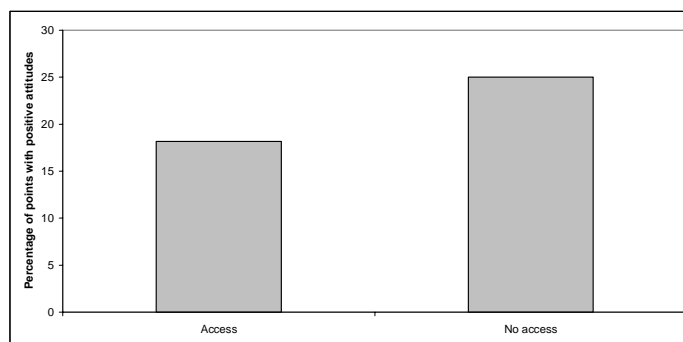


Figure 4.17: Percentage of points found within respondents who had a positive perception towards the India Eco-Development Project and their access rights to Periyar Tiger Reserve

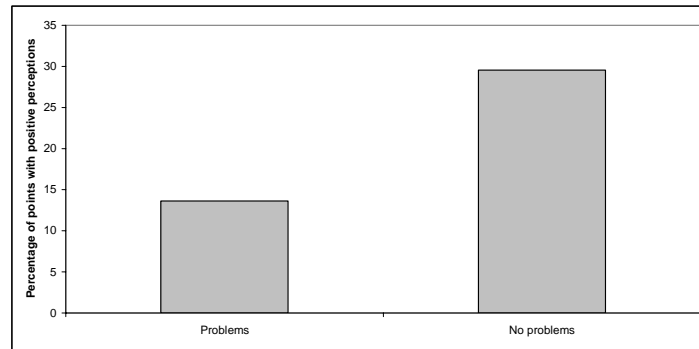


Figure 4.18: Percentage of points found within respondents who had a positive perception towards the India Eco-Development Project and their problems with wildlife

4.5.5 Willingness of non-IEDP respondents to participate in an ICDP

Among the non-IEDP respondents most (80%) were willing to participate in a similar project like the IEDP. Few (12.2%) were not willing and very few (7.7%) were unsure whether they wanted to participate or not. Some of the important reasons cited by respondents to participate in a similar project were to get alternative livelihood benefits (45.8%), to receive access rights benefits (33.3%) and household benefits (11.1%). Other less common reasons cited were ‘for conservation education’, ‘others have benefited’. In contrast, none of the respondents asked for community benefits. Of the 72 respondents who were willing to participate in a similar project as IEDP, most (62.5%) stated that they should be given benefits because they wanted alternative livelihoods, some (20.8%) stated as to reduce dependency on PTR, few (15.2%) were not sure why they should be given benefits. Other less common responses included ‘to reduce conflicts’ and ‘we will return loans given by the project’.

4.5.6 Perceptions of non-IEDP respondents towards the IEDP

Among non-IEDP respondents most (80%) were aware of the project and of these 72 respondents 25.5% held a positive perception towards the IEDP while 23.3% held a negative perception. In contrast, many (51.1%) did not have any perception towards the IEDP as they were not aware of the functioning of IEDP.

4.5.7 Conservation attitudes

When considered singly, the conservation attitude score of respondents was affected by a range of explanatory variables, including gender, education (Kruskal-Wallis $\chi^2=13.722$, $df=2$, $P=0.001$), occupation (Kruskal-Wallis $\chi^2=37.603$, $df=3$, $P<0.001$) and whether or not they had been affected by human-wildlife conflicts.

A comparison of the effect of different levels of education on the conservation attitude score showed a difference between having no education and a primary level or a high school level of education, but no difference between having primary level and high school level of education. Therefore, the education variable was recoded to include those respondents who had received no formal level education (0), and

those who had received primary or a high school level of education (1). A comparison of effect between different occupations on the conservation attitude score showed a difference between all the occupations, except user groups with neighbourhood groups. Therefore, different occupations remained separately coded in subsequent analyses. Overall, respondents appeared more likely to have a positive conservation attitude if they were male, had some level of formal education, were eco-tourism guides, user and neighbourhood groups, and had not been affected by human-wildlife conflicts (Table 4.11).

Table 4.11: Comparison of conservation attitude scores with a range of categorical variables, each tested singly with a Mann-Whitney *U* test, and of continuous variables each tested singly through Spearman's correlation

Variable	Mann-Whitney <i>U</i>	<i>Z</i>	<i>P</i>
Gender	2914.5	-2.011	0.044
Origin	3278.0	-2.77	0.782
Education			
None vs. primary	1070.0	-2.745	0.006
None vs. high school	581.5	-3.874	< 0.001
Primary vs. high school	2251.5	-0.936	0.349
Occupation			
Professionals vs. user groups	250.0	-2.394	0.017
Professionals vs. neighbourhood	806.5	-2.106	0.035
Professionals vs. eco-tourism guides	77.5	-4.970	< 0.001
User vs. neighbourhood	1373.0	-0.904	0.366
User vs. eco-tourism guides	238.5	-3.595	< 0.001
Neighbourhood vs. eco-tourism guides	471.5	-5.478	< 0.001
Agricultural land holding	3412.5	-1.294	0.196
Occupational dependency on PTR	3158.0	-1.807	0.071
Legality of the occupation	3168.5	-1.562	0.118
Personal experience of hunting wildlife in PTR	2965.0	-0.062	0.508
Human-wildlife conflicts	2505.0	-3.348	0.001
Conflict with Forest Department	773.0	-0.485	0.628
Benefits derived from PTR	3766.0	-0.569	0.569
IEDP beneficiary or non-beneficiary	3461.0	-1.698	0.089
	r²	correlation coefficient	<i>P</i>
Age	0.055	0.47	0.054
Distance to PTR boundary	<0.001	-0.47	0.531

When considered in combination, the conservation attitude scores of respondents were best explained by three explanatory variables, comprising education, occupation, and whether or not respondents had

been affected by human-wildlife conflicts (Table 4.12, Figures 4.19, 4.20, 4.21) with no effect from gender. Respondents with a more positive conservation attitude score tended to be working as eco-tourism guides, to have received formal education and to have not been affected by human-wildlife conflicts. The final regression model explained 82.8% of the original observations and had an AUC value of 0.883, indicating an accurate fit of the model.

Table 4.12: Best logistic regression model explaining the relationship between conservation attitude scores among communities in and around Periyar Tiger Reserve, and a combination of explanatory variables

Variable	Coefficient(β) \pm S.E.	Wald	df	P
Education				
Received education	(included in constant)			
No education	-2.053 \pm 0.602	11.642	1	0.001
Occupation				
Eco-tourism guide	(included in constant)			
Professionals	-5.366 \pm 1.310	16.778	1	<0.001
User	-4.243 \pm 1.227	11.970	1	0.001
Neighbourhood	-4.514 \pm 1.160	15.134	1	<0.001
Human-wildlife conflict				
Conflict	(included in constant)			
No conflicts	2.822 \pm 0.625	20.354	1	<0.001
Constant	2.552 \pm 1.037	6.058	1	0.014

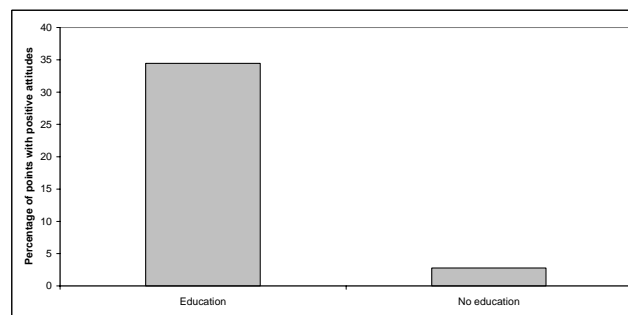


Figure 4.19: Percentage of points found within respondents who had or had not received any formal level of education.

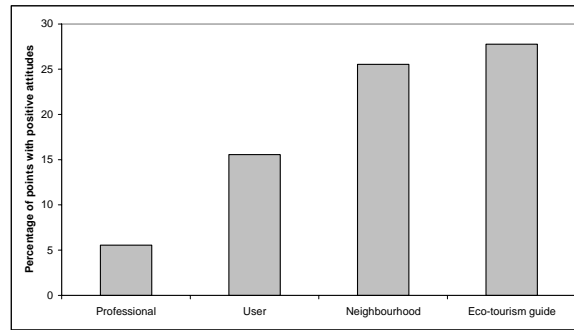


Figure 4.20: Percentage of points found within respondents who had a positive conservation attitude and their occupations

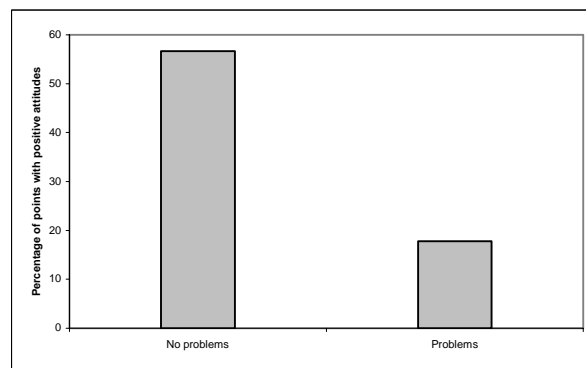


Figure 4.21: Percentage of points found within respondents who had a positive conservation attitude and whether they had experienced problems with wildlife

Chapter 5

Discussion



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Investments into community benefits need to be monitored over longer-term
to assess project success

5.1 Discussion

This study is one of the first to rigorously assess the impact of socio-economic measures taken under an ICDP, whether in India or elsewhere. The approach that has been taken comprises comparing the socio-economic benefits received by, and attitudes of, beneficiaries of the IEDP with non-beneficiaries. Most (71.1%) IEDP respondents understood that they had been given benefits to reduce negative impacts on PTR, thereby showing a very good understanding of project objectives. Nevertheless, local communities identified crop damage by wildlife as a key concern, yet while the IEDP had helped to set up mitigation strategies, these were not maintained. In this instance, the IEDP seemed to have been doing the right thing, but the community were uncommitted, so it may have been difficult for the IEDP to succeed regardless. Most critically, the results showed that whether or not a respondent was an IEDP beneficiary or non-beneficiary, did not influence their conservation attitude score. Other factors, such as being eco-tourism guides, level of formal education and being unaffected by human-wildlife conflicts were shown to be more important in shaping conservation attitudes. Therefore, it is recommended that future projects should focus more on these issues to increase their chances of success.

5.2 Possible limitations of this study

Time for the study was constrained to eight weeks, enabling only a limited sample of respondents. A larger sample size might have made the results more robust, although all the models in the analysis provided a good fit to the data. Possibly, the relatively small sample size might have given these encouraging results because the targeted population share relatively homogenous economic backgrounds, and are all from rural areas.

Importantly this study lacks any biological indicators to assess either the positive or negative impacts of the IEDP on PTR habitat or wildlife. Such indicators would be a very important tool in measuring the actual behaviours of IEDP beneficiaries, either as individuals or groups, towards conserving biological resources (see Chapter 6). Furthermore, an economic analysis of community benefits remains to be carried out, in order to assess the costs and benefits of the various community benefits that formed part of this project (also see Chapter 6).

5.3 Linkages to development tools and wildlife conservation

A common reason cited for failure of ICDPs is that the project objectives are poorly understood by the intended beneficiaries, either, because the linkages between incentives and conservation are weak or because the linkage is not properly explained (Sanjayan *et al.*, 1997). However, at PTR most (71.1%) beneficiaries were aware of IEDP objectives. The understanding of IEDP objectives was most strongly related to the respondents occupations, with eco-tourism guides having the best understanding of project objectives.

Eco-tourism was one initiative that was found to have succeeded under the IEDP. At PTR eco-tourism activity has provided a source of primary occupation for 43 households or about 0.8% of the 5,540

households targeted. Therefore any evaluation of success of eco-tourism activities within the context of IEDP at PTR based on eco-tourism activities should not be overstated (Bagla 2000, 2003; Kothari 2003; Kutty & Nair 2005, Kozhisseri 2005). Only a small subset of beneficiaries were used as flag bearers for the success of the project while a large section of the population around PTR has been ignored, and have either not been benefited or feel that the project does not make any difference either to them or to PTR. Nevertheless, well-managed eco-tourism could bring in revenue and provide sustainable livelihoods to at least some local communities.

Equally, it would also be highly impractical to replicate or expand the tourism activity on a larger scale since the size of PTR is comparatively small at 777 sq km and tourism is already recognised as one of the biggest threats to PTR because it poses threats such as fire, additional pressure on the forest staff especially during the Sabarimala pilgrim season, illegal timber felling and large-scale litter that has led to death of wildlife species (KFD 2003a). Unfortunately, most alternative IEDP sponsored livelihoods, apart from eco-tourism, were found to no longer function, including the bottle washing unit, rice pounding units, support for small businesses, livestock, bee-keeping, mushroom cultivation or were on the verge of closing down, including solar light marketing unit and co-operative milk marketing when this study was conducted.

Conservation education was an important component of the IEDP and US\$ 0.254 million was spent on educational activities at PTR (World Bank 2004). Various activities such as awareness campaigns, nature camps, publication of educational material and so on were used to increase the conservation awareness and knowledge of EDC members and children (KFD 2002; KFD 2003a). The only component where being an IEDP beneficiary was positively influenced responses was in understanding of the reasons for establishment of PTR. IEDP beneficiaries, males and those of local origin had a better understanding of the reasons for establishment of PTR. This was probably a result of the extensive conservation education activities undertaken by the IEDP, but is of limited use since it did not result in improved conservation attitudes.

5.4 Community benefits

Crop damage by wildlife was a key problem cited by most respondents. Therefore, it was sensible that the IEDP included infrastructure for mitigating human-wildlife conflict as a community benefit. Whilst other studies have cited a lack of consultation and consideration of local community perspectives as common failures in implementing human-wildlife conflict mitigation strategies (Hill, Osborn & Plumptre 2002), the IEDP at PTR did consult the focal communities and, at their request, provided improved guarding measures (World Bank 2004; Various EDC micro-plans). Labour to install these infrastructures was provided by the local communities. However, recipient communities still perceived human-wildlife conflict to be a major problem. Equally, none of the crop protection measures visited had been maintained by the EDCs that were responsible for their repair. This suggested that either the crop protection measures requested were too complicated for the communities to maintain or that, without sufficient community investment in the infrastructure, there was not a

sufficient sense of required ownership. Thus, developing crop damage intervention strategies might be better based on indigenous and local techniques, rather than on electric or barbed wire fences. A sound understanding of the ecology of the crop pests and of the spatio-temporal patterns of crop raiding patterns are a necessary prerequisite to identify conflict areas and tailor the specific and appropriate strategies to the main crop pests (Sitati *et al.*, 2003, Jeyasingh & Davidar 2003). There has been documented failure of electric fencing as a deterrent measure in a similar project funded by the World Bank in India (Jeyasingh & Davidar 2003; Arjunan 2006), and in other parts of the world under other projects (Sitati 2003). Lessons learnt from previous failures need to be incorporated into the management decision making process. Low-cost, low-tech measures such as the capsicum-based repellents and buffer crops (chillies) could be tried for elephants. A combination of traditional methods perhaps could yield better results in the longer-term (Sitati, Walpole & Leader-Williams 2005).

The IEDP implementation completion report evaluates the community infrastructures as beneficial to fringe area communities (World Bank 2004; JPS Associates 2004). However, heavy investment in wider community infrastructures that require constant maintenance and local commitment, including electric fencing, elephant proof trenches, bottle washing unit, cardamom drying unit, awareness centre and provision stores do not seem viable initiatives. Income generating infrastructures that are dependent on tourism were the only functioning assets identified, including souvenir shop and toilets at Thekkady, and Khuzimavu. Therefore, perhaps the direct funds generated from these activities meant that the intangible benefits received from the crop protection measures were perceived as being insufficient or non-existent, and did not warrant maintenance of those assets.

The investments made in these infrastructures require a cost-benefit analysis to determine if they result in local support for conservation, and prove useful to the communities. Monitoring the use and maintenance of these assets on a longer-term is an equally important issue. Otherwise such assets could end up as a burden on future tax-payers, since a substantial portion of the IEDP funding is a loan that has to be repaid by the Indian Government over 35 years.

Some studies have suggested that ICDPs should focus on reducing dependency on forest-based products and activities by promoting livelihoods such as private sector jobs, carpentry, shop-keeping and so on (Gunathilake 1998). Nevertheless, even the activities promoted under the IEDP that were not dependent on forest-based activities and products, such as the bottle washing unit, rice pounding unit, shop-keeping, souvenir shops, solar light marketing, bee-keeping, mushroom cultivation and so on, were not sustained by local communities, even in the shorter term.

To expand on the activities initiated under the IEDP, Periyar Foundation, a quasi-governmental organisation funded through the tourism revenue has been initiated. Future investments on high value community infrastructure through this new entity needs prudent review.

5.5 Longer-term sustainability

All the three categories of benefits that have been provided for nearly nine years under the IEDP have had little impact. Thus, the salient question that emerges from this study is what kind of incentive should be provided to improve local conservation attitudes and, more importantly, result in more conservation compatible behaviour? Equally it is important to determine how long the incentives should be provided for. As the population around PTR grows and new threats emerge the demand for incentives either through cash, kind or access to natural resources will increase. How do the limited funds available and the finite natural resource cope with the increasing demand?

One of the new threats emerging around PTR is the falling prices of agricultural products. There are eight large tea estates on the western periphery of PTR with an estimated workforce of over 3000 people. The eastern periphery of PTR is surrounded by 22 tea and cardamom estates with an estimated workforce of another 3000 people (KFD 2003a). The tea industry is currently facing a severe crisis and has seen a fall in both quantity and value (Tea Board of India 2006). Due to this crisis, many labourers on tea estates have lost their employment, and have consequently shifted their income generation activities to fuelwood collection and timber smuggling from PTR.

PTR lies on the border of Tamilnadu State where wage labour is about US\$ 1.38/day (DES 2005) compared to Kerala where it is about US\$ 2.09/day. Thus migration for better paid jobs into areas around PTR that have tea, cardamom, rubber and coffee plantations is a constant threat to PTR and its natural resources. This was evident with 48.8% of the non-IEDP respondents being migrants from Tamilnadu.

5.6 Perceptions of beneficiaries towards the project

More positive perceptions amongst the IEDP beneficiaries towards the project were related to no access rights to the natural resources of PTR and unaffected by human-wildlife conflicts. Though access rights are provided to some groups for both commercial and subsistence extraction of forest products, these groups hold negative attitudes towards the IEDP. This may be that the granting of rights raised community expectations of the benefits that they would receive, which turned out not to materialise.

Some of the important factors that seem to have influenced perceptions towards the IEDP were cancellation or reduction of micro credit schemes (31.1%), frequent change of government officials leading to poor understanding of project objectives (17.7%) and mismanagement of EDC funds (16.6%). Negative perceptions towards the project could even have reflected on the PA that the project was intended to conserve. Hence it is important that projects do not lead to more conflicts either with the PA or within the communities.

5.7 IEDP and social conflicts

Exclusion of certain sections of the communities and activities of certain groups formulated under the IEDP has impacted other groups leading to internal conflicts within communities. Forest dwelling communities like the *Mannans* and *Paliyans* who practise agriculture within PTR have been impacted due to crop damage by livestock belonging to the graziers EDC. Since these communities are marginal farmers these losses would seriously impact their livelihoods. Exclusion of certain groups or families within a community or a village has led to economic divisions within communities.

The identification of beneficiaries should also not be seen as an amnesty and reward to offenders (Sanjayan *et al.*, 1997). At PTR the community that most benefitted were the Ex-Vayana Bark Collectors EDC involved in high value eco-tourism activities, which brings relatively large ‘tips’ in addition to their regular salary. This has created resentment among several other EDCs who practised legal activities, but received lower economic benefits, while people involved in illegal activities do receive higher economic benefits.

Omission of *Malam-pandarams*, a forest dwelling community, from the IEDP is perhaps unjust. Benefits have been provided to several economically and socially affluent households, and the more needy communities such as the *Malam-pandarams* have been provided with no benefits and there have not been any attempts to reduce their dependency on PTR.

5.8 Conservation attitudes of local communities

A key output of the IEDP was “to provide a firmer base of public support for PAs and increased understanding of PA biodiversity, local people, and their interactions” (World Bank 1996). However, both IEDP beneficiaries and non-beneficiaries were found to hold similar conservation attitude scores towards PTR and wildlife conservation in general. Those respondents who were part of the eco-tourism enterprise set up under the IEDP held more favourable conservation attitude scores, presumably because these respondents are involved in conservation education activities and therefore have a better understanding of conservation issues in PTR. However, for the majority of the IEDP beneficiaries, receiving a project incentive had none of the intended influence on their conservation attitude scores.

Another core assumption of ICDPs is that stakeholders whose livelihoods depend on the PA should be more interested in conservation, and so providing them with incentives should lead to improved attitudes towards conservation (MacKinnon *et al.*, 1999; Newmark & Hough 2000; World Bank 2002). However, this study found that dependence on PTR for their livelihood did not determine whether respondents would hold a positive attitude to conservation. Instead, the IEDP should have focussed more on factors that might have impacted better on conservation attitudes, and a pre-project survey would have revealed what these factors might be.

Results from this study also showed that providing household benefits such as LPG and stove, and micro-credits had no influence on conservation attitude scores. The example of LPG as a household benefit to reduce dependency on the natural resources of PTR yielded mixed results. Commercial fuels, like LPG, are more expensive than natural fuels and represent a commitment to monthly expenditure among recipient households. Thus most respondents who had received LPGs either used them partially or had completely ceased to use them because of the costs placed on the low income households, and difficulty in transportation.

Provision of household benefits or community benefits, and granting of access rights to the natural resources of PTR made a negligible difference to influencing conservation attitude scores nor perceptions towards the PTR-IEDP. This study showed that providing access to natural resources did not lead to improved conservation attitude scores. Perhaps the cost of incentives has to be higher than the average income as with the eco-tourism jobs provided under the IEDP.

Chapter 6

Recommendations



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Monitoring of tiger and prey species is a key component in determining project success at Periyar Tiger Reserve

Recommendations

6.1 Biological monitoring

ICDPs that intend to conserve habitats of ecologically fragile species such as the tiger, also need to focus on monitoring the biodiversity that they are intended to protect, as well as the socio-economic indicators for measuring success or failure. The IEDP was primarily intended as a biodiversity conservation project. If too much emphasis is placed on the socio-economic indicators alone, then it will become a predominantly rural development programme, with little effort given over to the biodiversity conservation aspect, which is an integral part of the IEDP and ICDP philosophy. Biological monitoring based on sound science and statistical rigour would also provide managers with quantitative results and measures of management implications. Without such, evaluation of project success regarding biodiversity conservation would be very anecdotal.

Large donor funded projects can cost millions of dollars. Therefore, it is crucial to ensure that the resources spent meet the expected goals. In turn, this therefore requires rigorous evaluations of project performance, similar to those applied to testing hypotheses in ecological experiments (Ferraro & Pattanayak 2006). Otherwise, there is no clear indication of whether a project has been successful and cost-effective.

Access rights to natural resources within a PA do not necessarily eliminate or reduce the degradation of these resources or ecosystems (Bawa & Gadgil 1997). Harvesting methods need continuous monitoring to determine whether or not they are sustainable. After the initial studies to collect baseline data (Balasubramaniam 1999; Balasubramaniam undated, Veeramani 2002) no follow-up studies have been made to monitor levels or impacts of resource extraction at PTR. Little is known or assessed about the primary and secondary impacts of resource harvesting on the functioning of ecosystems at PTR. This could adversely impact PTR and its wildlife in the longer term. Harvesting methods, zones and volumes of fuelwood collection are all violated without any monitoring.

The impacts of livestock grazing in causing competition with wildlife have not been scientifically evaluated in PTR, while the implementation of grazing rights needs stringent monitoring. Exclusion zones and sanctioned times of grazing are all violated frequently. The presence of parasites such as *Murshidia* spp., *Strongyloidus* spp., *Ascaris* spp. and so on in both livestock and wildlife faeces has already begun to illustrate the negative effects of livestock grazing (KFD unpublished data).

Monitoring of biological parameters could be the most important indicator of project success in changing behaviours of communities, either as individuals or as groups. If a project aims to protect biodiversity or flagship species, then it is fundamental that it monitors these components of biodiversity using the appropriate scientific methods. This would help to show that project incentives do indeed lead to improved changes in behaviour that are compatible with conservation objectives (Hutton & Leader-Williams 2003). However, integrating monitoring within the realm of the daily schedule of PA managers is impractical. In India, PAs are understaffed with low budgets and burdening the staff with

more activities such as scientific monitoring and rural development and in addition to their regular management and law enforcement duties would be unreasonable. Monitoring requires trained technical expertise and long-term commitment, hence could be carried out by independent biologists with requisite technical skills.

Emphasis on an enhanced budget for scientific biological monitoring should be taken into consideration by future donors. However, biological indicators should be relevant and appropriate to measure project success. Funding monitoring projects such as mosquito diversity as in the case of Nagarahole-IEDP (Kumar, Ganesh & Vijayan 2004) would have very little relevance if they are beyond the scope of project objectives.

Since tigers and elephants are flagship species within PTR, building monitoring programmes around these species is a useful way of raising funds to protect the wider biodiversity of PTR. The density of tigers and other large carnivores is determined by the density of its prey (Madhusudhan & Karanth 2002; Karanth *et al.*, 2004). Thus over harvesting of NTFPs could seriously impact on herbivore populations and hence monitoring indicator NTFP species is vital.

Table 6.1: Suggested indicator species and methods for monitoring

Class	Method	Comments
Tiger	Estimating relative abundance using both tiger tracks and scats (Karanth & Kumar 2002).	Cost effective and can be carried out by field personnel with lower scientific skills.
	Index surveys using camera traps (Karanth & Kumar 2002).	Since the KFD already possess equipment and some level of basic skills, this could be a good methodology if sampling scheme and survey protocols are well-planned and implemented. This method requires fewer resources.
	Estimating absolute densities using capture-recapture sampling through camera trapping (Karanth, Kumar & Nichols 2002).	Requires highly trained personnel and resources, hence better implemented through scientific organisations. Needs testing at PTR, as the habitat characteristics might suggest it to be a low density area where camera trapping for estimating absolute densities might not be the best solution.
Tiger prey species	Estimating relative abundance using index based encounter	Requires fewer resources and less skilled personnel than estimating absolute

	<p>surveys through line transects (Karanth & Kumar 2002).</p> <p>Estimating absolute densities using line transect sampling (Karanth, Thomas & Kumar 2002).</p>	<p>densities.</p> <p>Requires skilled manpower, appropriate equipment and financial resources, systematic data collection and reliable sample sizes. Could be better implemented through scientific organisations.</p>
<p>Monitoring intensively harvested NTFP species</p> <p><i>Veteria indica</i></p> <p><i>Ochlandra travancorica</i></p> <p><i>Themida cymbaria</i></p> <p><i>Amaranthus spinosus</i></p> <p><i>Apis dorsata</i></p> <p><i>Apis cerana indica</i></p>	<p>Yield studies (Peters 1994)</p> <p>Regeneration surveys (Peters 1994)</p> <p>Harvest assessment (Peters 1994)</p>	<p>Gives a reasonable estimate of the total quantity of resource produced by a species in different habitat types. Needs to be repeated annually using same group of plants. Data collection does not need expertise.</p> <p>Monitoring densities of seedlings and saplings in the populations being exploited to measure over-exploitation using permanent regeneration plots. Measures long-term impacts of harvesting.</p> <p>Used to gauge ecological impacts of resource harvest. This is a quicker assessment method to detect problems with reproduction or growth using sample plants. Needs to be conducted during harvest seasons.</p>
Threat monitoring	Fixed width transects for estimating encounter rates of threats.	Requires less skilled personnel to monitor increase or decrease in threats such as timber smuggling, NTFP harvests, fire and livestock grazing.
Impacts of livestock	Regular monitoring for pathogens using dung and faecal samples.	Requires trained wildlife epizootologists and veterinarians.
Community benefits	On-ground checks and certification	Could be carried out through external rural development organisations
Human population	National and state statistics	Can indicate changing pressures and

monitoring		threats on PTR.
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6.2 Observed guidelines for better project implementation

All projects are a mix of successes and failures. Hence it is important to understand both the strengths and weaknesses of success or failure. Although the PTR-IEDP has made only modest progress in meeting its developmental goals, there are no data to assess whether or not it has met its conservation goals, it has nevertheless achieved some noteworthy gains:

- A good and committed network of individuals who work as co-ordinators (termed as non-governmental individuals under the project) who come from within the local communities. These individuals have strong social skills, and provide a key link between communities and IEDP.
- The involvement and interest of some senior forest department officers during the initial implementation of the project has had considerable impact on the project development. Nevertheless the frequent turnover of senior level government officers has certainly hindered the implementation of a project that needs long-term commitment.

The State of Kerala is first among the Indian human development index, and it also has the highest literacy rate (90.9%) in the country (Government of Kerala 2004). Furthermore, the state has one of the highest newspaper readerships in the world, a low tolerance of corruption and is a source of democratic activism. These social factors could prove strong points in favour of conservation within and around PTR. Hence, the implementation and limited success of projects such as the IEDP initiative at PTR would not prove a solution in all areas. The projects are site-specific, focussed around few individuals and are based on complex social structures which cannot be replicated in other places.

Non-natural resource economic opportunities then would have a much greater effect of reducing demand for natural resources. This may be achieved through increasing education levels of communities. Education is probably an issue that needs to be tackled for long-term conservation success in PTR. Hence this is an area rural development activities need to focus on, because higher levels of formal education are conducive to individuals obtaining higher paid jobs that do not depend on natural resources. A similar study in Sri Lanka has suggested that education would distract and reduce dependency on forest resources (Gunatilake 1998).

Rural development activities need distinctive skills and expertise as well as highly motivated and committed individuals. For longer-term success of community-based conservation activities such as the IEDP, eco-development activities should be implemented through specialist rural development individuals, organisations and departments who have social acceptability.

The tourism industry which gains the most out of PTR is contributing very little for the conservation of PTR and has provided livelihoods to only a very small subset of local people. Most hotels and souvenir shops at Kumili are owned by non-locals. In general, tourism provides little benefit to local communities and the local attractions that are the source of tourist interest (Gossling 2002). The same is likely true of re-investment in conserving PTR. Therefore, urgent steps have to be taken to encourage the tourist industry, including hotel and resort owners, restaurants, souvenir shops, travel agents and all others benefiting directly or indirectly from PTR, to contribute for conservation efforts through setting up a separate PTR conservation tax under the local municipal administration which can be later transferred to PTR.

Chapter 7

Conclusions



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Elephants are another flagship species of Periyar Tiger Reserve

Conclusions

The IEDP at PTR deserves considerable credit for addressing several concerns and issues raised by previous critics of ICDPs (Ghirmire & Pimbert 1997; Sanjayan *et al.*, 1997; Berkes 2004; Budhathoki 2004), such as failing to adopt participatory approaches, providing infrastructure without consulting local communities, equity, gender empowerment, and so on. Despite addressing these concerns, the IEDP at PTR has made little impact as a rural development project, while evidence is entirely lacking to determine its impact as a conservation project.

Based on the IEDP model, the GOI has nevertheless requested funding from World Bank for a new project titled “Rural Livelihoods and Biodiversity Conservation” costing US\$ 47.1 million (GEF 2006). Without biological evaluation of the success of previous investments, and with the equivocal evaluation of the results of the rural development aspects of the project documented in this study, it remains unclear whether or not it is worthwhile to implement similar ventures. Otherwise, however well-intentioned these projects are, they may fail to deliver their primary objective of providing incentives for wildlife conservation, while at the same time providing a major burden to the Indian taxpayer for the years over which loans have to be repaid.

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Appendices

Appendix 1

Local name (Malayalam)	English common name	Scientific name	Use
Inja	?	<i>Acacia caesia</i>	Alternative to soap
Kodam puli	Malabar tamarind	<i>Garcini gummi-gutta</i>	Spice
Kundarikum, Telli	Black damar	<i>Canarium strictum</i>	Used in varnish industry
Pathri poo Ponnam poo Painam poo	Nutmeg flower	<i>Myristica</i> spp.	Used as natural dye
Poon karandi	?	<i>Abutilon</i> spp.	Medicinal herb
Paal madaki	?	<i>Phaseolus</i> spp?	Medicinal plant
Anali vegam	?	<i>Alstonia venenata</i>	Medicinal plant
Kalluru vanji Kalvanjika	?	<i>Nigella sativa</i>	Medicinal plant
Ada puriyal	?	?	Medicinal plant
Then	Giant honey bee	<i>Apis dorsata</i>	Medicinal properties
Cheru then	Asiatic honey bee	<i>Apis cerana indica</i>	Medicinal properties, bee hive as medicine
Patta	Cinnamon bark	<i>Cinnamomum malabattrum</i>	Used in paint, soap, incense stick industries Spice
Kaatu Inji	Wild ginger	<i>Zingiber officinalis</i>	Medicinal properties Spice
Manjal	Wild turmeric	<i>Curcuma aromatica?</i>	Spice Medicinal properties
Aratha Mala Inji	?	?	?
Mootil puli	?	<i>Buccaria courtalensis</i>	Spice used in fish curry
Pulanji kaayi Cheve kaayi	Soapnut	<i>Acacia sinuata</i>	Shampoo
Nelligaayi	Indian goose berry	<i>Emblia officinalis</i>	Pickle, medicine
Channa ila	?	<i>Amaranthus spinosus</i>	Thatching grass
Meichal pullu	?	<i>Themida cymbaria</i>	Thatching grass
Paav koonu	Mushroom	?	Delicacy
Eelakai	Wild cardamom	<i>Elettaria cardamom</i>	Spice
Kaatu Kurumulagu	Wild pepper	<i>Pipper nigrum</i>	Spice
Pana	Toddy	<i>Caryota urens</i>	Alcoholic drink
Kaitha	?	<i>Pandanus</i> spp	?
Mullam choral	Cane	<i>Calamus thwaltessi</i>	Handicrafts
Eeta	Reed bamboo	<i>Ochlandra travancorica</i>	Handicrafts
Badraksha kaayi	Rudraksha Olive nut?	<i>Elaeocarpus tuberculatus</i>	Prayer beads
Yedambiri valambiri	East Indian screw tree	<i>Helecteris isora</i>	Medicinal property, rope from bark
Fish species Kuyil Kooral Gold fish Tilapia	Mahsheer Curmuca barb European carp Tilapia	<i>Tor khudree</i> <i>Puntius curmuca</i> <i>Cyprinus carpio communis</i> <i>Oreochromis mossambicus</i>	Food

All efforts have been made to find the correct scientific, English and vernacular names of the NTFP collected, but there could be errors due to variations in vernacular names leading to wrong identifications.

APPENDIX 2

Species	Scientific name	Mode of hunting	IUCN Category and criteria
Gaur	<i>Bos gaurus</i>	Gun	VU
Sambar	<i>Cervus unicolor</i>	Gun	LR/lc
Wild boar	<i>Sus scrofa</i>	Gun, snare, explosives in bait	LR/lc
Wild boar piglets		chase and catch	
Barking deer	<i>Muntiacus muntjak</i>	Gun, snare	LR/lc
Mouse deer	<i>Moschiola meminna</i>	Snare, blind with torch and kill with stick, hunting dogs	LR/lc
Indian giant squirrel	<i>Ratufa indica indica</i>	Gun, picking young ones from nest	VU
Indian giant flying squirrel	<i>Petaurista philippensis</i>	Smoke out from nest, poking into nest	LR/lc
Nilgiri langur	<i>Semnopithecus johnii</i>	Gun	VU
Bonnet macaque	<i>Macaca radiata</i>	Gun	LC
Porcupine	<i>Hystrix indica</i>	Hunting dogs	LR/lc
Common Otter	<i>Lutra lutra,</i>	Caught in fishing nets	NT
Sloth bear	<i>Melursus ursinus</i>	Gun	VU
Sambar	<i>Cervus unicolor</i>	Scavenging wild dog kills	
Gaur	<i>Bos gaurus</i>		
Wild boar	<i>Sus scrofa</i>		
Blacknaped hare	<i>Lepus nigricollis</i>	Snare	LR/lc
Nilgiri tahr	<i>Hemitragus hylocrius</i>	Circle the group and scare an individual down to a ditch	EN
Indian pangolin	<i>Manis crassicaudata</i>	Hunting dogs	LR/nt
Flying fox	<i>Pteropus giganteus</i>	Net, thorns stuck on branches	LR/lc
Indian elephant	<i>Elephans maximus</i>	Gun	EN
Leopard	<i>Panthera pardus</i>	Gun	LC
Grey Jungle fowl	<i>Gallus sonneratii</i>	Snare, trap, picking eggs from nests	LC

Malabar grey hornbill	<i>Ocyrceros griseus</i>	Catapult, gun	LC
Great hornbill	<i>Buceros bicornis</i>	Collecting young ones and eggs from nests	EN
Green imperial pigeon	<i>Ducula aenea</i>	Gun	LC
Malabar parakeet*	<i>Psittacula columboides</i>	Catapult, stoning	LC
Blossom headed parakeet*	<i>Psittacula roseata</i>	Catapult	LC
Hill myna*	<i>Gracula religiosa</i>	Catapult, stoning	LC
Common myna*	<i>Acridotheres tristis</i>	Catapult, stoning	LC
Coucal*	<i>Centropus sinensis</i> ,	Catapult, stoning	LC
	<i>Centropus bengalensis</i>		LC
Barbets*	<i>Megalaima Spp.</i>	Catapult, stoning	
Sunbirds*	<i>Nectarinia Spp.</i>	Catapult, stoning	
Bulbuls*	<i>Pycnonotus Spp.</i> ,	Catapult, stoning	
	<i>Iole indica</i>		
Indian oval-grain lizard (Monitor lizard)	<i>Varanus bengalensis</i> (<i>Varanus flavescens</i> ?)	Chase and kill with stick, chase and catch, hunting dogs, stoning	LR/lc
Turtles		Opportunistic picking, caught in fishing nets, hunting dogs	
Terrapin?	<i>Heosemys trijuga</i>		
Land Tortoise?	<i>Geochelone elegans</i>		

EN - Endangered, NT - Near threatened, VU - Vulnerable, LR/lc - Lower risk: least concern, LC - Least concern

* caught as pets

Appendix 3 IEDP Beneficiary questionnaire

Survey form number: _____

Name of the EDC: _____ Name/s of the surveyor: _____

Name of the village: _____ Date: _____

1 1.1 Name of the respondent: _____

1.1 Gender: male ☐ (1) female ☐ (2)

1.2 Age: _____

1.3 Religion/caste: _____

1.4 Traditional long-term main occupation:

agriculture ☐ (1) labour ☐ (2) business ☐ (3)

livestock ☐ (4) forest products ☐ (5) fishing ☐ (6)

fuelwood collection ☐ (7) govt employee ☐ (8)

private employee ☐ (9) others ☐ (10)

(explain others) _____

1.5 Was he/she born here: Yes ☐ (1) No ☐ (2)

1.6 If not, length of residence in this village: _____

1.7 Where did he/she/family come from: _____

2 2.1 Is it a single or a joint family: Single ☐ (1) Joint ☐ (2)

2.2 Household size (no. of people in the household): _____

2.3 Highest level of formal education of household head:

None ☐ (1) Primary ☐ (2) Secondary ☐ (3) Tertiary ☐ (4)

3 3.1 Do you own land: Yes ☐ (1) No ☐ (2)

3.2 If yes, how much land do you own: _____

3.3 The land has: title ☐ (1) encroached without title ☐ (2)

forest land ☐ (3) revenue land ☐ (4) private lease ☐ (5)

4 4.1 Have you heard of IEDP: Yes ☐ (1) No ☐ (2)

Reasons for answer, whether yes or no: _____

4.2 did your household receive any benefit under IEDP:

Yes ☐ (1) No ☐ (2) don't know ☐ (3)

4.3 If yes,

alternative livelihood ☐ (1) individual household benefit ☐ (2) both ☐ (3)

(what: _____) others ☐ (4) _____

4.3 Why were the benefits from IEDP given:
to reduce use of PTR resources ☐ (1) accepted as KFD gave it ☐ (2)

came free ☐ (3) don't know ☐ (4)

4.4 To reduce dependency of resources

grazing ☐ (1) NTFP ☐ (2) poaching ☐ (3) pilgrimage pressure ☐ (4)

fishing ☐ (5) others ☐ (6) _____

4.5 Did you have to contribute 25% toward the benefit either in cash or kind
Yes ☐ (1) No ☐ (2) don't know ☐ (3)

4.6 If yes, did you contribute in: cash ☐ (1) kind ☐ (2) labour ☐ (3) others ☐ (4)

If the respondent has received any alternative livelihood benefits under IEDP then answer question 5, if not skip question 5 and continue to question 6

5 5.1 What alternative livelihood did you/your family receive under IEDP: shop ☐ (1)
manufacturing unit ☐ (2) tourism related ☐ (3)

souvenir shops ☐ (4) tailoring unit ☐ (5) vermi-composting ☐ (6)

loans ☐ (7) others ☐ (8) _____

5.2 When did you start your alternative livelihood provided under IEDP: _____

5.3 What was your main occupation before IEDP: agriculture ☐ (1) labour ☐ (2)
business ☐ (3) livestock ☐ (4) forest products ☐ (5)

fishing ☐ (6) fuelwood collection ☐ (7) govt employee ☐ (8)

private employee ☐ (9) others ☐ (10) explain _____

5.4 Do you still continue your previous occupation: Yes ☐ (1) No ☐ (2)

5.5 Do you solely depend on the IEDP occupation: Yes ☐ (1) No ☐ (2)

5.6 Do you have any other side occupation: Yes ☐ (1) No ☐ (2)

5.7 If yes, what: _____

5.8 How much do you earn/month from the IEDP occupation (in Rs): _____

5.9 Is this income enough to support you and your family: Yes ☐ (1) No ☐ (2)

5.10 What's your income/month from your side occupation/s (in Rs): _____

5.11 What other benefits did your household receive under IEDP: _____

5.12 Are you an office-bearer of any EDC Yes ☐ No ☐

If the respondent's village/hamlet has received any community/village benefit/s under IEDP then answer 6, if not skip question 6 and continue with question 7.

6 6.1 What benefit did your community/village receive under IEDP:

community hall ☐ (1) support to school ☐ (2) solar fence ☐ (3)

community farms ☐ (4) EDC office building ☐ (5)

community electricity ☐ (6) farm produce marketing ☐ (7)

other ☐ (8) _____ None ☐ (9)

6.2 Do you think it is/was a useful benefit for the community/village:

Yes ☐ (1) No ☐ (2) can't say ☐ (3)

6.3 Does the community use the asset provided under IEDP:

Yes, often ☐ (1) occasionally ☐ (2) rarely ☐ (3)

No ☐ (4) can't say ☐ (5)

7 7.1 Were you dependent on PTR before IEDP: Yes ☐ (1) No ☐ (2)

7.2 If yes, for what: _____

(timber, fuel wood, grass for thatching, grazing, honey, MFP, hunting, etc.)

7.3 How often do you go into PTR for fetching your needs:

Past (before IEDP)

daily ☐ (1) once in 3 days ☐ (2) once a week ☐ (3)

once in 2 weeks ☐ (4) once a month ☐ (5)

Present

daily ☐ (1) once in 3 days ☐ (2) once a week ☐ (3)

once in 2 weeks ☐ (4) once a month ☐ (5)

7.4 do you use any natural resources from PTR for

livelihood ☐ (1) additional income ☐ (2) others ☐ (3) No ☐ (4)

self use ☐ (5) (explain others) _____

7.5 Do you think pressures on the PTR by other people has been reduced on PTR since the past five years

Yes ☐ (1) No ☐ (2) don't know ☐ (3)

If yes, why _____

7.6 Do you or have you hunted in the past Yes ☐ (1) No ☐ (2)

7.7 What have you hunted: birds ☐ (1) animals ☐ (2) other ☐ (3)

If yes, species: _____

7.8 What did you use to hunt: gun ☐ (1) traps ☐ (2) snare ☐ (3) others ☐ (4)

7.9 do/did you collect any of the following: nests ☐ (1) eggs ☐ (2) young ☐ (3)

8 8.1 Does the PTR provide you any benefit/s:

Yes ☐ (1) No ☐ (2) don't know ☐ (3)

if yes, what: _____

very positive ☐ (a) fairly positive ☐ (b) neutral ☐ (c) negative ☐ (d)

very negative ☐ (e)

8.2 Why do you think PTR was established?

wildlife preservation ☐ (1) to support local people ☐ (2)

for forest department ☐ (3) for tourism ☐ (4) others ☐ (5) (explain others) _____

9 What is your perception about IEDP? _____

very positive ☐ (1) positive ☐ (2) neutral ☐ (3) negative ☐ (4) very negative ☐ (5)

10.

Question	Yes	No	Don't know
It is important to protect wildlife inside PTR			
PTR is important for my children			
People should be allowed to graze livestock inside PTR			
PTR should be abolished			
People should not be allowed to hunt wild animals for food inside PTR			
Wild animals from PTR that cause crop-damage should be exterminated			
Wild animals from PTR are important as a source of tourism revenue			
People should be allowed to carry out agriculture inside PTR			

11. Please list any major problems that you experience living near PTR (list in rank order only the top three MAJOR PROBLEMS. Respondent does not have to list three problems)

No	Problem	Proposed solution
1.		
2.		
3.		

Appendix 4
Non-IEDP questionnaire

Survey form number: _____ Name/s of the surveyor: _____

Name of the village: _____ Date: _____

1 1.1 Name of the respondent: _____

1.1 Gender: male ☐ (1) female ☐ (2)

1.2 Age: _____

1.3 Religion/caste: _____

1.4 Traditional long-term main occupation:

agriculture ☐ (1) labour ☐ (2) business ☐ (3) livestock ☐ (4)

forest products ☐ (5) fishing ☐ (6) fuelwood collection ☐ (7)

govt employee ☐ (8) private employee ☐ (9) others ☐ (10) (explain others) _____

1.5 Was he/she born here: Yes ☐ (1) No ☐ (2)

1.6 If not, length of residence in this village: _____

1.7 Where did he/she/family come from: _____

2 2.1 Is it a single or a joint family: Single ☐ (1) Joint ☐ (2)

2.2 Household size (no. of people in the household): _____

2.3 Highest level of formal education of household head:

None ☐ (1) Primary ☐ (2) Secondary ☐ (3) Tertiary ☐ (4)

3 3.1 Do you own land: Yes ☐ (1) No ☐ (2)

3.2 If yes, how much land do you own: _____

3.3 The land has: title ☐ (1) encroached without title ☐ (2)
forest land ☐ (3) revenue land ☐ (4) private lease ☐ (5)

4 4.1 Have you heard of IEDP: Yes ☐ (1) No ☐ (2)

If yes, give a brief explanation: _____

4.2 Do you think IEDP should have been implemented in your household/community/village:

Yes ☐ (1) No ☐ (2) don't know ☐ (3)

4.3 Reasons for answer, whether yes/no: _____

4.4 What would you like to be provided if IEDP was implemented in your household/community/village:

alternative livelihood ☐ (1) community assets ☐ (2)

individual household benefits ☐ (3) others ☐ (4) (explain specifically, if possible) _____

4.5 If alternative livelihood, what do you most prefer:

shop ☐ (a) manufacturing unit ☐ (b) tourism related ☐ (c)

souvenir shop ☐ (d) tailoring unit ☐ (e) vermi-composting ☐ (f) loans ☐ (g)

others ☐ (h) _____

4.6 if community assets, what do you prefer:

community hall ☐ (a) support to school ☐ (b) solar fence ☐ (c)

community farms ☐ (d) EDC office building ☐ (e)

marketing of agricultural produce ☐ (g) others ☐ (f) _____ None ☐ (g)

4.7 If individual households benefits, what do you prefer _____

4.8 Why should benefits from projects like IEDP given:

to reduce dependency on PTR ☐ (1) it comes free ☐ (2)

useful to the community ☐ (3) don't know ☐ (4)

to improve our livelihoods ☐ (4)

5 5.1 Would you still continue your previous occupation if an alternative livelihood is provided:
 Yes ☐ (1) No ☐ (2) can't say ☐ (3)

5.2 Would you solely depend on the IEDP occupation: Yes ☐ (1) No ☐ (2) can't say ☐ (3)

5.3 What is your perception about IEDP? _____

very positive ☐ (1) fairly positive ☐ (2) neutral ☐ (3) negative ☐ (4)

very negative ☐ (5)

- 6 6.1 Do you use any natural resources from PTR for
 livelihood ☐ (1) additional income ☐ (2) others ☐ (3) No ☐ (4)
 self use ☐ (5)
- 6.2 If yes, what: timber ☐ (1) fuelwood ☐ (2) grass for thatching ☐ (3)
 grazing ☐ (4) honey ☐ (5) MFP ☐ (6) hunting ☐ (7)
 others ☐ (8) _____
- 6.3 how often do you go into the PTR for fetching your needs:
 daily ☐ (1) once in 3 days ☐ (2) once a week ☐ (3)
 once in 2 weeks ☐ (4) once a month ☐ (5) can't say ☐ (6)
- 6.4 Do you or have you hunted in the past Yes ☐ (1) No ☐ (2)
- 6.5 What have you hunted: birds ☐ (1) animals ☐ (2) other ☐ (3)
 If yes, species: _____
- 6.6 What do/did you use to hunt: gun ☐ (1) traps ☐ (2) snare ☐ (3) others ☐ (4)
- 6.7 do/did you collect any of the following: nests ☐ (1) eggs ☐ (2) young ☐ (3)
- 7 7.1 Does the PTR provide you any benefit/s:
 Yes ☐ (1) No ☐ (2) don't know ☐ (3)
 if yes, what: _____
- very positive ☐ (a) fairly positive ☐ (b) neutral ☐ (c) negative ☐ (d)
 very negative ☐ (e)
- 7.2 Why do you think PTR was established?
 wildlife preservation ☐ (1) to support local people ☐ (2)
 for forest department ☐ (3) for tourism ☐ (4) others ☐ (5) (explain
 others) _____

8.

Question	Yes	No	Don't know
It is important to protect wildlife inside PTR			
PTR is important for my children			
People should be allowed to graze livestock inside PTR			
PTR should be abolished			
People should not be allowed to hunt wild animals for food inside PTR			
Wild animals from PTR that cause crop-damage should be exterminated			
Wild animals from PTR are important as a source of tourism revenue			
People should be allowed to carry out agriculture inside PTR			

9. Please list any major problems that you experience living near PTR (list in rank order only the top three MAJOR PROBLEMS. Respondent does not have to list three problems)

No	Problem	Proposed solution
1.		
2.		
3.		

Appendix 5



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Investments into community benefits need to be monitored on longer-term



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Most community benefits were neither used or maintained during the study period



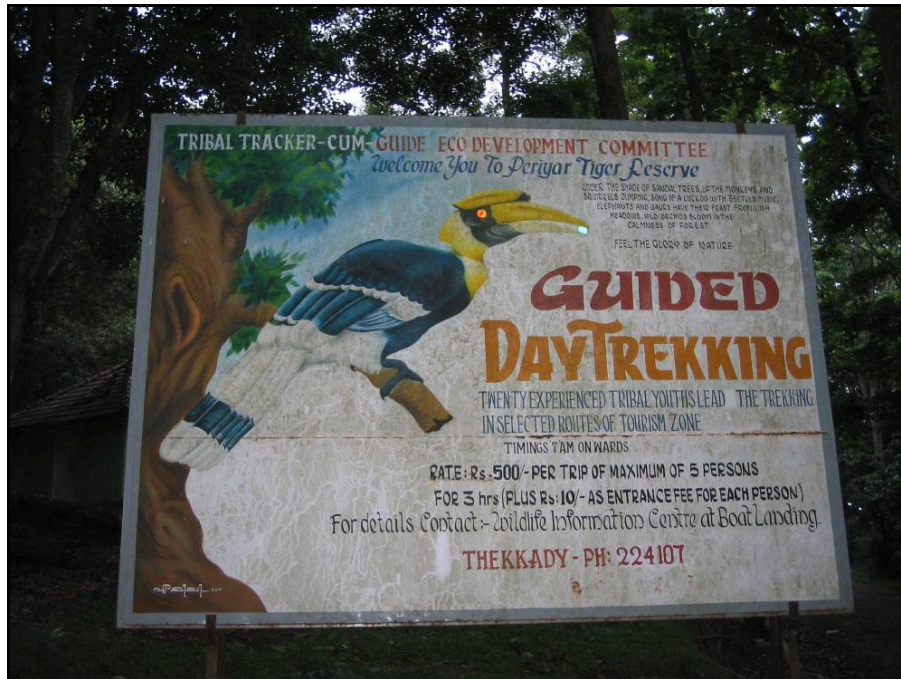
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None of the crop protection benefits were used or maintained during the study period



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Low investment community benefits are easier to maintain



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The tourism oriented EDCs set up under the IEDP have performed well and have provided livelihoods for few households.



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Excessive, uncontrolled harvest of fuelwood could be impacting regeneration



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Excessive uncontrolled harvesting of NTFP could impact herbivore densities, a godown of black damar and cinnamon bark



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Some methods of non-timber forest produce extraction are unsustainable