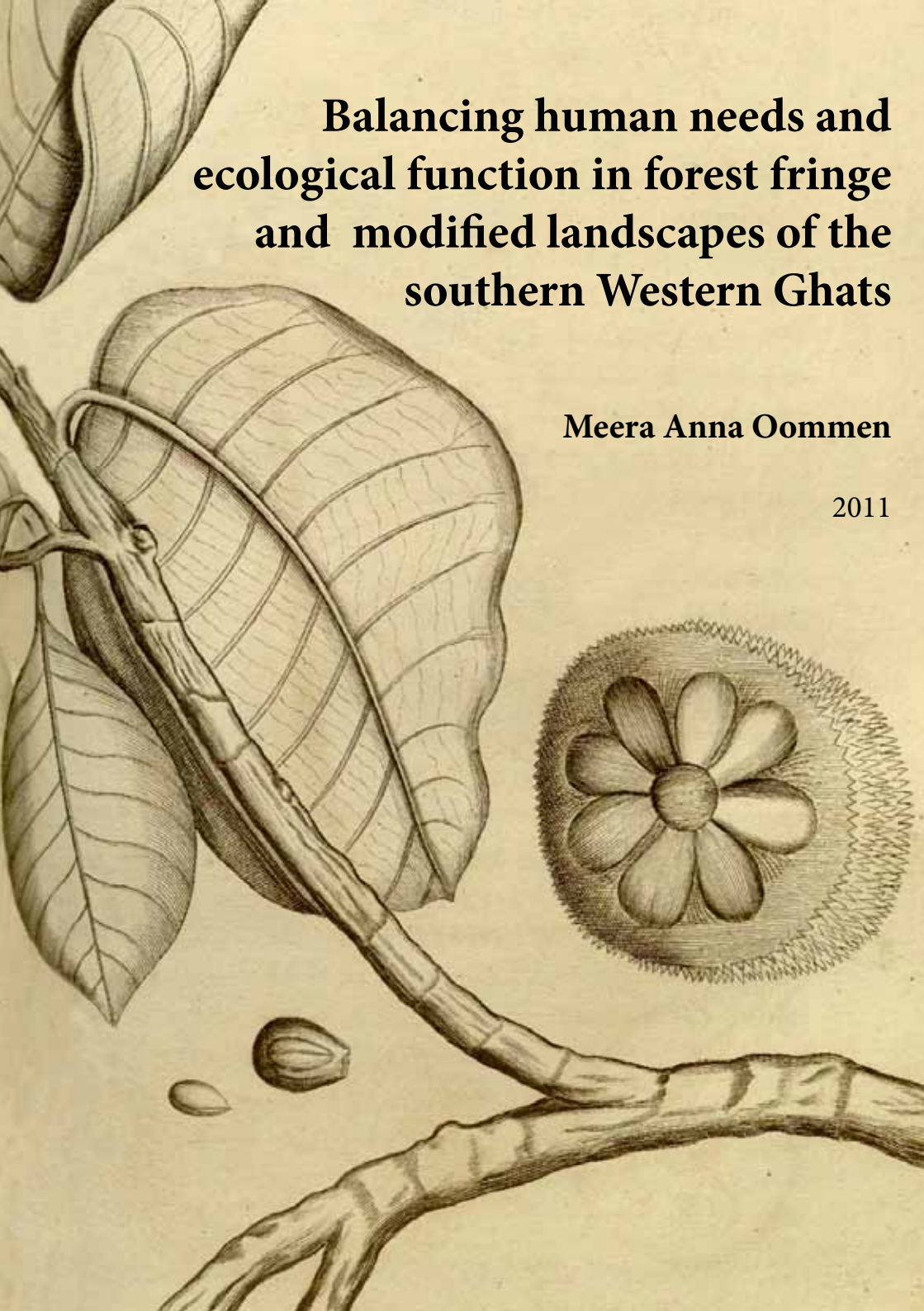
Balancing human needs and ecological function in forest fringe and modified landscapes of the southern Western Ghats

Meera Anna Oommen

2011



Citation: Oommen, M.A. 2011. Balancing human needs and ecological function in forest fringe and modified landscapes of the southern Western Ghats.

Funding support: Critical Ecosystem Partnership Fund, Western Ghats Hotspot

Cover photograph and illustrations: Species representations from the original edition of van Rheede's *Hortus Malabaricus*

Design and edits: Seema Shenoy

For copies contact:

Meera Anna Oommen
Dakshin Foundation,
Flat No 8, Dwarakamai Residency,
2278, 24th Cross, Sahakarnagar 'C' Block,
Bangalore 560 092
Email: meera.anna@gmail.com

Balancing human needs and ecological function in forest fringe and modified landscapes of the southern Western Ghats

Meera Anna Oommen

2011

About the handbook

This is an awareness handbook that discusses dominant and emerging themes related to biodiversity conservation, ecosystem services and sustainable development in human-modified, forest fringe landscapes in the southern Western Ghats (specifically, Ranni Forest Division in the Periyar-Agasthyamalai Corridor).

This document emerged from a series of discussions with landowners, community leaders, local government officials and bureaucrats, with whom potential multiple use arrangements for forest fringe areas were discussed. While most participants of the interviews were familiar with the benefits derived from forests and natural resources, many individuals expressed an interest in understanding the dynamics of human-modified landscapes in greater detail. During the course of our discussions, it was also communicated to the author that a simple document introducing landscape level planning incorporating biodiversity conservation and ecosystem services, and outlining some of the pros and cons of proposed interventions with potential for human welfare would be welcome. Being a politically aware and literate community, this interest was not limited to the operational aspects of conservation interventions, participants also expressed a desire to understand these approaches within a wider political ecological context.

Therefore, in addition to providing an overview of ecological aspects, this handbook also hopes to inform interested parties about the various interventions that are currently being adopted in different parts of the developing tropics and their linkages with development. The assumptions underlying some of these concepts are problematised and wherever appropriate, discussed in the context of the Western Ghats. Although the study area where the surveys were carried out in areas adjoining the Ranni FD, this handbook could be of use in a wider context - especially settler pockets in forest-fringe areas in the southern Western Ghats.

This is not a guide on how to design interventions nor does it promote any one approach, rather the intent is to provide decision-makers with information on the key features of each of these interventions, some of the contexts in which they have been effective (or not) and the potential benefits and pitfalls. It is hoped that this handbook will provide a set of decision support tools for managers involved in landscape level planning and management. In its current form, the handbook is a first attempt at outlining some of the issues and is not comprehensive. Readers are requested to treat this as a work in progress and provide any useful comments and suggestions to the author.

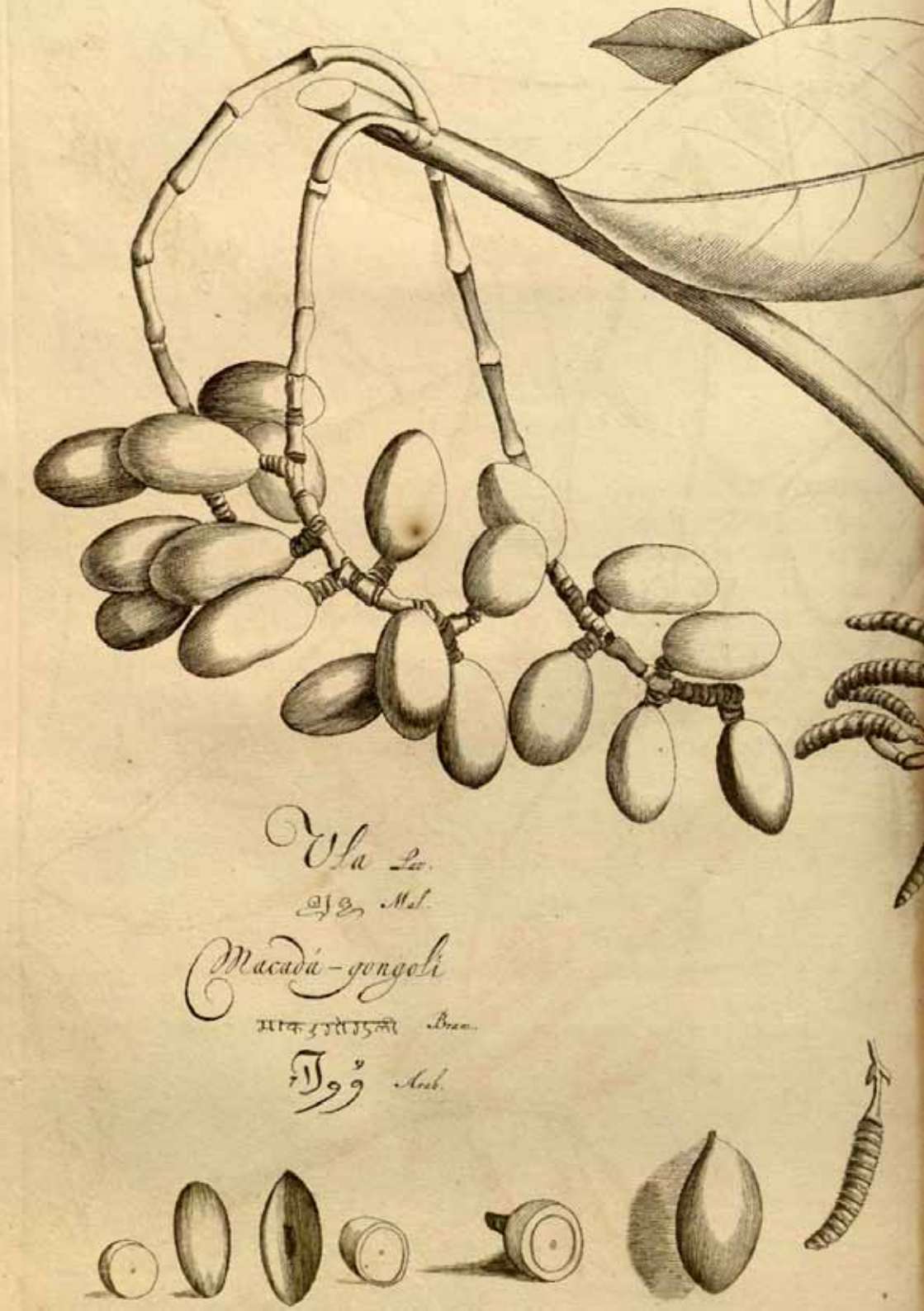
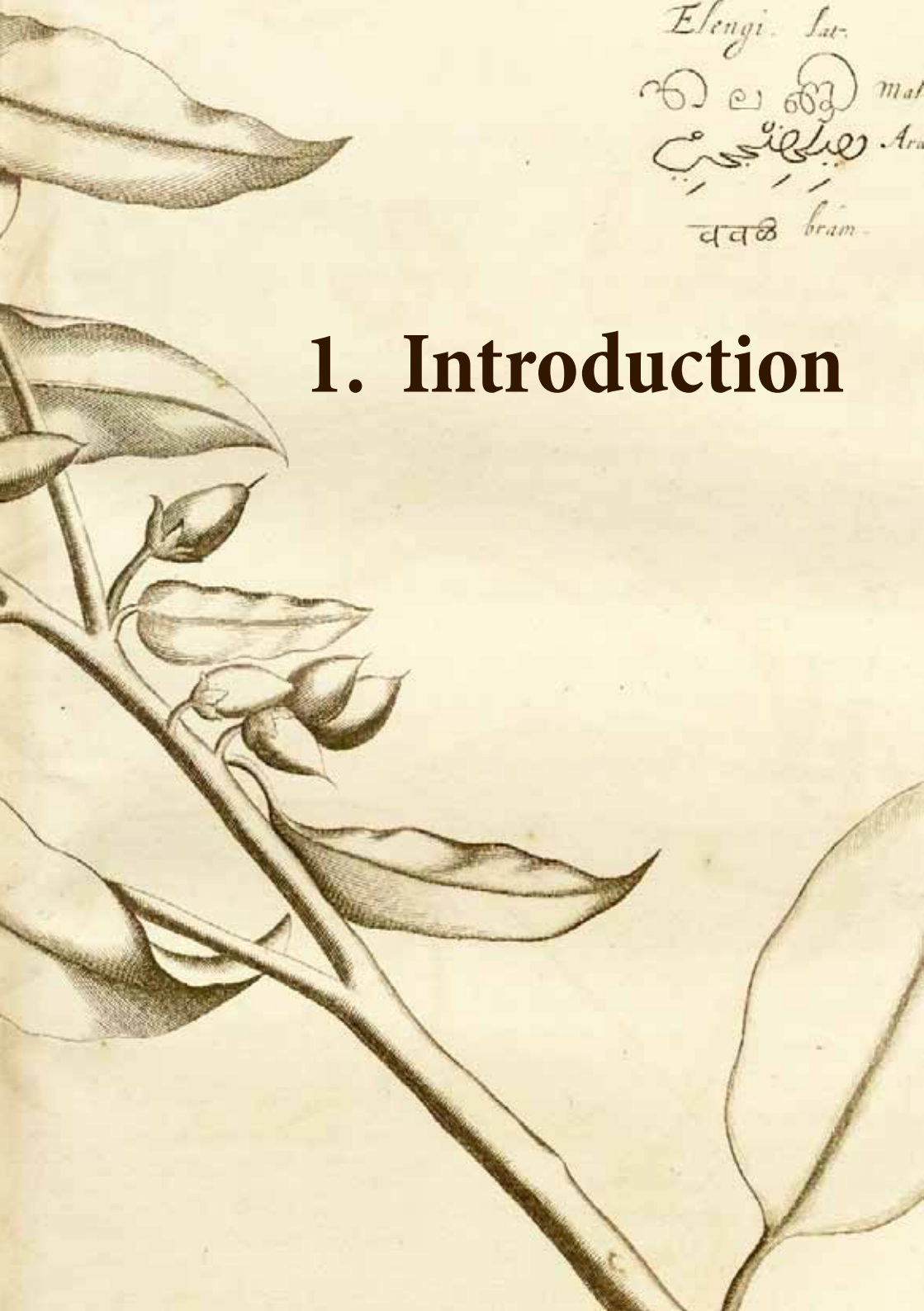

Ula Lat.
Mal.
Macadá-gongoli
Arab.

Table of Contents



1. Introduction

The needs of biodiversity and people are entwined. This is especially true in hotspots such as the Western Ghats which host enormous levels of biological diversity and high human settlement densities. The forests of the Western Ghats provide extensive benefits in terms of goods and services to communities that live in and around them. At the same time, as is the case with most tropical hotspots, increased rates of deforestation and biodiversity loss have been evident in the Western Ghats over the past few decades. Much of the region is now a matrix of agriculture and forest, and both cultivated land as well as forests provide extensive benefits for human livelihoods and sustainability. To sustain livelihood benefits and ecological services in landscapes where this transformation has already taken place, a set of appropriate strategies and management designs is necessary. However, to achieve these ends it is also necessary to understand that the drivers of this transformation go beyond the local to encompass a wider set of elements including public policy, socio-economic and cultural changes as well as the impacts of globalisation and its many manifestations including agricultural industrialisation.

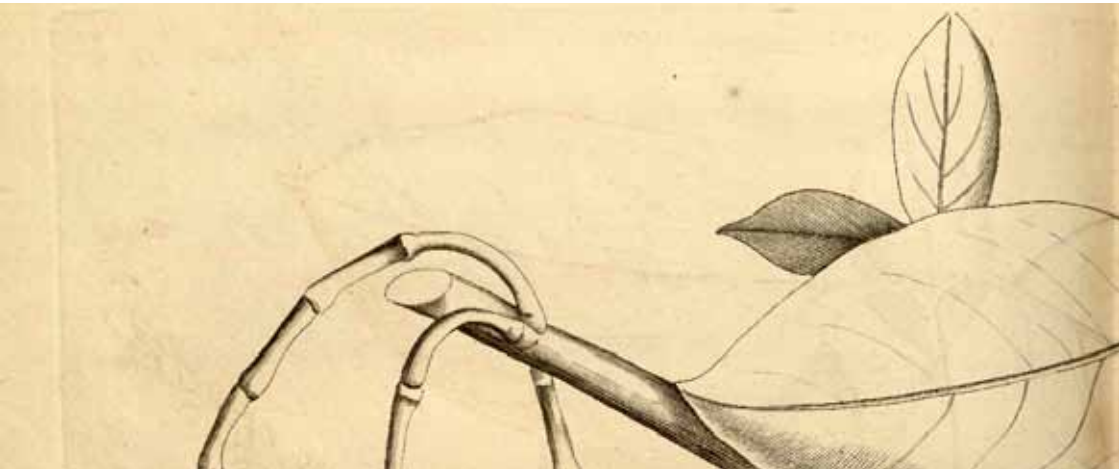
Under the current scenario, agricultural landscapes are managed with the sole focus of maximising economic gains or sustenance returns, whereas forested landscapes are largely managed under the protected area network or with specific forestry production aims. To combine non-productive land uses (e.g. biodiversity conservation) with those of production, it is important to adopt integrated perspectives towards landscape management which incorporate the conservation of biodiversity and ecosystem services, agricultural production and long-term sustainability. Efforts need to be dedicated towards achieving resilience of the landscape as a whole instead of managing parts of the whole. Diversification of agricultural landscapes is seen as a means of simultaneously retaining multiple values including production, conservation, social and amenity values. Although challenging, the potential for deriving these multiple benefits is very much present. This handbook is intended to provide an introduction to the key ecological elements that could be incorporated for multi-use planning as well as the socio-economic and political mechanisms by which some of these aspects are being incorporated in other parts of the developing world.

1.1. The setting and context

Considered one among the eight 'hottest' hotspots of global biodiversity, the Western Ghats-Sri Lanka complex is a critically important region from the point of view of species diversity and endemism. The region harbours approximately 5,000 species of vascular plants, over 50% of which are endemic. Even higher rates of endemism have been recorded for groups such as freshwater fishes (72%), reptiles (65%), amphibians (73%) and a number of invertebrate groups (e.g. tiger beetles). The southern Western Ghats (the region south of the Palakkad Gap), particularly the Agasthyamalai Hills and adjoining areas is the most diverse with highest recorded levels of plant diversity and endemism (http://www.biodiversityhotspots.org/xp/Hotspots/ghats/pages/biodiversity.aspx). The forests in the southern Western Ghats also host significant populations of large mammals including endangered large carnivores such as the tiger, elephants, gaur, and other wild ungulates. At the same time, the region has among the highest human densities among all hotspots as well as extensive agricultural landscapes which support cash crop cultivation and food production. Human occupation of the Western Ghats dates back over 12,000 years, starting initially as hunting activities and culminating in agriculture in the last two millennia (Chandran 1997). However, it was during the last two hundred years that the region underwent massive transformations largely as a consequence of clear felling for timber and agriculture especially commercial plantations. The central

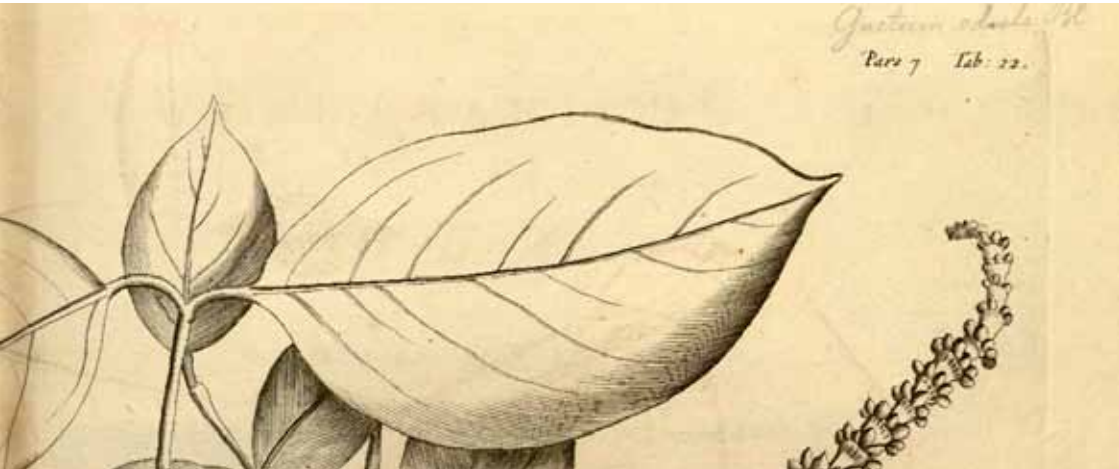
and southern Western Ghats is estimated to have lost 40% (approximately 8,000 km^2) of its forest cover between 1920 and 1997 (Menon and Bawa 1997). For the Agasthyamalai region in the southern Western Ghats, Ramesh et al. (1997) estimated a forest loss of 2.9% between 1920 and 1960, and for the following thirty years (till 1990) as 9.9%. Following the establishment of protected areas, deforestation has been curbed to a large extent.

The area under discussion presents a unique context for conservation and development. The Ranni Forest Division is a critical landscape for species as well as corridor level outcomes identified by various regional assessments like that of the Critical Ecosystem Partnership Fund. Situated between two protected area complexes of Periyar and Agasthyamalai, Ranni is one of the largest forest divisions in the region. Of particular importance within this region is the Gudarakal Range, a biodiversity rich and poorly studied landscape in the southern Western Ghats. The forests within Ranni FD constitute some of the most significant wet evergreen forests (forests of the Periyar Tiger Reserve and Gudarakal Range together constitute close to 700 km^2 of wet evergreen forests, the largest remaining contiguous patch of climax vegetation in peninsular India), mid-elevation grasslands, semi-evergreen and moist deciduous forests (Periyar Foundation 2006). The Forest Division also comprises plantations of Eucalyptus (largely planted by the Forest Department under the Grassland Afforestation Programme) as well as cardamom plantations. Abutting the protected areas are commercial plantations (primarily rubber) which are nearly as extensive and are appropriate for explorations of conservation value. Although leased for an extended period of time or privately owned, most of these areas have a high degree of vegetation cover and are refuges for a variety of taxa including mammals



and birds. For lesser taxa, these habitats hold nearly as much importance as the surrounding reserve forests.

Of equal importance to both biodiversity and rural livelihoods are the thousands of smallholdings that fill the interstices in the landscape. Smallholders typically cultivate a few food crops, kolinji (*Alpinia galanga*) and a small number of rubber trees which despite their small acreage brings in significant revenue. A large number of these land parcels belong to migrant settlers who moved in from various localities in central Kerala in during the government prompted 'Grow More Food Programme'. This scheme which was initiated as a response to a period of acute food grain shortage post-Independence saw the migration of a large number of the poor and the landless to clear and cultivate forests with hill paddy. When hill paddy yields plummeted after a few years of farming, tapioca, banana, and other crops were planted. As a consequence of a number of initial factors including Kerala's past development and welfare programmes which relegated these populations to the forest fringes, the smallholder settler community remains marginalised and less affluent. These areas are characterised by poor access to even basic infrastructure and facilities, unstable agricultural markets, unemployment and indebtedness. Compared to large landowners (or lessees) with cash crops such as rubber whose fortunes are determined largely by non-local forces and cushioned by corporate investment, small-holder livelihoods are locally determined and dependent on their overcoming of uncertain land tenure, agrarian distress, local political upheavals and extended periods of human-wildlife conflict. It is imperative that conservation/development interventions target smallholder settlers as the focus group and pay greater attention to their socio-economic and cultural milieu.

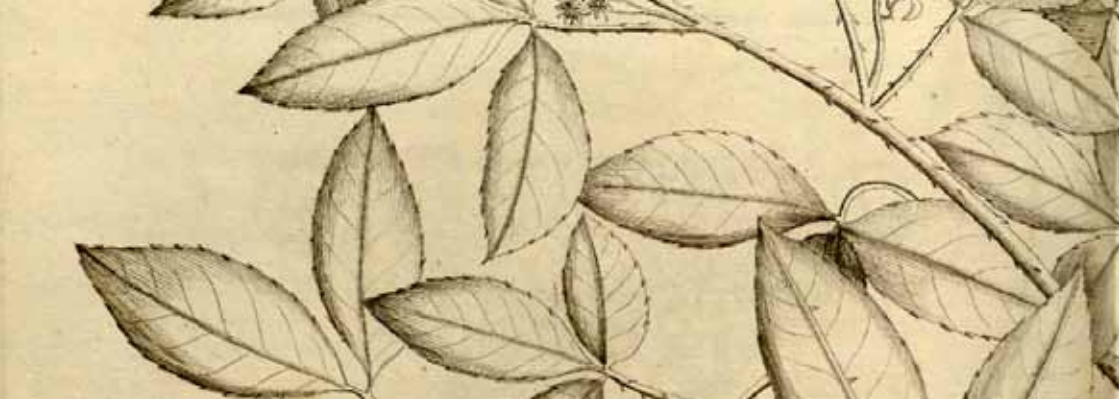


1.2. Challenges

In the context of forest-fringe landscapes in the southern Western Ghats, it is also important to understand the origins of some of the ongoing challenges which have the potential to bring about rapid landscape-level transformations. Although there have been previously documented transformations of significance, the history of settlement in this region that is of interest to the present study begins with the late 1940s and early 1950s. An extensive period of food grain shortage following India's independence from colonial rule and land reform saw the influx of large landowners, marginal farmers, kudikidappukars (formerly attached agricultural labourers who were hutment dwellers), and the landless from other regions of Central Travancore to the forests which were till now the realm of a few forest-dwelling nomadic tribal groups such as the Malampadaram. This migration – which was prompted by calls from the government to clear forest and cultivate rice – was widespread and continued over a period of time. Settler colonies became a typical feature of many forested districts in the Western Ghats. Although derived from different regional, caste and community denominations, a unique settler identity and livelihood ethic emerged, fostered by common experiences and obstacles which they surmounted as a group (e.g. abject poverty during the initial years, conflict with wildlife, etc.). Over a period of time, the Forest Department which emerged as the custodian of these lands persuaded some settlers to move elsewhere and others who remained were given title deeds with numerous restrictions. The intervening period also witnessed the implementation of far reaching forest related legislation (described in the next paragraph) which was protectionist in scope, and decades after their arrival in the area, a number of settler families are yet to receive title deeds to their lands. Much of this revolves around the issue of encroachments (in addition to allotted lands) which is contested both by the local people and the Forest Department. More recently, in an effort to preserve

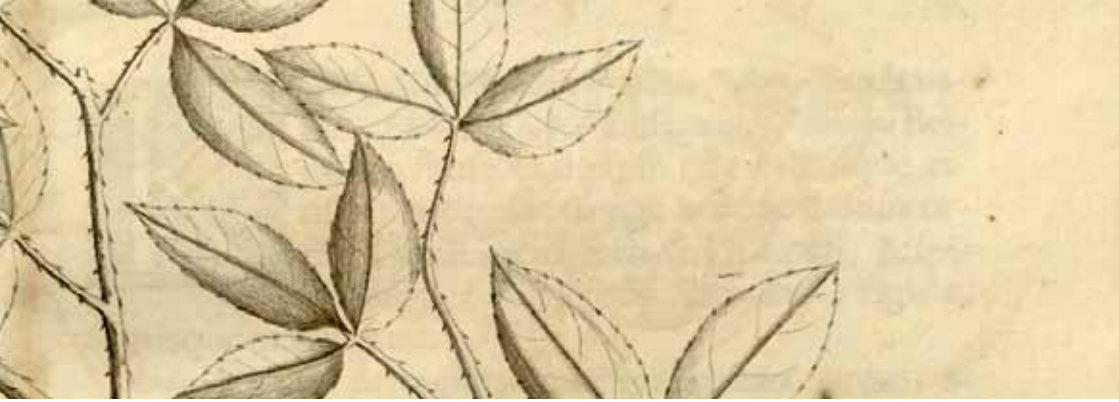
these forests, there has been a tendency by conservationists to downplay factors such as historical use of forests in the area. Surveys in this landscape indicate that uncertainty over property rights have resulted in wariness of conservation schemes, especially those which promote the maintenance of native tree cover.

From an ecological perspective, a significant challenge in the region relates to the preservation of native vegetation within individual plots of land. A number of far reaching laws enacted by the state government relating to the vesting of private forests, protection of valuable trees and taking over by resumption of leased lands laid the ground for the Kerala Preservation of Trees and Regulation of Cultivation in Hill Areas Ordinance, 1983, and the Kerala Preservation of Trees Act, 1986. The latter legislations were brought about to curb rampant and indiscriminate clearing of tree cover from private lands and to promote soil and water conservation in ecologically fragile upland areas. In a marginalised region already troubled by land tenure related issues, these restrictions have been viewed by local people as unfair and has resulted in a negative attitude to tree planting. Commentators on forest legislation in Kerala have pointed out that in contrast to large scale tree planting drives by the farm and social forestry sectors, the provisions of this legislation make people wary of cultivating trees in their homesteads (Thomas and Johnson 2008). In the study area a number of direct confrontations between the local people and authorities were recorded over tree felling from private properties. Surveys in the region also reveal that local people often inhibit the regeneration of native species as they see no benefits from trees, the use of even common species such as jack and *anjili* (*Artocarpus hirsutus*, a Western Ghats endemic) for household purposes is restricted or problematic (bribes demanded for genuine use permits, extended court cases for illegal felling, etc.).



Human-wildlife conflict is a defining feature of many forest-fringe communities. High levels of crop depredation has been reported by many households living proximate to forests in the southern Western Ghats. In the agricultural landscapes adjoining the Ranni FD, crop damage by wild boar, elephants, giant squirrels, flying squirrels porcupines and bonnet macaques have been reported. The highest degree of crop depredation is attributed to wild boar which is known to travel the furthest distance from forests into agricultural landscapes. Bonnet macaques are more frequently encountered in modified landscapes than within forests. Crop damage by elephants, although potentially catastrophic is less frequent. Compared to most other species, people appear to have a greater degree of tolerance towards elephants. Extended periods of conflict have prompted most farmers to prefer crops such as rubber and *kolinji* which are less palatable and therefore less prone to depredation. In fact, a number of survey respondents were of the opinion that the current agricultural land use pattern was primarily a response to an extended period of conflict. A recent government order permitting the culling of wild boar (specifically problem animals) is expected to bring relief to farmers in five districts in Kerala including Pathanamthitta district where the study area is located. Compensation schemes for crop damage seem to be viewed unfavourably by landholders. Many individuals were critical of the tedious compensation procedure where crop loss had to be verified with both the Forest Department and the Krishi Office and the compensation received was in many cases reportedly less that the amount spent on procuring it.

Trade agreements, policies and markets operational in other parts of the world can sometimes act as external drivers of socio-economic and environmental change. Moreover, many such drivers often bring about abrupt, drastic



change to agricultural land use. Studies from a many countries also show that agricultural incentive policies, taxation, subsidies and trade policies are more influential than forest policies in determining land use (James et al. 2001; Nanjundaiah 2008). Agricultural subsidies, market intervention by the government, promotion of exports and international trade agreements have been identified to be instrumental in the development of plantation crop markets. The forward looking land policies of the erstwhile kingdom of Travancore and the new state of Kerala which brought about reform and equity also encouraged extensive conversion forest and agricultural land to plantations especially rubber (Thomas 2004). Large tracts of forest land were also leased for the cultivation of a number of plantation crops including rubber. More recently in the 1980s, rubber has also been planted with funding from schemes such as the Western Ghats Development Programme (http://www.sfckerala.com/state_farming_%20about_us.htm).

In the recent rubber boom, it has to be noted that in the southern Western Ghats, agricultural lands (as opposed to forest) are being replaced by rubber plantations. While the contribution of this plantation crop to the economy and livelihoods continues to be significant to the study area as well as to the state of Kerala, as exotic monocultures their benefits to biodiversity conservation are limited, and presents high risks from price fluctuations and to food security. For South Asian smallholders in particular, rubber mixed cropping systems with fruit, medicinal plants and timber (that enhance food security, livelihood benefits and local biodiversity) has been recommended (Nath 2010). In the forest fringe areas of the southern Western Ghats, rubber is one of the few crops that can withstand crop raiding from species such as wild boar. The role of revenues from rubber in arresting conversion of private lands to residential properties

need to be explored in detail. As rubber brings in significant revenues, it has been speculated that sales of land are more likely only in exigent circumstances. Pilgrimage related activities have escalated in the region over the past few years. The Sabarimala temple situated within the region has become one of the most popular pilgrim centres in southern India. The areas in and around Ranni Forest Division, particularly routes within the Gudarakal Range are used extensively during the pilgrim season. Spillover sites in the neighbouring panchayats (especially high vantage points from which the Makarajyoti is visible) also attract an increasing number of pilgrims. However, as a pilgrimage that involves millions of devotees, there are extensive and ecological and economic dimensions, some of which are challenges. Among the significant ecological impacts that have been reported include the extensive pollution of the upper catchment of the Pampa River from human waste, degradation around the temple complex, major approach routes, grasslands and reservoirs such as Pampa and Kakki (http://www.cedindia.org/2008/10/study-of-ecological-and-environmental-status-of-upper-catchment-area-of-pamba-river-basin-using-satellite-data/). There has also been reports of ingestion of food and plastic waste by wild mammals such as elephants, wildboar, sambar, primates, etc. and elephant deaths have also been reported in this connection. A few incidents involving direct conflicts between elephants and pilgrims have also received press. A number of cleanup drives and studies that have been launched to tackle these issues, and range from regular waste removal drives,

plastics-free campaigns and awareness programmes by the Van Samrakshan Samithi (VSS), the Forest Department and non-governmental groups and focused studies by local groups (e.g. a study by TIES reporting on plastic in elephant scat). While these initiatives are truly commendable, it cannot be stressed adequately that a larger framework for ecological sustainability of the pilgrimage has to be devised considering the enormity of the situation. It has to be also noted that in addition to the revenues received by the Travancore Devaswom Board (TDS), the pilgrimage is a lucrative business season for a large number of people, from all denominations, including the local communities and a temporary populace that services the pilgrims. Since 1998, a number pilgrim amenity centres have been managed by the fringe-area communities under the Eco-development project that was initiated in neighboring Periyar Tiger Reserve in that period. An economic analysis of the latter reports a number of drawbacks (Pillai 2007). However, the expansion of the Sabarimala pilgrimage and associated business opportunities have acted as a catalyst for further demands of development of other smaller pilgrim centres in the region. A notable example is the Aluvankudi temple in the Gurunathanmannu-Kunnam area which is visited by pilgrims during Mahasivaratri. This pilgrimage is of a more regional nature. The Gurunathanmannu-Kunnam area is considerably more backward than the surrounding areas and in need of basic facilities. However, any development in the area needs to be first assessed for environmental sustainability.

2. Why are modified landscapes important?

2.1. Biodiversity conservation

One of the primary conservation dilemmas today is the limited availability of areas for expansion of the protected area network whose primary aim is biodiversity conservation. As a result, innovative strategies need to be adopted towards maximising benefits from systematic conservation planning as well as the preservation of biodiversity outside parks and sanctuaries. Reconciliation ecology provides such a framework that shows promise in supplementing reservation and restoration efforts. The main theoretical premise of reconciliation ecology is based on one of ecology's most universal laws – the species area relationship. When isolated reserves are the only habitats that receive protection, the projected loss of species in areas that are completely unprotected can show a linear relationship with the loss in area over the long term. On the other hand, reconciliatory landscapes have the potential to maintain considerably high levels of species diversity, acting as refuges and buffers for a variety of species, and playing a key role in long term persistence (Rosenzweig 2001, 2003).

In the Western Ghats, these aspects have been explored for a number of habitat types and certain habitat types have already been identified as integral to biodiversity conservation. Examples include cardamom plantations and polyculture coffee plantations that typically have native canopies and need to be evaluated further. However, in spite of the call for reconciliation, the integration with socio-cultural aspects and policy has not been attempted so far and the actual identification and prioritisation of reconciliatory landscapes are yet to be carried out. The case for reconciliation is particularly strong in areas such as the Western Ghats which is regarded as one of the most densely populated hotspots in the world. Much of the area is a mosaic of forest and human impacted landscapes. Extensive areas of the modified landscapes in the study area are made up of plantations of rubber, tea, coffee and cardamom, which have considerable vegetation cover and conservation value. Many of these areas have the potential to play a vital role in the long term persistence of biological diversity. Similarly, many of the forested landscapes can provide ecosystem level benefits to agricultural landscapes.

Biodiversity

Biodiversity or biological diversity refers to the variety of all forms of life ranging from genes to species to ecosystems. Biodiversity is not evenly distributed across the world. Its distribution within various regions of the earth depends on a variety of factors. It is widely accepted that an environment with its complete complement of biodiversity offers the broadest options for sustainability. Biodiversity is an interplay of three primary attributes: composition, structure and function.

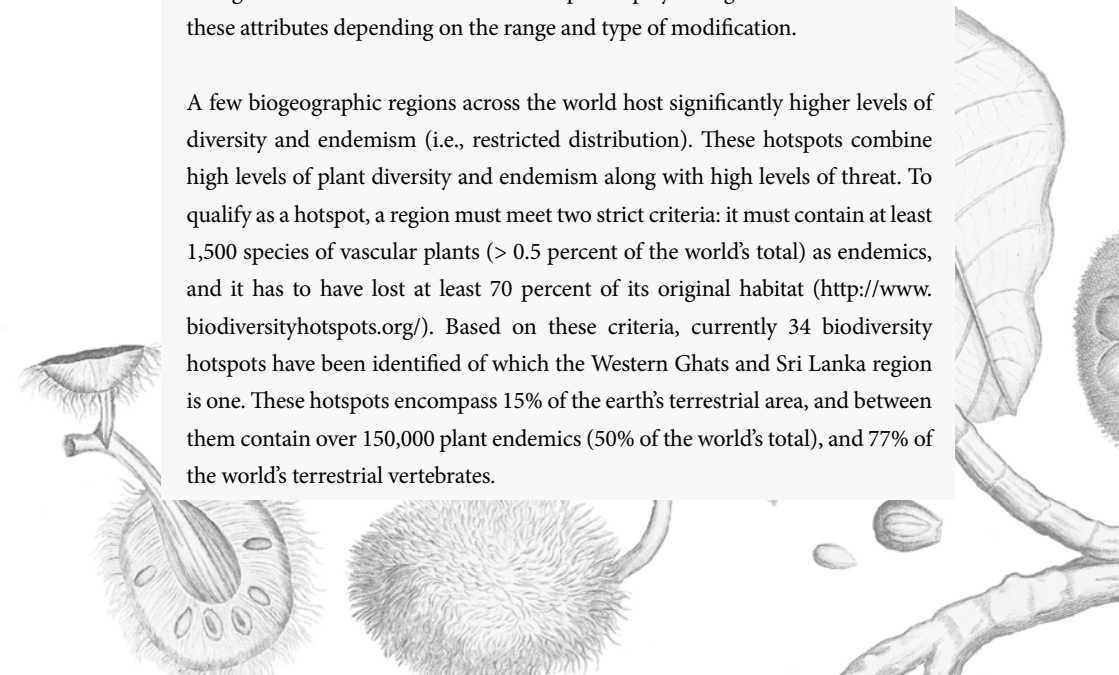
Composition - refers to the identity of elements. These elements can be identified at various levels from genetic to ecosystem level components.

Structure - refers to the physical patterns of life forms that result in emergent features such as habitat complexity, patch characteristics, etc.

Function - refers to functional aspects and physical, ecological and evolutionary processes that take place within ecosystems. Function refers to a range of processes including biogeochemical cycles, gene flow, etc.

Since these three features are interrelated, changes in one can bring about changes in the others. Modified landscapes display changes in one or more of these attributes depending on the range and type of modification.

A few biogeographic regions across the world host significantly higher levels of diversity and endemism (i.e., restricted distribution). These hotspots combine high levels of plant diversity and endemism along with high levels of threat. To qualify as a hotspot, a region must meet two strict criteria: it must contain at least 1,500 species of vascular plants (> 0.5 percent of the world's total) as endemics, and it has to have lost at least 70 percent of its original habitat (http://www.biodiversityhotspots.org/). Based on these criteria, currently 34 biodiversity hotspots have been identified of which the Western Ghats and Sri Lanka region is one. These hotspots encompass 15% of the earth's terrestrial area, and between them contain over 150,000 plant endemics (50% of the world's total), and 77% of the world's terrestrial vertebrates.



2.2. Ecosystem services

An ecosystem is a community of organisms interacting with each other and with the environment in which they live. Ecosystems include different groups of plants and animals as well as physical and chemical components such as nutrients, soil, water, etc. They vary enormously in size and scale and depending on their definition can vary from minute microhabitats (e.g. a temporary pool of water in a tree hole) to extensive areas such as an ocean basin or a rainforest. Natural and managed ecosystems provide a variety of goods and processes that are beneficial to human welfare. These services range from products that are harvested directly from ecosystems (e.g. food, fibre, timber, minerals and water), cultural and spiritual benefits, to more complex regulating and supporting services such as carbon sequestration, nutrient cycling, crop pollination, etc. which indirectly support and improve human livelihoods. While functioning ecosystems provide a variety of products and services, the majority of ecosystems are under pressure from human activities that result in the over-exploitation of resources and the disruption of linkages. The Millennium Ecosystem Assessment (the largest scientific assessment to date addressing the health of ecosystems worldwide) concluded that over 60% of the world's ecosystems are currently used in an unsustainable manner. In many parts of the world, the loss of ecosystem services is paralleled by an associated loss of other aspects of human welfare - e.g., loss of traditional knowledge, increased vulnerability, poor agricultural productivity, etc. Studies on the social aspects of ecosystem services also show that ecosystem degradation affects poor people (especially poor and marginalised communities in rural areas) as they lack the financial and institutional buffers that the affluent elite have (MEA 2005).

To illustrate the concept of ecosystem services further, we can examine several examples that are pertinent to the southern Western Ghats. The Western Ghats is a key production landscape for several species of timber, fibre and food crops whose wild varieties are derived from its forest as well as a number of introduced species that are cultivated at the plantation scale. Wild populations of species such as pepper (*Piper* sp.), cardamom (*Elettaria cardamomum*), cinnamon (*Cinnamomum* sp.) and nutmeg (*Myristica* sp.) are found growing in the forests of the region. Extensive areas are also under crops such as coffee, tea and rubber which have been introduced into the area. One of the most expensive spices in the world, cardamon growing wild in the mid elevation wet evergreen forests of the Western Ghats is pollinated by solitary bees belonging to the genus Megachile and Amegilla. Cultivated populations of this spice benefit from pollination by the social bees *Apis dorsata*, *A. cerana* and *Trigona iridipennis*, which are themselves commercially important species. Other recorded pollinators include a wasp (*Xylocopa verticalis*), the purple sunbird (*Nectarina asiatica*) and the little spiderhunter (*Arachnothera longirostra*). In addition to higher farm incomes and subsistence benefits from honey and bees wax, native as well as introduced pollinators have the potential to increase yields and revenues for a variety of crops including coffee which is grown in different parts of the hotspot. Pollinators include a variety of animal groups including bees, butterflies, beetles, birds and even mammals. To cite an example where such valuation studies have already been conducted, studies from Costa Rica show that forest-based pollinators increased coffee yields by 20% in farms (within a kilometre of forest pacthes) resulting in annual profits to the tune of $ 60,000 per farm (Ricketts, et al. 2004).

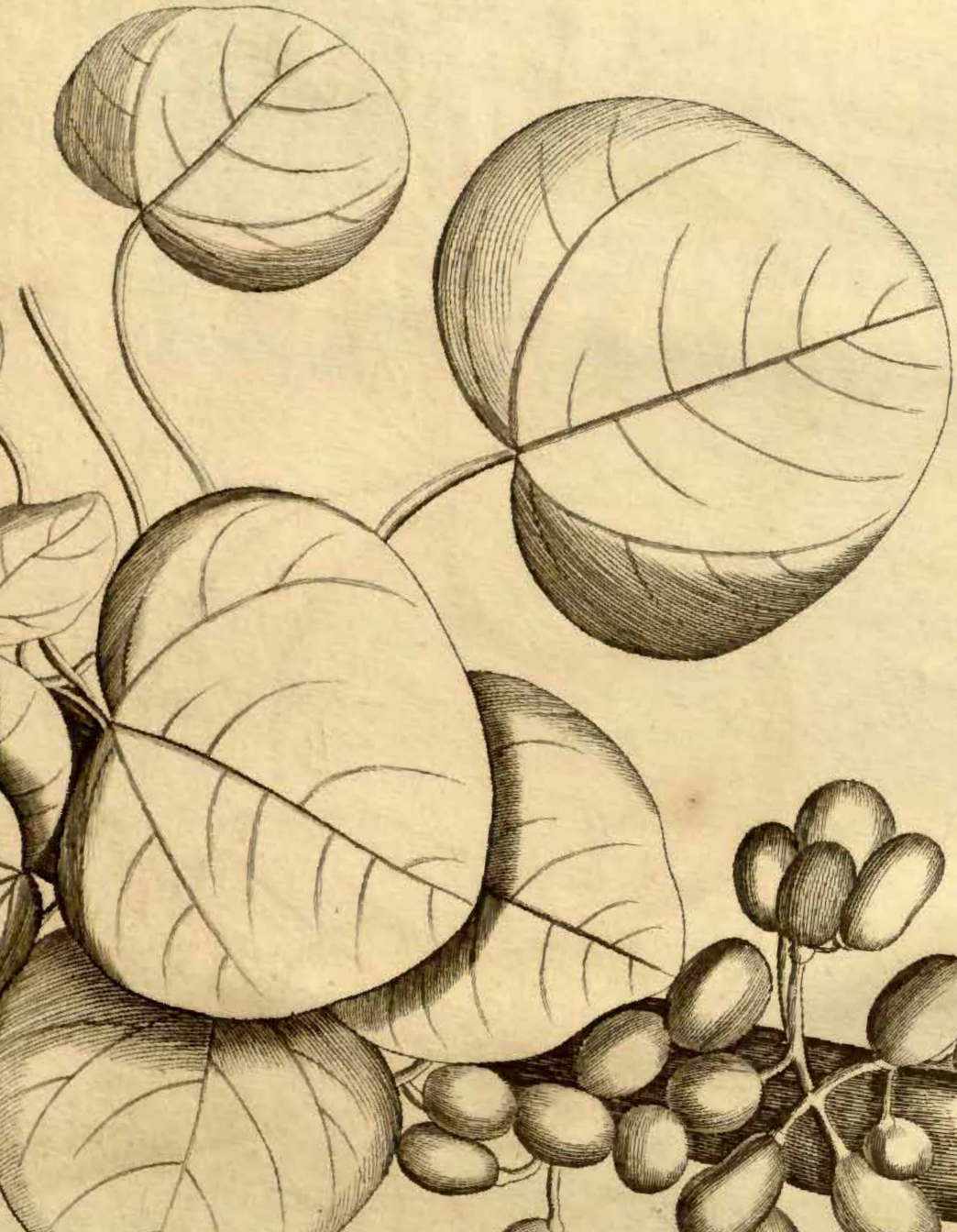
Similarly, natural ecosystems proximate to farms also improve crop production by reducing the incidence of herbivores, pathogens and weeds. It has been reported that rubber cultivations tend to suffer from lower levels of herbivory when they are located adjacent to diverse, natural forests (Diaz et al. 2005). High crop richness (e.g. polycultures, intercropping systems) and proximity to natural forests therefore enhances benefits to agriculture as the frequency with which biocides need to be applied (and developed to counter resistance) and providing additional benefits such as biocide free farm products (Diaz et al. 2005). Pollination and natural pest control are just two examples of important biodiversity related ecosystem services that have direct linkages to agricultural yields and food security. Although many such services have been quantified till date or estimated easily, it is accepted that farmlands in proximity to forest or interspersed with forest patches stand to benefit extensively from these services. Benefits for agricultural systems from biodiversity is just one example of ecosystem services. On a larger scale, provisioning ecosystem services including clean water and hydel power from the Sabarigiri Project in the southern Western Ghats are already widely known.

Regulating
These services include indirect benefits such as maintenance of air and water quality, climate regulation, carbon sequestration, prevention of water runoff and soil erosion, crop pollination, pest and disease control, protection from natural hazards, etc.

Supporting
Soil formation, nutrient cycling, photosynthesis, primary production, water cycling, seed dispersal, etc. are also indirect benefits provided by way of supporting services from ecosystems.

Provisioning
These services include goods and products obtained directly from ecosystems such as food, fibre, medicines, fuelwood, timber, freshwater, minerals, energy, etc.

Cultural
Cultural services include the non material benefits obtained from ecosystems such as recreational and aesthetic enjoyment, spiritual renewal, intellectual and scientific discovery, etc.



3. Ecological strategies for retaining and enhancing biodiversity and ecosystem services in modified landscapes

Most ecological systems are complex entities often encompassing interrelationships between a large number of organisms and the environment in which they live. In the past a great deal of ecological work focused on individual species but ecologists now work on linking patterns in biodiversity with ecosystem function. Even so, collecting, analysing and interpreting data for each place and system is neither practical nor feasible. Establishing reliable scientific knowledge that can assist in planning interventions is therefore not easy. However, examining an increasing number of studies from across the world has helped us to infer some general rules and recurrent patterns which can contribute to our understanding of the relationship with biodiversity, ecosystem services and landscape modification. These results when linked with appropriate locality specific factors might provide the best results in planning sustainable modified landscapes.

This section outlines some of the introductory principles of landscape design which are central to understanding landscape integrity. This section also attempts to summarise key results of existing studies from the Western Ghats and elsewhere that deal with the relationship between landscape change and biodiversity and ecosystems services. Together, these aspects can assist forest managers, planners and other stakeholders in developing ecological strategies for landscape level planning. It has to be stressed here that this section deals primarily with ecological concepts related to landscapes; human ecological dimensions ranging from natural resource dependent livelihoods, equity, social and environmental justice, local histories, ethics and governance are equally and sometimes more important criteria for developing overall strategies.

Some useful concepts relating to landscape and regional ecology
(from Forman 1995)

Landscapes and regions

A mix of local ecosystem or land use types is repeated over the land forming a landscape, which is the basic element in a region at the next broader scale composed of a non repetitive, high-contrast, coarse-grained pattern of landscapes.

Both landscapes and regions are land mosaics at different spatial scales. All mosaics are composed of spatial elements. Those at the landscape scale are commonly called landscape elements, and those at the regional scale are landscapes.

Patch, corridor and matrix

The arrangement or structural pattern of patches, corridors, and a matrix that constitute a landscape is a major determinant of functional flows and movements through the landscape, and of changes in its pattern and process over time. Every point in a landscape is either within a patch, a corridor, or a background matrix, and this holds in any land mosaic, including forested, dry, cultivated, and suburban. This simple model provides a handle for analysis and comparison, plus the potential for detecting general patterns and principles.

Large natural vegetation patches

These are the only structures in a landscape that protect aquifers and interconnected stream networks, sustain viable populations of most interior species, provide core habitat and escape cover for most large-home-range vertebrates, and permit near-natural disturbance regimes. Large natural-vegetation patches serve many major ecological roles and provide many benefits in a landscape. A landscape with only large patches of natural vegetation misses few values. On the other hand, small natural-vegetation patches serve as stepping stones for species dispersal or recolonization, protect scattered rare species or small habitats, provide heterogeneity in the matrix, and habitat for an occasional small-patch-restricted species. Small patches provide different benefits than large patches, and should be thought of as a supplement to, but not a replacement for, large patches. An optimum landscape has large patches

of natural vegetation, supplemented with small patches scattered throughout the matrix. Alternatively, most of the small-patch functions can be provided by small corridors in the matrix.

Patch shape

To accomplish several key functions, an ecologically optimum patch shape usually has a large core with some curvilinear boundaries and narrow lobes, and depends on orientation angle relative to surrounding flows. A compact or rounded form is effective in conserving internal resources, by minimizing the exposed perimeter to outside effects. The orientation of the long axis of a patch relative to flows in the landscape, i.e., the orientation angle, is also key to several ecological phenomena such as wind and water flows, which sculpt patch shapes, produce distinct areas of turbulence, and cause soil erosion.

Interactions among ecosystems

All ecosystems in a landscape are interrelated, with movement or flow rate of objects dropping sharply with distance, but more gradually for species interactions between ecosystems of the same type. From ecosystem science we learn that energy and mineral nutrients flow from one object to another within, or between, ecosystems. From behavioral science, because certain habitats are more suitable than others for a species, many locomotion-driven movements are directional, toward patches of the same type. Combining these principles with the first law of geography (everything is interrelated, but near objects are more related than distant objects) provides this spatial-flow principle, useful for example, in estimating which ecosystems of the mosaic to focus on in planning and management.

Metapopulation dynamics

For subpopulations on separate patches, the local extinction rate decreases with greater habitat quality or patch size, and recolonization increases with corridors, stepping stones, a suitable matrix habitat, or short inter-patch distance. A metapopulation is a population consisting of spatially-separate subpopulations that are connected by the dispersal of individuals. Metapopulation dynamics is of special importance, because subpopulations may drop to zero (local extinctions), especially in small isolated patches - resulting in the extinction of the population. However, because individuals sometimes move between

subpopulations, two results occur. First, the local extinction rate (the number of species disappearing from a patch per unit time) is lowered. Second, when local extinction does take place, recolonization of individuals may reestablish a new subpopulation at the site. Consequently, with extinctions followed by colonizations the metapopulation as a whole persists. Recolonization is enhanced by spatial patterns such as corridors, networks, a row of stepping stones, and a cluster of small patches.

Landscape resistance

The arrangement of spatial elements, especially barriers, conduits, and highly-heterogeneous areas, determines the resistance to flow or movement of species, energy, material, and disturbance over a landscape. Landscape resistance is described as the effect of spatial pattern impeding the rate of flow of objects, such as species and materials. For example, boundaries separating spatial elements are locations where objects usually slow down (or in some cases accelerate). Hence, boundary-crossing frequency, i.e., the number of boundaries per unit length of route, appears to be a useful measure of resistance. Certain landscape elements are more suitable, and others less suitable, to movements and flows. In addition, corridors can act to channel or enhance flow, or act as barriers or filters inhibiting spread. Highly-heterogeneous areas have a high probability of containing unsuitable elements, thus requiring a high boundary crossing frequency and/or a convoluted route. Therefore, we expect heterogeneous fine-grained areas to have a high resistance.

Grain size

A coarse-grained landscape containing fine-grained areas is optimum to provide for large-patch ecological benefits, multihabitat species including humans, and a breadth of environmental resources and conditions. The grain size of a landscape mosaic is measured as the average diameter or area of all patches present. A coarse-grained landscape with only large patches may provide large natural-vegetation patches for aquifer protection and specialist interior species, large built areas for industrial specialization, and so forth. In contrast, a fine-grained landscape has predominantly generalist species, since specialists requiring a large patch of one land use cannot survive. Compared to a coarse grained landscapes, a fine-grained landscape is less monotonous (every portion is about the same), although site diversity is high (each adjacent point is a different land use). Species that survive need only move short distances. A

medium-grained landscape misses the large patch benefits and offers no other advantages. In short, all of the preceding benefits, and few shortcomings, are provided by a coarse-grained landscape that contains some fine-grained areas.

Landscape change

Land is transformed by several spatial processes overlapping in order, including perforation, fragmentation and attrition, which increase habitat loss and isolation, but otherwise cause very different effects on spatial pattern and ecological process. Habitat fragmentation is but a phase in a broader sequence of spatial processes transforming land by natural or human causes from one type to another. Perforation is the process of making holes in an object such as a habitat or land type (e.g., dispersed houses or fires in a forest). Dissection is the carving up or subdividing of an area using equal-width lines (e.g., by roads or power lines). Fragmentation is the breaking of an object into pieces (that are often widely and unevenly separated). Shrinkage is the decrease in size of objects, and attrition is their disappearance. These five spatial processes overlap through the period of land transformation. They also are usually ordered in their importance, with perforation and dissection both peaking in relative importance at the outset. Fragmentation and shrinkage predominate in the middle phases, and attrition peaks near the end. These spatial processes all increase habitat loss and isolation. However, average patch size decreases in the first four processes, and typically increases upon attrition, because small patches are most likely to disappear. Connectivity across an area in continuous corridors or matrix typically decreases with dissection and fragmentation. The total boundary length between original and new land types increases in the first three processes, and decreases with shrinkage and attrition. In short, each spatial process has a highly distinctive effect on spatial pattern, and consequently on ecological processes, in a changing landscape.

Mosaic sequence

Land is transformed from more- to less-suitable habitat in a small number of basic mosaic sequences. Diverse mechanisms from logging and suburbanization to wildfire and desertification transform land from one type to another. Each land transformation is effectively a mosaic sequence, i.e., a series of spatial

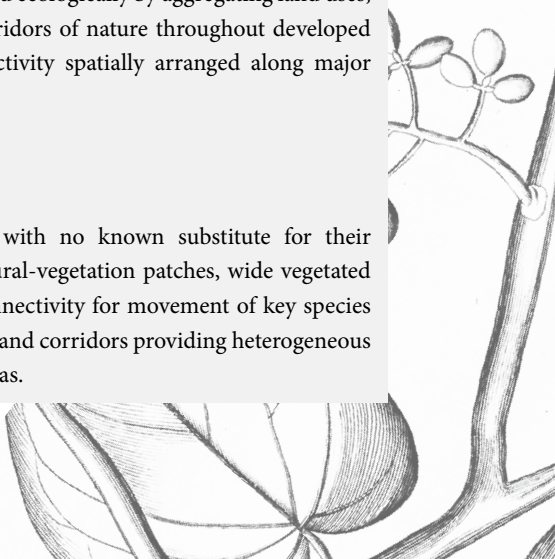
patterns over time. Five sequences are widespread. (1) Edge: a new-land-type spreads unidirectionally in more or less parallel strips from an edge. (2) Corridor: a new corridor bisects the initial-land-type at the outset, and expands outward on opposite sides. (3) Nucleus: spread from a single nucleus within the landscape proceeds radially, and leaves a shrinking ring of the initial-land-type. (4) Nuclei: growth from a few nuclei produces new land-type areas expanding radially toward one another. (5) Dispersed: widely dispersing new patches rapidly eliminates large patches of the initial-land type, produces a temporary network of the initial land- type, and prevents the emergence of large patches of the new-land-type until near the end. The five sequences can be compared based on a wide range of ecological characteristics known to correlate with the spatial attributes. Assuming that the initial land-type is more ecologically suitable than the new type, the mosaic sequences are compared to determine which retains the ecologically best arrangement of initial-land-type for the longest period. Based on the ecological characteristics correlated with the spatial attributes, the 'edge' mosaic sequence is considered ecologically the best of the five transformation sequences. It has no perforation, dissection, or fragmentation. It is best for the large patch attributes, and good for connectivity. Yet, shortcomings of the 'edge' sequence include no 'risk spreading', a progressive narrowing of the remnant initial-type until it is only a strip, and an extensive area of new-land-type without small patches and corridors.

Aggregate with outliers

Land containing humans is best arranged ecologically by aggregating land uses, yet maintaining small patches and corridors of nature throughout developed areas, as well as outliers of human activity spatially arranged along major boundaries.

Indispensable patterns

Top-priority patterns for protection, with no known substitute for their ecological benefits, are a few large natural-vegetation patches, wide vegetated corridors protecting water courses, connectivity for movement of key species among large patches, and small patches and corridors providing heterogeneous bits of nature throughout developed areas.



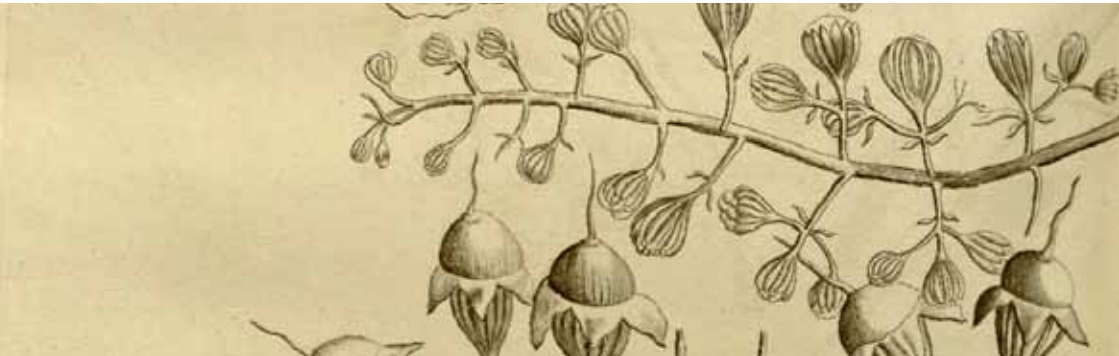
A number of studies are available that explore general principles for sustainability in modified landscapes (e.g. DeFries et al. 2007; Chazdon et al. 2008; Harvey et al. 2008).

The following points summarise some of the general results from studies across the world:

- Many studies have recorded a positive relationship between high structural and floristic complexity and levels of biodiversity.

- Heterogenous landscapes which retain abundant, native tree cover (e.g. forest fragments, fallows, riparian corridors, shade canopies, dispersed trees, live fences, etc.) act as refuges, buffers and movement corridors for a large number of species, retain the potential for regeneration and restoration, and contribute to the maintenance of ecosystem services (e.g. carbon sequestration, pest management, soil and water conservation, etc.).

- At large spatial scales, forest patches and connecting corridors can enhance connectivity between protected areas (e.g. between Periyar and Agasthyamalai) acting as effective conduits for movement of even large mammals species; landscape configurations where connectivity is maintained with forest patches, which contain a diverse array of habitats with higher levels of biodiversity are beneficial; forest corridors, riparian corridors, hedgerows, live fences and windbreaks are examples; riparian corridors (vegetation along rivers and streams) which connect agricultural landscapes with forests are among the most beneficial habitat structures for biodiversity.



- Tall emergent trees are particularly important in tropical landscapes as they provide food resources, nesting and roosting sites to large numbers of birds and small mammals; in tropical Asian landscapes, *Ficus* species act as keystone species on which a large number of other species depend; *Ficus* trees are also ideal shade trees that can be planted along roadsides, are important from a cultural and religious perspective; in the forests and agricultural landscapes of southern India, large, fast-growing *Bombax* species also sustain a large number of bird and mammals populations; *Bombax* are also preferred trees for bee hives and the locations of these trees are often monitored by forest-dwelling tribal groups that collect honey.

- Restoration projects are more likely to work if corresponding interventions are selected according to the level of degradation of the landscapes.

- Traditional agricultural practices are often more ecologically friendly as they often harbour wild biodiversity and a diverse array of indigenous varieties; in addition to biodiversity services, these landscapes are more valuable for food security and cultural diversity.

- sacred groves and vegetation patches of cultural importance also play an important role in maintaining local biodiversity and by providing resources such as medicinal plants.

- Small farmers who have worked on the land for generations often know their land intimately, preserve indegenous varieties and practices and cultivate for subsistence; the downside is that in the current scenario (increased food prices and small landhodings), there is a tendency to apply more chemical inputs to increase productivity.

- Some agricultural systems have a greater potential for natural regeneration and restoration than others; industrial agriculture, especially monocultures are less biodiversity friendly than small-scale traditional agroforestry systems; large scale industrial agriculture especially involving exotics (e.g. soybean, oil palm, rubber) is generally considered detrimental to biodiversity.

- Remnant and restored native biodiversity provides ecosystem services for agricultural production; agricultural crops dependent on insect pollination for their seed set (e.g. coffee) greatly benefit from natural pollinators; in the Western Ghats a number of species including greatly valued spices like cardamom benefit from insect pollination; other benefits include control of predators and pests, and reduction of fungal attacks and weed growth that benefit crop production; some of these services help reduce expenses for fertiliser and pesticide inputs while at the same time provide the advantages of organic agriculture; in farming systems which have grain and tubers, rodent populations are often controlled by snakes.

- Forest fragments and remnant trees provide are critical to restoration of surrounding degraded areas as they provide propagules

- In some instances, livestock provide beneficial services to biodiversity by helping the spread of propagules, reducing grass cover and fuel loads in the understorey; however, increased livestock numbers often have severe negative consequences to sustainability; these range from diseases spread from cattle to wild species, competition for forage as well as the degradation of forest edges.

- Different taxa respond to landscape change differently; groups such as bats are known to adapt to a high degree of habitat modification and fragmentation, whereas those such as dung beetles, small amphibians and some reptiles are sensitive to even low levels of fragmentation;

bat populations on the other hand are known to react adversely to chemical and pesticide use; among birds, specialists such as understory insectivores are widely known to be affected by fragmentation and other forms of disturbance whereas frugivores and generalists are less affected especially if there are fruiting trees in the landscape; some groups of birds such as shrikes and other generalist insectivores show increased abundance and provide predatory control of ants and other invertebrates; although various groups of taxa respond differently to the fragmentation and loss of native habitats, the richness and abundance of most groups decline with increasing distances from forests and forest patches and the extent of native vegetation cover in a landscape.

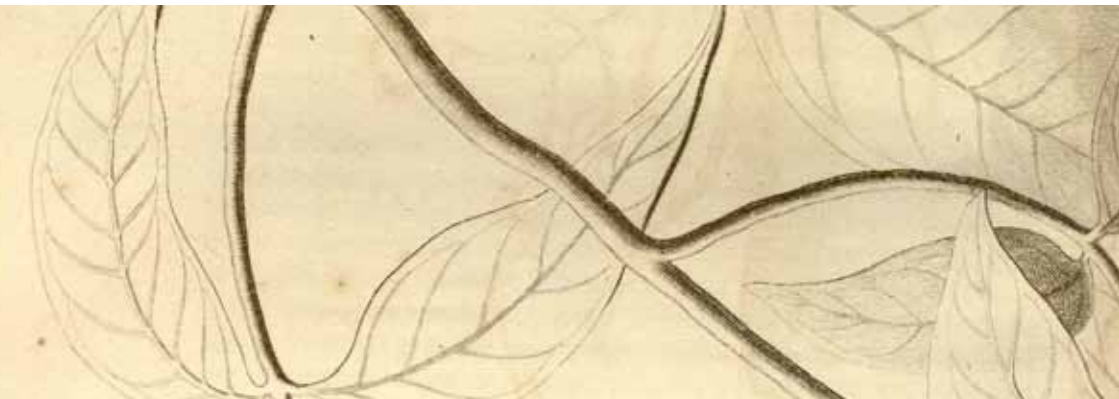
The fragility of mountain systems

Ecological processes and their responses to human disturbance need to be viewed differently in mountains. Mountain ecosystems are generally considered to be ecologically fragile especially in terms of terrain and climatic changes which can have significant impacts on biodiversity. The integrity of slopes is maintained by their vegetation cover, and the removal of vegetation often results in soil instability particularly landslides and downstream impacts like soil erosion and sedimentation. In many mountain systems, higher elevation biomes contain the highest concentration of soil organic matter, which gets rapidly degraded with disturbance. For many taxa, species richness along elevational gradients peaks in the middle of the gradient. Human land use especially plantation agriculture that favours middle altitudes with gentler slopes fragments species ranges and isolates low elevational and high elevational species. These processes disrupt metapopulation dynamics, source sink effects, genetic diversity and a number of evolutionary processes that are regulated by mid-elevational peaks in species diversity. This is a particularly crucial issue against the backdrop of climate change, as fragmentation along altitudinal gradients is likely to disrupt species migration and colonisation to cooler climates. Threats from invasive species are also more for disturbed systems.

3.1. The Western Ghats and human modification

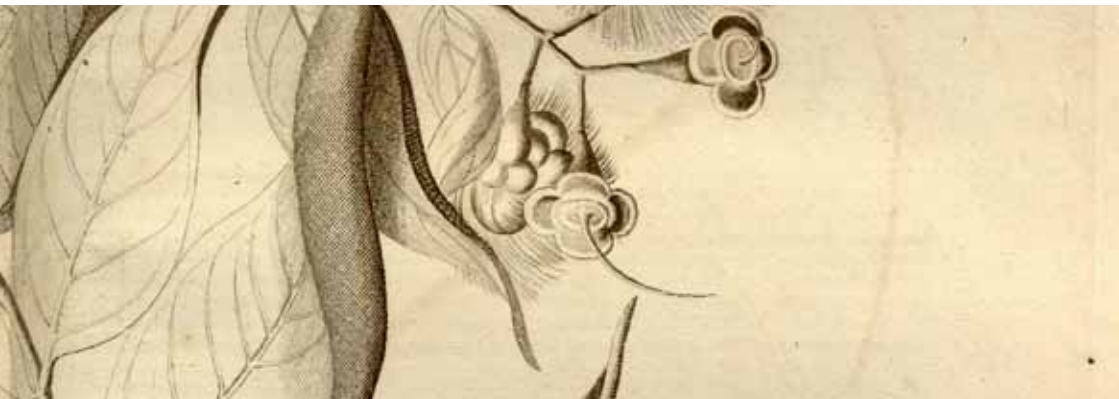
The Western Ghats has received a lot of attention from biologists and conservationists in the country, perhaps more so than any other biogeographic zone in India. Therefore as one of the most extensively researched regions in the country, it would be interesting to see what can be inferred about biodiversity and its relationship with habitat modification. Numerous studies have assessed biological diversity in plantations, forest fragments and logged areas of the Western Ghats, and it has been pointed out that significant levels of biological diversity still exist within these modified habitats. This section provides a brief review of key findings from studies on relatively well-studied taxa such as plants, mammals, birds, herpetofauna and some insect groups. Specifically, the relationship between species richness (the most commonly evaluated biodiversity metric) patterns among taxa and habitat modification has received significant attention. A number of studies link the loss of species from an area with a few key factors: these include increasing distance to forests, increased disturbance within forested areas, decrease in the area of forest patches, and simplification of habitat structure (Kumar et al. 2002; Muthuramkumar et al. 2006; Raman 2006; Bali et al. 2007; Anand et al. 2008; Dolia et al. 2008 - for a review, see Anand et al. 2010). Studies from other regions of the world also show that the quality of the matrix, i.e, native elements within the primary land use also play an important role (Prugh et al. 2008).

An important factor to be noted in the context of modified/disturbed habitats is the relationship between species richness and disturbance. This relationship is



neither simplistic nor linear. Secondary forests, logged forests and agricultural landscapes with interspersed forest and open spaces sometimes host more species than nearby intact forests giving the impression that they are more diverse. These landscapes often encompass a number of habitat types and species richness maybe in part elevated by the presence of generalist and non-native species. In a pattern which is consistent across many taxa, it is the habitat specialists, rare and endemic species which disappear when a forest becomes degraded. Manipulated landscapes often have a profusion of common generalist species that are adapted to a number of habitats. Cleared patches and open spaces also facilitate the growth of pioneer species which are the first to colonise these areas.

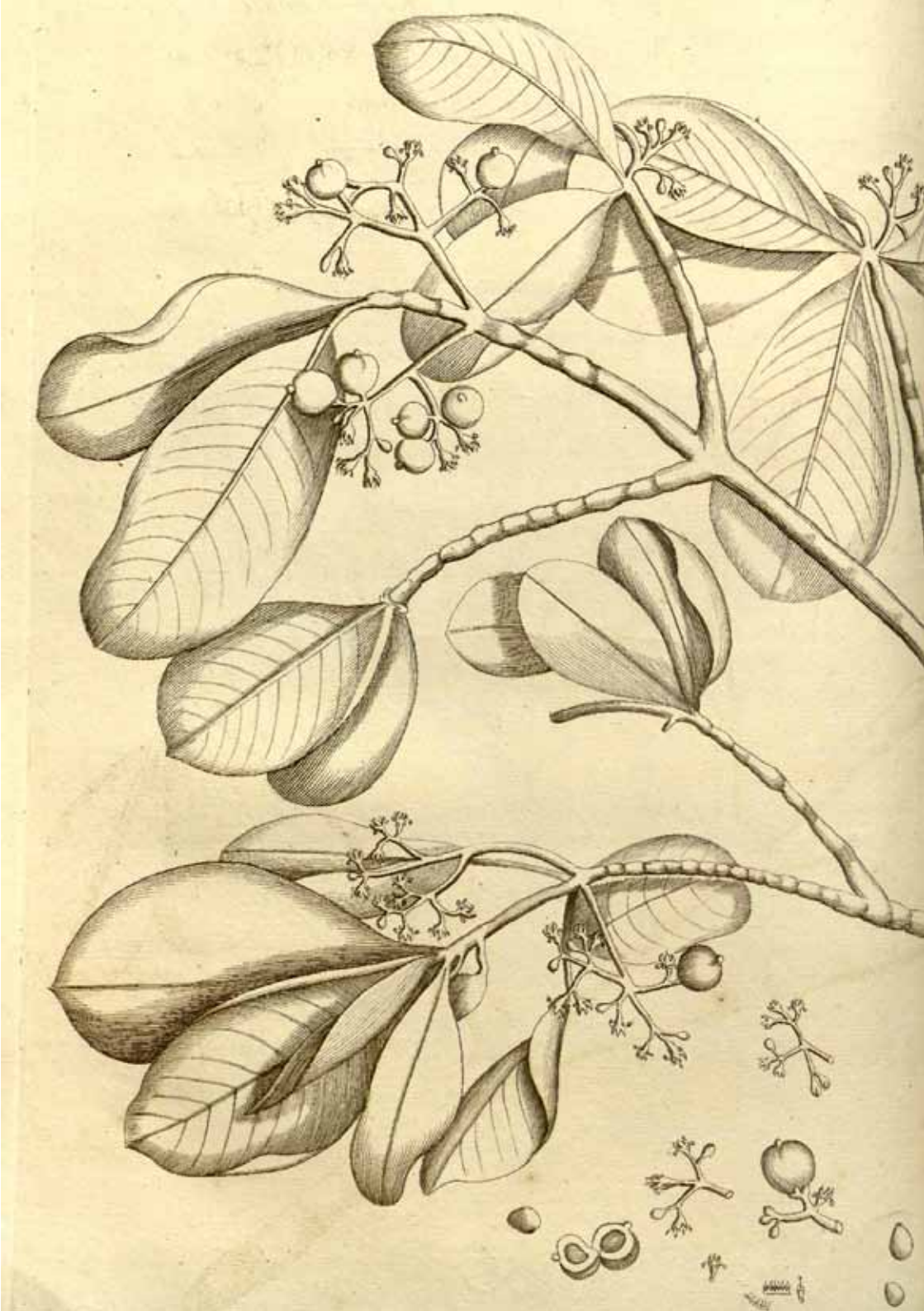
The best information for the Western Ghats is available from a number of studies that have carried out comparisons between biodiversity and habitat structure/ complexity in modified landscapes with that of control sites in the same landscapes. As a general observation for the region as a whole, human-modified landscapes in the Western Ghats have more natural elements than many other tropical landscapes of significance. These landscapes are characterised by greater degrees of habitat heterogeneity and structural complexity, as well as the presence of significantly greater forest cover within areas of human use. Greater forest cover in the Western Ghats landscapes has also been positively correlated with the presence of higher levels of biodiversity, especially vertebrates and flora (Anand et al. 2010). Some of the land use types are more similar to forests

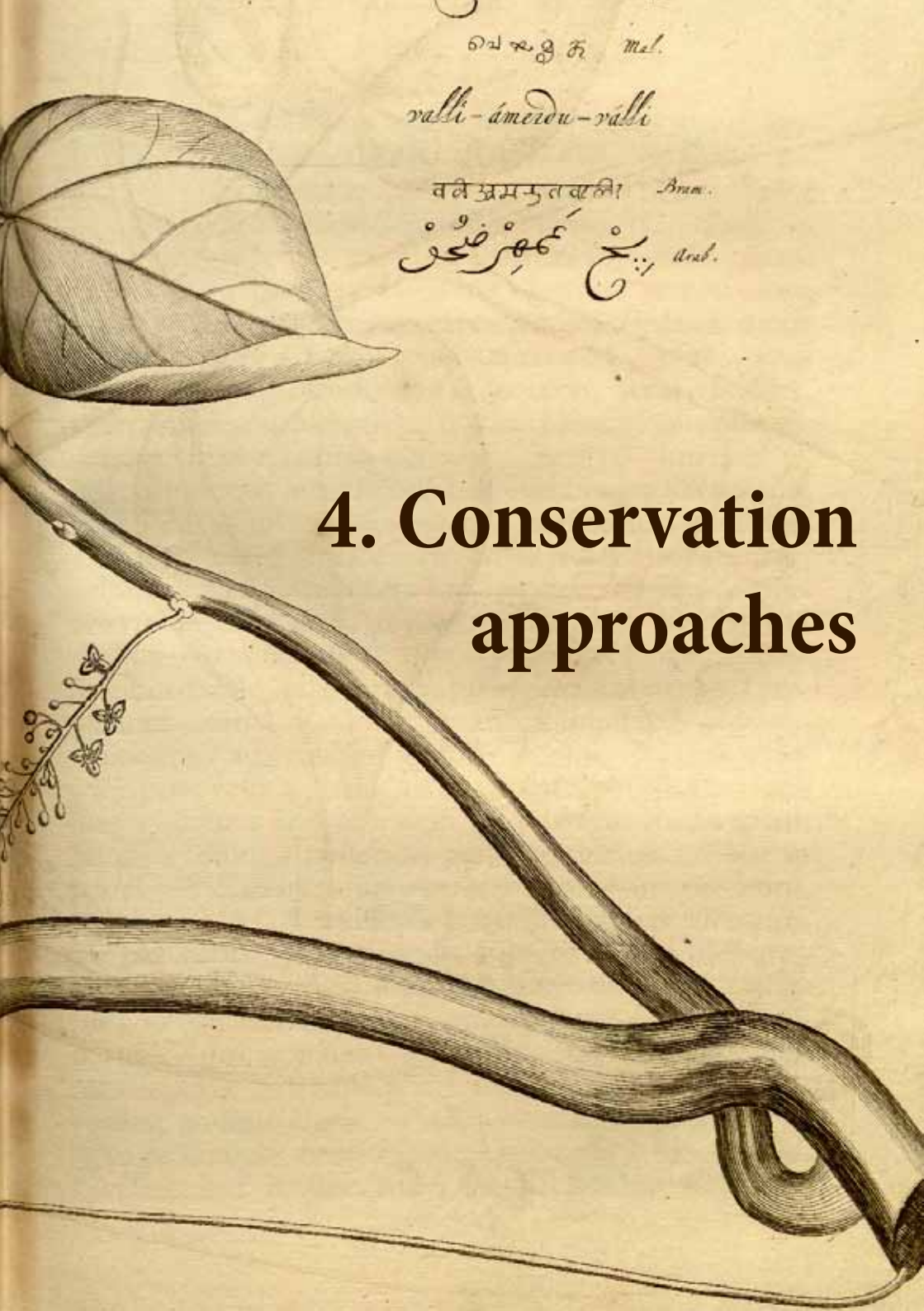


than others - e.g. cardamom plantations with native canopies and shade coffee - playing a greater role in supporting biodiversity and ecosystem services. The high spatial juxtaposition of remnant forest patches with other typical land uses also has biodiversity benefits for the latter. Anand et al. (2010) suggests that their effect is sometimes so significant that land management practices within such landscapes (e.g. polyculture vs. monoculture coffee) may only have a secondary or localised impact on the biodiversity response. Exotic monoculture plantations, however have been reported to be highly dissimilar with natural forests in terms of structure and composition and therefore less beneficial for biodiversity conservation.

The maintenance of remnant forest patches, sacred groves, riparian corridors and other corridors linking larger forest blocks are therefore beneficial to biodiversity as they buffer the loss of biodiversity. Rapid biodiversity loss is slowed down as many of these structures provide temporary and permanent habitats, refuges and foraging areas for at least a number of generalist species (Bhagwat et al. 2005a,b; Bhagwat et al. 2008; Anand et al. 2010). In the context of the Western Ghats the preservation of sacred groves is relevant not only from the perspective of biodiversity conservation and ecosystem services, but also in terms of their socio-cultural and heritage values. Although there are fewer groves (known locally as *kavu*s) in the montane region of the southern Western Ghats, rejuvenation of groves in the plains stretching towards *Kuttanad* and beyond could provide extensive benefits.

Taxa	No. of species	% endemism
Angiosperms	4000	38%
Mammals	120	12%
Birds	508	3%
Reptiles	156	62%
Amphibians	121	78%





4. Conservation approaches

Till recently, biodiversity conservation in India and elsewhere was primarily operationalised under the protected area or 'fortress conservation' approach. Under this approach which has been criticised as being 'exclusionary', and 'coercive', the emphasis was on maintaining natural habitats with minimal or no human impact. However, while establishing protected areas has been effective in some instances, and yielded mixed results in others, there have also been significant social costs associated with this approach, primarily in the form of conflict with local communities over access to forests and resources as well as displacement and relocation from PAs. This resulted in the adoption of newer more inclusive alternatives such as the Integrated Conservation-Development Projects (ICDPs) during the 1980s as well as community-oriented initiatives such as Joint Forest Management (JFM) in the 1990s. The main emphasis of such community-based conservation (CBC) projects was on poverty alleviation and participatory governance of PAs using a variety of methods. A number of enterprised-based conservation (EBC) activities were also experimented with during this period. These initiatives focused on increasing economic benefits to local communities by investing in conservation-compatible activities (e.g. ecotourism, sale of NTFPs, etc.). However, over the past few years, there has been a slow, yet definite shift in focus to the maintenance of biodiversity and ecosystem services in human dominated areas which now constitute a greater proportion of the earth's terrestrial area. This shift from the mainstream protected area approach has been paralleled by the development of a series of alternate conservation approaches which are applicable to HDLs. Many of these are market-oriented approaches which have transformed the inherent use values of products and services into monetised exchange values. Most focus on human-modified landscapes that have the potential to provide multiple services. This trend is also in part due to the focus on poverty reduction, an enormous and real challenge that calls for innovative ideas and interventions. The need to combine the conservation of biodiversity and ecosystem services is particularly pronounced in tropical hotspots where high human densities and dependence on natural resources have resulted in tradeoffs between these services and the degradation of ecosystems. A review of the pros and cons of various conservation approaches can be found in Lele et al. (2010).

4.1. Market-based approaches - Payments for ecosystem services (PES)

Biodiversity conservation and preservation of ecosystem services in HDLs can be approached from two different perspectives. The first involves utilising landscapes in such a way that elements of biodiversity are preserved by way of biodiversity friendly agriculture (e.g. organic farming, tolerance to crop depradation, etc.) and other sustainable practices. The second approach explores setting aside areas within HDLs for conservation (e.g. maintenance of sacred groves, remnant patches, etc.). In the Western Ghats there are opportunities for both approaches to work depending on the types of land uses that are prevailing and the mechanisms that are used to implement interventions. A new set of market oriented approaches that aims to provide economic incentives to offset the cost of biodiversity friendly agriculture, and to bring more areas under native forest cover has been initiated in the last decade or so.

Among the creative strategies that are developed to promote ecological sustainability and livelihoods in human-modified landscapes, include 'payments for ecosystem services' whereby individuals and communities are paid for their contribution to the maintenance of a particular environmental service or a bouquet of services. PES is expected to 'suit intermediate and/ or projected threat scenarios, often in marginal lands with moderate conservation opportunity cost' (Wunder 2005). PES may involve different modes of payment and organisation. Often, these involve direct payments to individuals landowners or communities by governments or non governmental agencies with support from donors including large corporations. For example, farmers in forest fringe landscapes could be encouraged to participate by maintaining native forest cover within their landholdings for a yearly fee. Payments are received from the government or from large industrial corporations seeking to offset their carbon dioxide emissions by promoting sustainable land uses elsewhere. In other scenarios, the payments could be derived from within the region. To cite an example, downstream users of a resource such as clean water pay upstream users for maintaining uplands by preserving trees, preventing overgrazing, practicing organic farming, etc.

What is a PES?

Although there is no formally accepted definition of a PES, typically five simple criteria are used. PES schemes usually fulfil one or more of these criteria. On this basis, Wunder (2005) defines a PES as a:

1. a *voluntary* transaction where
2. a *well-defined* ES (or a land-use likely to secure that service)
3. is being 'bought' by a (minimum one) ES *buyer*
4. from a (minimum one) ES *provider*
5. if and only if the ES provider secures ES provision (*conditionality*).

adapted from Wunder 2005

Supporters of payments based approaches argue for the need for innovation especially in a scenario of declining conservation funding and limited alternatives. PES has the scope to raise funds from the private sector for communities selling these services (MEA 2005). PES often has measurable deliverables, and has the advantage of simplicity unlike approaches that link conservation and development which can be complicated. Moreover, in many cases, payments systems directly link buyers with producers of environmental services, creating market linkages and reducing the need for regulation by the state. However, despite the inherent attractiveness of the concept, operationally, it is often difficult to value, measure or incorporate estimates of ecosystem services into planning, policy and decision-making. Incorporation of these services into market transactions, land use planning, decision making and governance has been slow even when attempted. In practice, there has been a marked inability to deal with the the complex political and socio-cultural dimensions of environmental services. Although the concept of ecosystem services initially started out more as an eye-opening metaphor to make people think about the value of nature, critics are uncomfortable about the sudden dominance of PES as a practical conservation tool (see Norgaard 2010). In addition to the complexities of operationalising projects, PES incorporates the

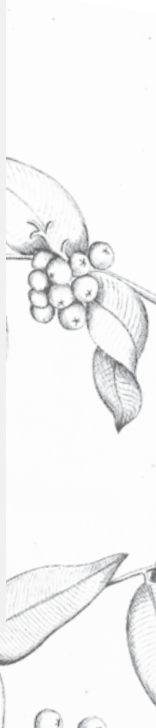
critical drawbacks of most neoliberal policies which seem to increase disparities in wealth and consumption, overturns long-standing traditional practices they rarely benefit the poor. Critics of this conservation approach point out that commodification schemes such as PES might result in a fallback to exclusionary policies and in the decoupling of conservation from development. Benefits might get appropriated by the elite, may deprive communities of their legitimate claims and aspirations towards development, result in ecosystem collapse when a particular environmental service (and the justification for it) loses market viability, result in the replacement of deeply rooted cultural ethics with profit-driven motives, and lead to further marginalisation of the poor (MEA 2005; McCauley 2006; Lele et al. 2010). The flip side to these arguments is the question as to whether non neo-liberal approaches work anymore in an already globalised/ monetised world.

The poor and PES (Adapted from Wunder 2008)

PES schemes are intended to be beneficial for both environmental conservation and poverty alleviation. In the context of the developing tropics this assumption holds particular relevance since ecologically significant sites often coincide spatially with poverty-stricken, marginal areas (Sunderlin et al. 2007; Wunder 2008). However, since the relationship between poverty and conservation is typically made out to be extremely complicated (and therefore not easily dealt with by traditional development or conservation interventions), PES has been offered as a simpler alternative with relatively clear outcomes. It would therefore be beneficial for managers and decision-makers to be aware of the selection pressures that poor people typically undergo in PES schemes, and overcome these constraints when executing projects:

Eligibility

Land-based eligibility criteria exclude a large number of poor people, especially the rural landless, those with lands without a particular environmental value, or land without strategic 'ES' value. Many public as well as private schemes have stringent land tenure requirements, some discriminate against smallholders (Greig-Gran et al. 2005) (a potential solution here may involve the creation of linkages with employment guarantee schemes, e.g., NREGS



or as a pro-poor targeting measure following models such as South African Work for Water programme - Turpie et al. 2007).

Desire

Although the potential for rewards from PES may be attractive, the risk of losing land might be too high unless land tenure security is simultaneously strengthened. Transaction costs also act as deterrents if enrolment requires extensive paperwork or permits. Landholders are sometimes suspicious of outside agencies offering contracts, especially those involving land-use caps - mistaking these for the first step towards land expropriation - especially in uncertain land tenure settings and where PES schemes are completely untested (in the case of southern Western Ghats, surveys indicate that people living close to forests are apprehensive about the Forest Department taking over lands if their landholdings provide biodiversity level benefits; this seems to be a result of landholder animosity to The Kerala Preservation of Trees Act, 1986 and associated acts and policies).

Ability

Poor households may lack the necessary capital, skills or labour, access to credit or technical assistance to implement changes required by PES schemes. Small families are sometimes less willing to enrol land into conservation set-aside PES, as they perceived their food security to be compromised (Southgate et al. 2007).

Competitiveness

The first competitiveness factor is that whether the willing, able and eligible poor constitute competitive ES providers, or whether ES buyers may actually better off looking for non-poor providers (i.e. the farm specific opportunity costs of the poor may be too high to enable them to make a net profit form PES). A second competitiveness factor is whether poor farmers will be reliable service providers as often (as a result of insecure land tenure and low control), they may not be in a position to resist intrusions or land takeovers by outside entities. Third and most important competitive factor (referred to in Wunder 2008 as a 'killer assumption') is the high PES transaction costs ES buyers face while working with smallholders (e.g. transaction costs will be much lower for 3 large landholdings of 1000 ha each as opposed to 1000 small landholdings of 3 ha each). The transaction costs of working with a large number of small

landholdings in terms of PES negotiations, contracts, monitoring, enforcement and sanctions will be significantly higher. Creative schemes sometimes bundle projects for region to alleviate this constraint.

Another constraint that has been raised relate to long term contracts involving payments. It has been proposed that long-term land use deals when offered under asymmetric access to information could result in poor service sellers ending up in 'PES traps' resulting in lasting negative outcomes from which they find it difficult to recover. Although conceptually plausible, real world evidence has not been reported and it has been argued that well administered and properly funded projects could avoid this drawback.

The large number of anti-poor criteria and constraints have resulted in suggestions from some quarters that it might be best if PES schemes concentrated only on a single objective of environmental conservation. However, this would then reinforce the wide range of criticisms relating to poor environmental governance, marginalisation and disenfranchisement of the poor which has been put forth as the most critical drawback of the approach.

4.1.1. Some design features that facilitate and limit the success of PES schemes

(adapted from CEC 2004)

PES projects are most likely to be successful if and when:

- they are based on clear, consensual scientific evidence linking land uses to specific ecosystem services
- the ecosystem service/s to be provided are defined clearly
- contacts and payments that are offered are flexible, ongoing and open-ended
- transaction costs are low and do not exceed potential benefits
- money flows are sustained (preferably relying on multiple sources) and sufficient
- compliance, land use changes and provision of ecosystem services is monitored regularly
- projects are flexible enough to allow for adjustments that improve efficiency and efficacy in changing conditions.

PES schemes are found to have have serious limitations when:

- they are based on tenuous assumptions or scientific generalisations with no empirical support
- they are implemented in a context where they may not be the most cost-effective method to attain a conservation goal
- there is poor clarity about the service being provided as well as no proper identification of service providers or users
- proper monitoring and control mechanisms are not in place
- costs of services are set arbitrarily or properly gauged and do not

correspond to the actual value of a resource
- their design is not supported by baseline socioeconomic or biophysical studies
- when perverse incentives are offered or when environmental problems or unsustainable practices are displaced or transferred to other areas
- there is dependence on external financial aid/ resources
- programmes and activities are disseminated inequitably among the local population

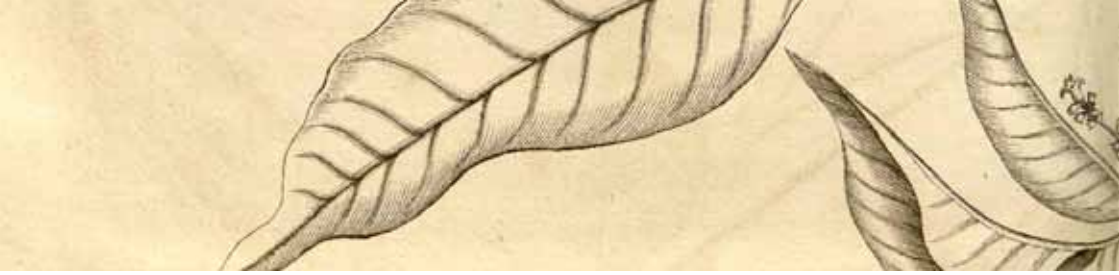
4.1.2. Different types of PES schemes

Although considered a separate approach for conservation, PES projects are quite diverse and could incorporate a variety of interventions, institutions and methodologies.

Currently, four categories of PES initiatives have received significant funding. These vary in geographical scope, the strength and structure of demand, and the nature of services which are provided (CEC 2004). For a review of the performance of the first phase of PES projects see Landell-Mills and Porras (2002).

Carbon sequestration and storage

The carbon marketplace is most often global in scope and often involves the presence of international buyers or donors. Buyers fund service providers to increase carbon sequestration by planting trees. Much of the transactions in carbon trading involve buyers from the developed world paying sellers in the developing tropics. Carbon trading is now a well developed highly competitive market and much of the global carbon market now is encompassed under REDD



(Reducing Emissions from Deforestation and Forest Degardation) and REDD+ (a more comprehensive form of REDD that incorporates a number of elements additional to avoided deforestation) arrangements. While forest carbon markets are considered effective by some the two main operational criticisms leveled against these forms of carbon trading include the risk of natural forests being replaced by plantations (resulting in perverse incentives to deforest and reforest with monocultures which may be of exotics) and the financing of conservation in places where no deforestation is taking place (resulting in low value addition). The concepts underlying REDD, REDD+ and their implications are discussed in detail in other sections of this document.

Biodiversity conservation

PES schemes for biodiversity conservation resemble carbon markets or watershed schemes (or both) and can be operated at local, regional or international levels. In most cases the buyers of these services are international conservation organisations, especially large conservation NGOs which pay local people for establishing protected areas, as well as setting aside or restoring areas to develop wildlife movement corridors. Pharmaceutical companies are also known to have been involved in such schemes. However, the various components of biodiversity are difficult to measure or put a value to and the diversity of these demands make biodiversity payments very complicated. Another factor complicating biodiversity schemes involve the current modes of financing. Financing for biodiversity projects have largely taken the form of single-time payments. If payments are not sustained, they run the risk of biodiversity sellers reverting to older land use practices or newer more lucrative land uses.

Watershed services

PES projects for watershed services are typically local or regional in scope. Rather than trading water as a commodity, these services are usually funded by means

of user fees to improve land uses that provide watershed benefits. The most common example of this type of service is in the form of fees or payments from downstream users such as farmers, producers of hydel power, domestic water users, etc. These user groups are often well organised and their mobilisation is often easier because users are often aware of the direct links between upstream watershed management and watershed services. However, the measurement of many of the hydrological services themselves are complex and downstream uses usually pay upstream users for adopting land uses which limit siltation, sedimentation, soil erosion, flooding, etc.

Landscape beauty

Services with respect to landscape beauty can be undertaken at multiple scales. Ecotourism is the main activity by which these services are currently explored. Although it has been largely national governments who have been responsible for the establishment of protected areas and areas of heritage value, these services are increasingly being provided by local communities. However, ecotourism also brings with it a set of distinct advantages and limitations. For example, a local community might benefit from payments from a tourism safari company as a reward for restricting hunting. This might in turn pose problems from wildlife conflict to some members of the community or other communities proximate to the safari areas. The socio-economic and cultural ramifications of ecotourism also need to be addressed meaningfully before ecotourism projects are taken up. Among PES schemes, ecotourism remains one of the least developed payments schemes and is considered to be an immature market.

Bundled services

In some cases, services are also bundled with different services being sold from a single area. Services can be sold in merged bundles where it is not possible to separate them within a bundle or they can be sold in shopping basket bundles where

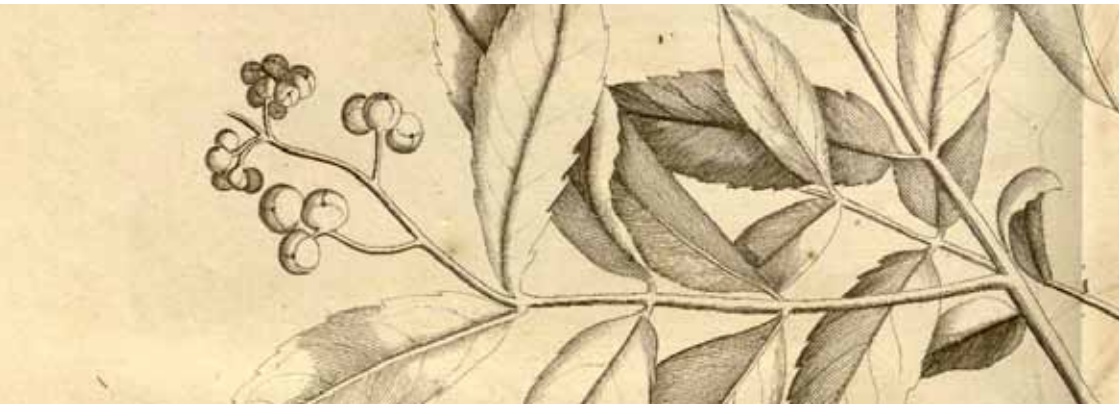
specific services are sold to different buyers. Merged bundles usually involve low transaction costs and are often easier to manage. On the other hand, the shopping basket approach might maximise returns but may involve complex establishment and management effort and much higher transaction costs (Wunder 2005).

Depending on the vehicles used to achieve conservation objectives, PES can be classified as area-based or product-based schemes, public or private schemes, use-restricting or asset-based schemes.

Area-based vs. product-based schemes

As the name implies, area-based schemes primarily aim to develop land use and resource-use caps for an ecologically important area. Area-based approaches take a variety of forms such as easements, concessions, protected catchments, forest carbon plantations, etc. Product-based approaches include schemes where customers pay higher prices for products that are perceived to be environment friendly or produced under sustainable production systems. This 'green premium' is especially promoted for products that are environmentally friendly especially with respect to biodiversity.

Product-based schemes have been developed for diverse scenarios - e.g. use or non-use values of pristine landscape (ecotourism, jungle rubber), agro-ecological production systems that promote biodiversity and other ecosystem services (organic farming, shade coffee, polyculture coffee), using best practice methods to negate environmental impacts(e.g. certified timber, proposed certification schemes for cattle ranchers and soy producers in Brazil who shift to sustainable systems), etc. (Wunder 2005).



Public vs. private schemes

Public schemes are those where the government acts on behalf of the buyers, collecting funds and distributing it to the providers. Government backing provides a certain amount of confidence and largescale application, however government sponsored programmes also come with little room for flexibility or appeal as well as the problems associated with electoral politics and corruption. Countries such as Costa Rica, Mexico and China have been among the first to buy into the concept of ecosystem services and to start large scale PES programmes that are centrally sponsored. For example, China's Sloping Land Conservation Programme, is one of the largest land restoration programmes that have been initiated to date in Asia.

Private schemes are usually those attempted at smaller scales (usually at the local level) where buyers make direct payments to ES providers. As opposed to public projects, private schemes are more focused, efficient, flexible. However, their introduction and implementation depend on a variety of factors including local level buy in, politics and poor guarantees of continuance.

Use-restricting vs. asset-based schemes

PES schemes that are use restricting are those which set aside land and/ or restrict the extraction of products beyond a certain level. They can be contrasted with asset building schemes which encourage processes such as restoration, tree-planting, etc. While use-resting schemes are applied to land which is already providing environmental benefits, asset-building schemes typically target degraded lands. These schemes also have the potential to generate

employment opportunities for people and sometimes agricultural benefits are also availed through sustained agriculture.

4.1.3. Evidence

PES is a relatively new approach with majority of work on it being conceptual or theoretical. Its inception in different parts of the world has been patchy with the majority of projects being executed in Latin America and South East Asia. As a result, there is limited evidence yet from practice to make decisions about its efficacy. At the same time, some patterns have emerged from projects around the world. Initial results from the Chinese Sloping Land Conservation Programme, considered to be the developing world's most extensive land retirement programme (with a goal of increasing China's forest area by 10 - 20%) report that some farmers have incurred net losses with tree planting producing less benefits than farming which was carried out previously. A top down approach and lack of conditionality have been blamed for these initial failures (Bennett 2007). Similarly, in Vietnam where farmers received long-term allocations of public land (which were already declared 'protection forest'), the contribution from household incomes were only 1 - 2 % (Wunder 2005). On the other hand, preliminary evidence from Costa Rica and Bolivia indicate modest contributions to household incomes in general and significant increase in incomes to poverty-stricken households. Similarly, in Bolivia In some cases (e.g., Indonesia and Bolivia), PES schemes have also resulted in non-income gains including consolidation of land tenure, improvements in human and social capital via human organisation (especially enhanced collective bargaining action) and increasing visibility/ popularity of a site or community in terms of attracting investors, donors, etc. (Rosa et al. 2003; Greig-Gran et al. 2005; Robertson and

Wunder 2005; Wunder et al. 2007). It is also important to understand that in some cases equity related to benefits for some can cause social tensions. These are especially pertinent for individuals or sections of the society who bear disproportionate opportunity costs (and are rendered worse off) but are not in a position to reject a PES. Examples of such instances include the CAMPFIRE programme in Zimbabwe where landowners directly adjacent to wildlife areas lost out, and the case of a logging community in Florida that lost their livelihoods as a result of forest protection (Asquith et al. 2002; Frost and Bond 2007). It is also important to note in this context that the success or failure of initiatives are also coloured by the way in which they are reported. In the case of PES, there is a view point that despite tenuous evidence, this approach and its derivatives seem to have gained momentum as a result of careful, yet forceful marketing by a network of influential organisations (that vouch for its credibility and success) to further their own neoliberal policy outlook. To cite an example, publications and reporting related to the Maloti-Drakensberg Transboundary Project (South Africa and Lesotho) PES tell widely differing accounts.

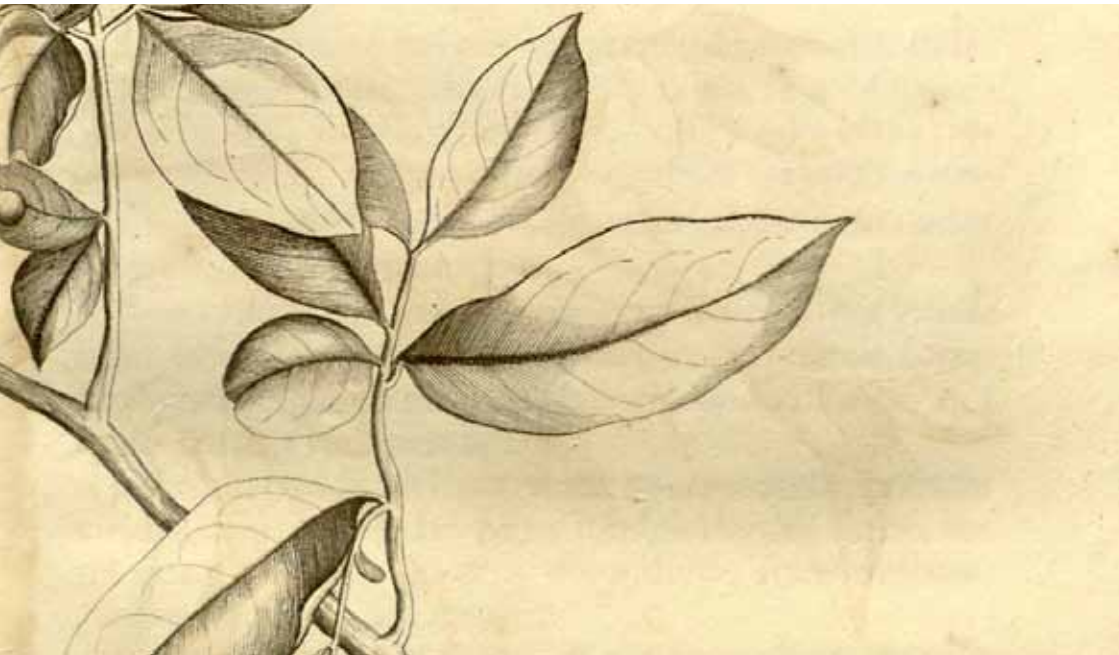
4.1.4. Pointers for the southern Western Ghats

PES projects are currently being initiated at a few locations in the Western Ghats. All of these are in the early phase of implementation and it is too early for site specific evaluations of their success or failure. There are however several arguments which could be put forth both in favour of as well as opposing the adoption of PES strategies. The argument in favour of PES in this region could be that since smallholder livelihoods are currently linked intricately with the cash crop economy, primarily rubber (which has seen

heavy price fluctuations in the past), it could be worth exploring if payments could bring additional stable incomes. However, the stability of these payments themselves need to be guaranteed over the long term especially if the funding is derived from private donors who are invested into the economy (rubber prices tend to decline during global economic downturns due to the poor performance of the automotive tyre segment). To initiate a payments scheme when rubber prices are on the high side will be difficult as payments may not be high enough to provide sufficient incentive to alter land use in any manner. Currently, due to the existence of legislation such as the Kerala Tree Preservation Act, 1986 and other restrictions on tree felling within the region, landowners fail to see any value attached to native trees on their properties. As a result, many farmers restrict regeneration by removing seedlings and saplings. A payments system could potentially remove this bias. However, this could jeopardise tree protection in the surrounding reserve forests by the Forest Department as it will be then difficult to differentiate between wood removed from the forest illegally. Wood is a highly priced commodity and enforcement of illegal felling and transport is problematic in an area which has porous boundaries.

On the flipside, some settlers expressed concerns that if they allowed native trees to regenerate (and resemble forest land) for payments or otherwise, there

would be further interest in their land from the Forest Department. A number of factors that have been listed as anti-poor criteria in the 'PES and the poor' section could be considered as red flags for PES implementation in this area. Historically, this area has been marginal one, with poor food security, small landholdings and access to information and infrastructure. Most significantly, claims to tenured land have not been resolved and many landholders are yet to receive legal ownership of their land or part of their land (which is regarded as encroachments). Private PES buyers are bound to be faced with high transaction costs. Government programmes are more likely to find favour not only from the point of view of transaction costs, but also because there is a negative perception towards outside agencies due to the political leanings of different groups. An additional factors that might go against environmental schemes in general include extended periods of human-wildlife conflict (primarily crop raiding by wild boar and to a lesser extent conflict with elephants) which has imposed limitations on the crops that they can cultivate (to rubber and kolinji) and the poor record of compensation for damage by wildlife This has again resulted in perceptions that the settlers bear the brunt of living close to forests while people far away seem to benefit from in many way. That any PES intervention in this area would require extensive planning and contextualisation goes without saying.



4.2. Clean Development Mechanism (CDM), Reduced Emissions from Deforestation and Degradation (REDD) and REDD+

Forests form a significant part of the global carbon cycle by utilising carbon dioxide, sequestering (storing) carbon by accumulating it in leaves, twigs, stems and roots and also by replenishing soil carbon levels on decomposition. However, the removal of forests and their conversion to other land uses can result in the rapid release of carbon into the atmosphere. It has been estimated that these practices account for nearly 20% of global greenhouse gas emissions, i.e., more than the contribution of the transport sector and second only to emissions from the energy sector. Recently, there have been efforts such as Reducing Emissions from Deforestation and Forest Degradation (REDD) to offer incentives to developing nations to protect their forests and to adopt low carbon paths to sustainable development. These stem from the Clean Development Mechanism (CDM), an article defined within the Kyoto Protocol which allows a country with an emission-reduction or emission-limitation commitment to implement an emission-reduction project in developing countries. Such projects become eligible to earn saleable certified emission reduction (CER) credits. To be eligible, CDM projects must provide emission reductions which are additional to what would have otherwise been business as usual scenarios. With over 1650 projects, this mechanism which has been operational since 2006 is anticipated to produce CERs amounting close to 3 million tonnes of CO2 equivalent in the first commitment phase of the Kyoto Protocol (till 2012).

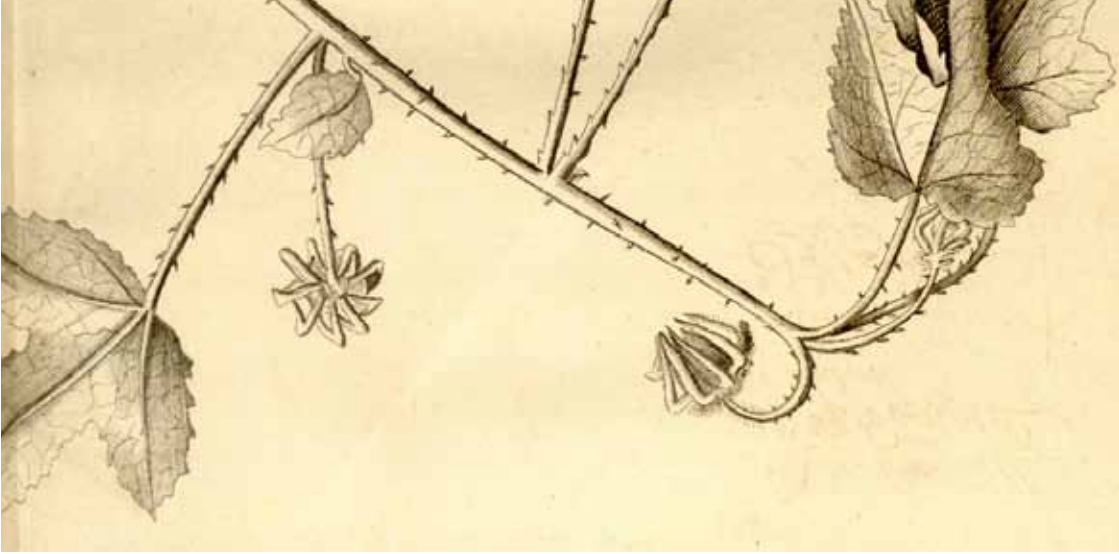
Conceptually, REDD revolves around a very simple basic idea that countries which are willing to reduce emissions from deforestation should be compensated

financially. REDD+ is a broader approach that goes beyond compensation for just forest destruction and degradation to incorporate positive incentives for conservation, restoration and rehabilitation, sustainable management and the enhancement of forest carbon stocks. Human-modified landscapes in forest fringe areas would theoretically be able to derive benefits from REDD+ on account of its potential to offers options for restoration and conservation related aspects than in terms of avoided deforestation.

Opinion is divided over REDD's potential for mitigation. While its proponents urge countries to make use of this rare opportunity, the concept has as many detractors who consider REDD to be too ambitious, or even work at cross-purposes to its goals. The most compelling argument for REDD and REDD+ strategies is that it encourages developing countries to develop low carbon strategies or plans in the context of sustainable development. However, under current scenarios, deforestation could be allowed to continue and REDD could even be used to reward logging and industrial agriculture (paying the polluter), at the same time ignoring countries and communities that has low rates of deforestation. Countries with carbon-intensive economies and lifestyles would be allowed to continue these trends by buying cheap offsets in the developing world (FoE 2008). A number of issues relating to carbon stocks, processes and reference levels are poorly understood and defined under the current REDD framework. For example, clarity as to the eligibility of monoculture and exotic plantations for REDD funding is highly debatable from the point of view of carbon storage and biodiversity.

In terms of market value, it has been estimated that an amount in excess of $ 20 billion will be transferred from developed nations to the developing world (European Commission 2007). Critics argue that since developed countries neither have the budgets or the political will to sustain such high levels of payments, REDD will need to be financed by private capital which is unstable and unpredictable. The basic market structure for REDD is also considered

inadequate on account of its poor transaction structure (over the counter arrangements leading to misallocation of funds and the nature of commodity markets which are often unfavourable to producers such as local communities and farmers who are not in a position or qualified to trade carbon and instead promote a few very large intermediaries, resulting in monopsony. Simply defined, monopsony is to buying as to monopoly is to selling, this results in producers having little bargaining power and to access whatever price is being offered. Additionally, the operationalisation of REDD will require the establishment of multinational organisations which has extensive capital, expertise and managerial capacities. It is unlikely that such entities with high transaction costs will be housed in developing countries and more likely that benefits from REDD will revert to developed nations to these organisations that service the market. The secondary market required to support the primary market figure of $ 20 billion is at least likely to be an order of magnitude higher. Looking at other commodities which have been controlled by monopsony pricing, the financial estimates for this surpass $ 500 billion. Defining and quantifying complex properties, products and processes for ecosystems are among the most challenging aspects of REDD especially since carbon is a complex asset with uncertain accounting standards. Currently, much of REDD related operationalisation is carried out by forestry and development experts who may not have the inclination or expertise in dealing with the market related aspects of interventions. Numerous examples of projects that have been carried out without the incorporation of essential economic (e.g. failure to incorporate inflation) or ecological concepts (e.g. failure to look at the impacts of industrial plantations of exotics on biodiversity conservation) signal a lack of expertise and comprehensiveness of the approach. The logistical and methodological difficulties of counting, verifying, reporting and validating carbon could result in the loosening of standards or simplified systems which eventually will result in the whole process being counterproductive. On the practical side, worst case scenarios are likely to involve damage to both forests and people: communities will be forced to generate cash flow by leveraging forest timber, their most readily available and marketable asset (Anonymous 2011).



The criticism of REDD are not limited to its market viability and include critical social and governance related concerns. Payments for REDD are likely to increase the value of forest resources in developing countries as well as the incentives to conserve these resources further. Critics argue this this is likely to result in a situation where central government bureaucracies and elite entities will be tempted to capture, retain, or re-centralise control over forests and carbon trading. If incorporated without the right institutional and governance mechanisms approaches such as REDD may result in undoing the large gains in decentralisation in forest management that some countries have achieved after long years of struggle (Sandbrook et al 2010). Pitfalls also include fictional carbon trading by powerful companies, land grabbing for commercial afforestation of agricultural lands, pasture lands, and biodiversity rich 'wastelands' and the appropriation of common lands which provide valuable livelihoods supports to the poor and the marginalised. Although many policies and approached including REDD are now 'participatory', 'fair' and 'neutral' in theory, in practice, many local communities still live in a disabling environment rooted in class, gender, identity and social relations, and marginalised by unequal access to capital, labour and credit (Ribot 2011). Past attempts with projects under the Clean Development Mechanism (CDM), PES and voluntary carbon offset projects have resulted in very few successes (FoE 2008). CDM and REDD implementation is expected to take place at a rapid scale in the developing world. For developing countries to benefit in any manner from such arrangements, it is important that such efforts (if at all)

are carried out with the right social, economic and environmental safeguards. For REDD to be beneficial for local communities as opposed to the elite, a critical requirement would be to enable them to democratically participate in all aspects of decision-making and to guarantee access as well as control over benefits arising from such interventions (Sandbrook et al. 2010; Ribot 2011). This would involve investments in various aspects of property rights, tenure and autonomy. Community-driven approaches which provide for greater rule making autonomy and commons arrangements have been known to be associated with increased carbon storage (Agrawal and Chhatre 2009). Instituting the necessary inclusive forest governance criteria into long term planning and avoiding at least some of the pitfalls of exploitative neoliberal agendas therefore would be a prerequisite before REDD projects are initiated.

4.2.1. CDM and REDD, REDD+ approaches in the context of the southern Western Ghats

A large number of projects have been undertaken in developing tropical countries such as Indonesia and Brazil. Most of these have been facilitated by conservation NGOs, private investors and the government with the help of supporting services provided by dedicated multilateral organisations and readiness programmes. India, which has arrested deforestation to a significant extent is expected to benefit from REDD+ and has been planning large scale projects such as the Green India Mission (one of the eight National Missions designed to secure benefits from carbon stocks under REDD+). However, although ambitious, these projects are likely to suffer from the drawbacks listed in the preceding sections. Modified landscapes in the Western Ghats which have the potential to come under the purview of REDD+ include crop plantations

which have the potential to sequester carbon. Recently, within developing countries such as India and Sri Lanka, there have been calls to include cash crop plantations such as rubber within various categories under CDM and REDD+ frameworks. The CDM potential for rubber can be categorised into sectors including carbon sinks, alternative/ renewable energy, avoided deforestation and fossil fuel substitution (Jacob n.d, Rubber Board of India 2005). The proposal by the industry is that natural rubber is better alternative to the less desirable, hydrocarbon derived alternative, rubber being a tree crop with over 20 years lifespan and high carbon sequestration capabilities, has an entitlement to be forest tree plantation. Since business as usual scenarios are disallowed under CDM, the rubber industry also calls for planting in non-traditional areas (Rodrigo and Munasinghe 2011). Countries such as Brazil have already submitted proposals for 'forests in exhaustion' whereby plantations are potentially eligible for CDM credits if they were established on non-forested land after 1990'. The argument against this is that these would amount to nothing more than subsidies for industrial plantations like rubber which would have commercial viability and would amount to support for business as usual activities (i.e., as a consequence of the good performance of the rubber market which is expected to continue over the next decade or so, support would be for business as usual activities).

The issue of CDM credits for monoculture rubber cultivations need to be examined in detail through dedicated studies. As one of the main revenue earners for the region, planning and policy decisions related to rubber can have extensive socio-economic consequences especially for smallholder agriculture in the southern Western Ghats. At the same time, the problems associated with rubber needs to be evaluated in detail. Although rubber cultivations hardly replace forests in the Western Ghats (anymore) and much of the CDM related investments might be targeted for northeast India, the conversion of other agricultural land to rubber has been significant over the past few decades in the Western Ghats. Such conversions can have negative consequences for food security in a region which already faces moderate levels of agricultural distress. Monoculture rubber if planted without the right soil and hydrological safeguards could also induce soil erosion and excessive water consumption. Monoculture rubber also sustains much lower levels of diversity of a variety of taxonomic groups and therefore its contribution to biodiversity conservation is very limited (Donald 2004; Aratrakorn 2006).

4.3. Some related conservation and income generation tools in the developing world

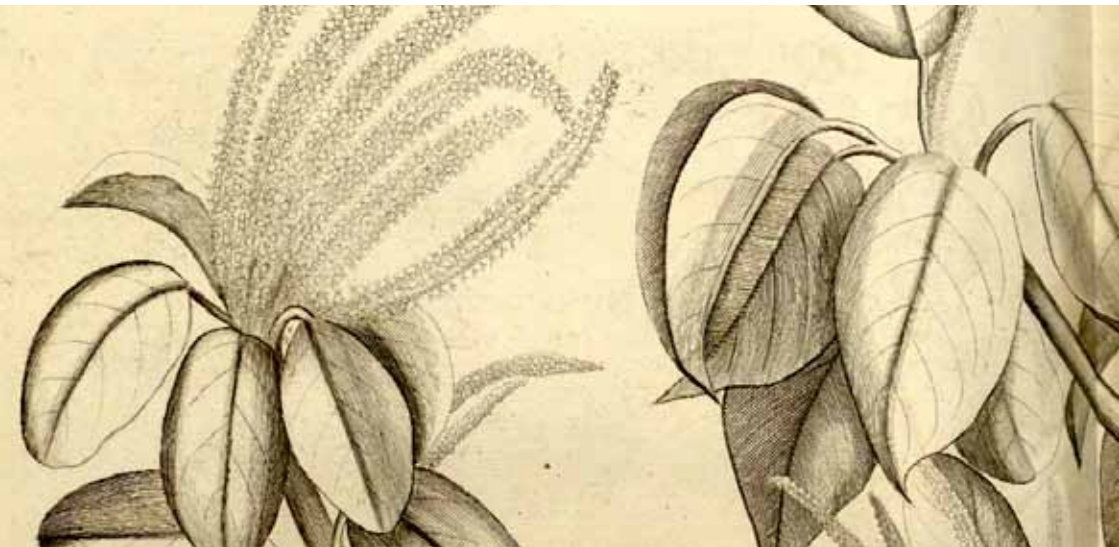
A number of innovative measures and tools have been attempted across the developing world with the purpose of effecting conservation. Some of these are market-based strategies that fall within the broad umbrella of payments for ecosystem services. For example, ecotourism projects were initiated in many parts of the world before the advent of formal PES arrangements. Ecotourism has been attempted in India and a few ventures have been initiated in the Western Ghats. In practice, though, while ecotourism brings in revenues, it is often unclear as to whether local communities actually benefit significantly. Severe economic inequities are sometimes compounded by negative consequences for social and cultural equity and justice. This problem is particularly true for high-end ecotourism. From a conservation point of view, ecotourism projects if carried out without the right environmental safeguards results in influx of large numbers of people and might be detrimental to the environment. Although not commonplace in India, land purchases have also been carried out with a view of conserving critical habitats and species. The major criticism for land purchases is that they are impractical. As is the case with ecotourism, land purchases have the potential to alienate indigenous communities with traditional access and use rights. Ecotourism has been initiated on a small scale in the southern Western Ghats.

Value addition including agricultural and forest certification, organic farming, development of additional income generation activities, etc. have been attempted in many parts of the world as parts of sustainability exercises favouring alleviation. Many of these initiatives have been tried with the help of tie-ups with local communities, self help groups, etc. Medicinal plant cultivation, bee-keeping, etc. have been adopted to supplement smallholder farm incomes. In the Western Ghats, where local knowledge plant based medicines and *ayurveda* is significant, such efforts may bear fruit. In the southern Western Ghats, in addition to *Apis dorsata* and *A. cerana*, honey from *Trigona iridipennis*, which is produced by small-scale traditional methods fetches significant prices in the market. With respect local agricultural products, *kolinji* (*Alpinia galanga*), is a candidate for possible certification and targeted marketing.

5. Transitioning to sustainability:

Some linkages with institutions and development, new alliances

Building partnerships in sustainability management will also involve the development of social and cultural capital. Social preparation, empowerment and self-organisation are essential for marginalised communities to break habitual dominance patterns, access benefits, make decisions and fight for their rights. However, these tasks require careful context specific interventions. The implementation of landscape level strategies sometimes calls for the modification of existing institutional arrangements. Firstly, this involves the development of the right institutional structure, particularly the identification of the network of institutions that play key and ancillary roles. Ideal networks evolve participatory consensus between multiple stakeholder groups. In the case of the southern Western Ghats, such networks could incorporate a number of actors including (but not restricted to) government departments (e.g., forests, agriculture, public works), *Vana Samrakshana Samitis* (VSS), Eco-Development Committees (EDCs), local self government institutions such as panchayati raj institutions, scientific organisations, NGOs, self-help groups, labour unions, etc. The Kerala Forest Department which is one of the most foreward looking forest departments in the country has been very receptive to inclusive conservation strategies such as participatory forest management (PFM). Unlike a number of other state forest departments, KFD has a history of working well with many stakeholder groups including local communities, researchers, etc. In the Ranni FD, it was noted that the VSS was active in some areas and was receptive to discussions about sustainability in modified landscapes. The fact that most VSS office holders are local representatives, seems to play an important role in buffering interactions with the Forest Department.



Additionally, the self help groups for women, especially the Kudumbashree initiative (The Kerala State Poverty Eradication Mission) is viewed positively in the region. In a region where agricultural and livelihood related distress have resulted in desperate measures such illegal arrack brewing (which in turn impacts family incomes), schemes like Kudumbashree have helped women tide over these crises by making them more financially independent. In some parts of Kerala, Kudumbashree's innovative approach to food security is reported to be a success, especially farming collectives that lease land to cultivate it for subsistence, and sell the surplus locally. The positive impacts of Kudumbashree in this area is not just restricted to poverty alleviation and but also in social inclusion and making women politically aware and empowered. A number of women and women's groups interviewed in the region expressed an active interest in income generation activities related to sustainable management of landscapes. The convergence between Kudumbashree activities and those of the National Rural Employment Generation Scheme (NREGS) has had a positive impact in the Ranni region. In Kerala, NREGS has been reported to be effective in raising social capital in the state (especially in inculcating a better work culture), and has been already linked with natural resource management through the Forest Department. There have also been plans to link NREGS with large scale social forestry initiatives like '*Haritha Keralam*' (Green Kerala Scheme) as well as calls for modification of permissible lists of NREGS works for implementation of the Forest Rights Act (Vijayanand 2009). The scope for linking NREGS with landscape afforestation programmes and specific schemes (e.g. *Vazhiyorathanal Padhati* - Road-side planting of shade trees initiative) is

very much present and is already being explored. The ecological robustness of some of these initiatives remain lacking. To cite an example, shade trees species as well as social forestry species that are available for planting needs to be selected from a pool of biodiversity friendly native species as opposed to exotics. Locality specific plans are required for an effective tree planting strategy. Finally, it also needs to be noted that planning for sustiainabiltiy in modified landscapes may have consequences for forest landscapes. For example, if restrictions on tree use are lifted from private lands fringing protected areas, local forest departments maybe burdened by additional workloads, controlling illicit felling from forests, etc. It is therefore important to ensure weigh the pros and cons of each strategy that is to be adopted.

The choice of interventions is contingent on a number of factors. Some of these may be locality or region specific (e.g., willingness/resistance of a local community to adopt a strategy), or could be derived from previous experience (e.g. the success of collective movements in Kerala). The links between, land use change, conservation, poverty, and sustainability in modified landscapes are complex and dynamic. The sustainable management of these landscapes is at present an emerging area of study. As a result, our understanding of these complex entities is limited. However, for effective decision making, planners have to use available information, instinct and knowledge of their system.

5. References

Ajay Joseph, C. and M. Balakrishnan. 2005. Abundance and richness of insects in Kazhakuttam Grama Panchayat in Kerala. Bulletin of the National Institute of *Ecology* 16:19-27.

Anand, M.O., Krishnaswamy, J., Das, A., 2008. Proximity to forests drives bird conservation value of coffee plantations: Implications for certification. *Ecological Applications* 18, 1754-1763.

Anand, M.O., J. Krishnaswamy, A. Kumar and A. Bali. 2010. Sustaining biodiversity conservation in human-modified landscapes in the Western Ghats: Remnant forests matter. *Biological Conservation* 143(10): 2363-2374.

Anonymous. 2011. REDD and forest carbon: Market-based critique and recommendations. The Munden Project. URL: http://www.mundenproject.com/forestcarbonreport2.pdf

Aratrakorn, S., Thunhikorn S., Donald P.F. (2006) Changes in bird communities following conversion of lowland forest to oil palm and rubber plantations in southern Thailand. *Bird Conser Int* 16, 71–82.

Asquith, N., M. Vargas-Rios, and J. Smith. 2002. Can forest-protection carbon projects improve rural livelihoods? Analysis of the Noel Kempff Mercado Climate Action Project, Bolivia. *Mitigation and Adaptation Strategies for Global Climate Change* 7: 323-337.

Bali, A., Kumar, A., Krishnaswamy, J., 2007. The mammalian communities in coffee plantations around a protected area in the Western Ghats, India. *Biological Conservation* 139, 93-102.

Bhagwat, S.A., Kushalappa, C.G., Williams, P.H., Brown, N.D., 2005a. A Landscape Approach to Biodiversity Conservation of Sacred Groves in the Western Ghats of India. *Conservation Biology* 19, 1853-1862.

Bhagwat, S.A., Kushalappa, C.G., Williams, P.H., Brown, N.D., 2005b. The role of informal protected areas in maintaining biodiversity in the Western Ghats of India. *Ecology and Society* 10, 8.

Bhagwat, S.A., Willis, K.J., Birks, H.J.B., Whittaker, R.J., 2008. Agroforestry: a refuge for tropical biodiversity? Trends in Ecology & Evolution 23, 261-267.

Bennett, M.T. 2007. China's Sloping Land Conservation Programme: Institutional innovation or business as usual? *Ecological Economics* 65(4): 699-711.

CEC. 2004. Payments for Environmental Services: A Survey and Assessment of Current Schemes. Commission for Environmental Cooperation of North America.

Chazdon, R., et al. 2009. Beyond reserves: A research agenda for conserving biodiversity in human-modified tropical landscapes. *Biotropica* 41(2): 142-153.

DeFries, et al. 2007. Land use change around protected areas: Management to balance human needs and ecological function. *Ecological Applications* 17(4): 1031-1038.

Diaz, S. et al. 2005. Biodiversity regulation of ecosystem services. Chapter 11, In, '*Ecosystems and Human Well-Being: Current State and Trends, Millennium Ecosystem Assessment*'. Island Press, Washington, D.C.

Dolia, J., Devy, M.S., Aravind, N.A., Kumar, A., 2008. Adult butterfly communities in coffee plantations around a protected area in the Western Ghats, India. *Animal Conservation* 11, 26-34.

Donald, P.F. (2004) Biodiversity impacts of some agricultural commodity production systems. *Conservation Biology* 18, 17–37.

European Commission. 2007. European Commission Communication, eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0645:FIN:EN:PDF

Forman, R.T.T. 1995. Some general principles of landscape and regional ecology. *Landscape Ecology* 10(3): 133-142.

Frost, P.G.H. and I. Bond. 2007. The CAMPFIRE programme in Zimbabwe: Payments for wildlife services. *Ecological Economics* 65(4):776-787.

Greig-Gran, M., I.T. Porras and S. Wunder. 2005. How can market mechanisms for forest environmental services help the poor? Primary lessons from Latin America. *World Development* 33:1511-1527.

Harvey, C.A., et al. 2008. Integrating agricultural landscapes with biodiversity conservation in the Mesoamerican hotspot. *Conservation Biology* 22(1): 8-15.

Jacob, J. n.d. The Kyoto Protocol and the Indian natural rubber sector. Rubber Research Institute, Rubber Board, Kottayam. www.rubberboard.org.in/articles/websitematerialDDPhysiology.doc

James, A., K.J. Gaston, A. Balmford. 2001. Can we afford to conserve biodiversity? *Bioscience* 5(1): 43-53.

Kumar, A., Chellam, R., Choudhury, B.C., Mudappa, D., Vasudevan, K., Ishwar, N.M., 2002. Impact of rainforest fragmentation on small mammals and herpetofauna in the Western Ghats, south India. WII-USFWS Collaborative Project, Final report, Wildlife Institute of India, Dehradun.

Landell-Mills, N. and L. Porras. 2002. *Silver Bullet or Fool's Gold? A Global Review of Markets for Forest Environmental Services and their Impact on the Poor*. IIED, London.

Lele, S. et al. 2010. Beyond exclusion: Alternative approaches to biodiversity conservation in the developing tropics. Current Opinion in Environmental Sustainability 2(1-2):94-100.

McCauley, D. 2006. Selling out on nature. *Nature* 443:27-28.

MEA. 2005. Ecosystems and Human Well-Being: Current State and Trends, Millennium Ecosystem Assessment. Island Press, Washington, D.C.

Menon, S. and K.S. Bawa. 1997. Applications of geographic information systems, remote-sensing,nand a landscape ecology approach to biodiversity conservation in the Western Ghats. *Current Science* 73, 134-145.

Muthuramkumar, S., Ayyappan, N., Parthasarathy, N., Mudappa, D., Raman, T.R.S., Selwyn, M.A., Pragasan, L.A., 2006. Plant Community Structure in Tropical Rain Forest Fragments of the Western Ghats, India. *Biotropica* 38, 143-160.

Nath, T.N. 2010. Rubber planting for forest rehabilitation and enhancement of community livelihood: A comparative study in three South Asian countries. 18th Commonwealth Forestry Conference.

Norgaard, R. 2010. Ecosystem services: from eye-opening metaphor to complexity blinder. *Ecological Economics* 69:1219-1227.

Periyar Foundation. 2006. The landscape, ecological status, conservation potential, threats to the forests and biodiversity of the Gudarakal Range, Ranni Forest Division (Southern Forest Circle, Kerala).

Pillai, R. 2007. Economic significance of pilgrimage: A focused micro level study from Kerala,India. MPRA Paper No. 22161.

Prugh, L.R. et al. 2008. Effect of habitat area and isolation on fragmented animal populations. *PNAS* 105(52): 20770-20775.

Rubber Research Institute. 2005. National Workshop of Clean Development Mechanism and the Indian rubber sector. Rubber Research Institute, Rubber Board, Kottayam.

Robertson, N. and S. Wunder. 2005. *Fresh Tracks in the Forest: Assessing Incipient Payments for Environmental Services Incentives in Bolivia.* CIFOR, Bogota.

Rosenzweig, M.L. 2001. Loss of speciation will impoverish future diversity. *PNAS* 98(10): 5404-5410.

Rosenzweig, M.L. 2003. *Win-Win Ecology: How the Earth's Species can Survive in the Midst of Human Enterprise*. Oxford University Press, New York.

Southgate, D., T. Haab, J. Lundine, and F. Rodriguez. 2007. Responses of poor, rural households in Ecuador and Guatemala to payments for environmental services. Ohio State University (unpublished).

Subash Chandran, M.D. 1997. On the ecological history of the Western Ghats. *Current Science* 73:146-155.

Sunderlin, W.D., S.D. Dewi, and A. Puntodewo. 2007. Poverty and Forests: Multi-country analysis of spatial association and proposed policy solutions. CIFOR, Occasional Paper No. 43 & 44.

Thomas, R.P. and G. Johnson. 2008. Manual of Forest Laws in Kerala. EM TEE EN Publications, Kochi.

Thomas, T.A. 2004. Changing production conditions in agriculture: A case study of Kuttanad. Ph.D. Thesis, Mahatma Gandhi University, Kottayam.

Turpie, J.K., C. Marais, and J.N. Blinaut. 2007. The Working for Water Programme: Evolution of a payments for environmental services mechanism that addresses both poverty and ecosystem service delivery in South Africa. *Ecological Economics* 65(4): 788-798.

Vijayanand, S.M. 2009. NREGS and forestry: The experience of Kerala. http://www.crd.kerala.gov.in/2009/march/presentaion4_04_09.pdf

Wunder, S. 2005. *Payments for Environmental Services: Some Nuts and Bolts*. CIFOR Occasional Paper No. 42,24.

Wunder. S, 2008. Payments for environmental services and the poor: Concepts and preliminary evidence. *Environment and Development Economics* 13(3): 279-297.

Wunder, S. et al. 2007. When donors get cold feet: The community conservation concession in Setulang (Kalimantan, Indonesia) that never happened. *Ecology and Society* 13(1): 12.

6. Acknowledgements

Funding Support - Critical Ecosystems Partnership Fund
Chief Wildlife Warden, Kerala Forest Department
Dr. B.S. Corrie, CCF(WL), Kerala Forest Department
Shri. Krishna Prasad, DFO, Ranni FD, Kerala Forest Department
Shri. Venu, Ranni FD, Kerala Forest Department
Dr. Bhaskar Acharya, RIT - ATREE, Bangalore
Ms. Amrita Tripathy, RIT - ATREE, Bangalore
Sitatodu Panchayat President and Members
Krishi Office, Seethathode
VSS, NREGS & Kudumbashree Representatives
Malanadu Development Society
Fr. Ignatius, Nilakkal Ecumenical Centre
Dr. Naveen Namboothri, Dakshin Foundation
Ms. Aarthi Sridhar, Dakshin Foundation
Dr. Kartik Shanker, CES, IISc., & Dakshin Foundation
Shri. J.K. Thomas, CEO, Malankara and President, UPASI
Shri. Abraham Varghese, Aangamoozhi
Dr. Ajith Kumar, NCBS
Dr. Mahesh Sankaran, NCBS
Shri. M. O. Ipe, Mananthra
Shri. P.K. Vasudevan, VSS
Shri. Devasya, Kissumum
Shri. Sridharan Nair, Gurunathanmannu

The author gratefully acknowledges the support of over 40 key informants and over 450 households for discussions and interviews.

Field team:
Meera Anna Oommen, Sanjay C. Noel, Bindhu Varghese, Ramani Sandesan, Sharon Verghese

CEPF

The Critical Ecosystem Partnership Fund (CEPF) is a global programme that provides grants to non-governmental organizations to protect biodiversity hotspots with the participation and involvement of civil society. It provides strategic assistance to non-governmental organizations, community groups and other civil society partners to help safeguard biodiversity hotspots. This conservation investment is guided by a region-specific investment strategy developed with inputs and in consultation with diverse stakeholders. For more details, visit www.cepf.net

ATREE

Ashoka Trust for Research in Ecology and the Environment (ATREE) was selected as the Regional Implementation Team (RIT) to implement the conservation strategy outlined in the Western Ghats Ecosystem profile in partnership with CEPF. The RIT will lead implementation of the CEPF investment strategy for achieving the conservation goals. The RIT will work in collaboration with civil society partners to achieve the shared conservation goals identified in the Ecosystem Profile. For more details, visit www.atree.org

Dakshin Foundation

Dakshin Foundation is a non-profit, non-governmental organisation with a mission to inform and advocate conservation and natural resource management, while promoting and supporting sustainable livelihoods, social development and environmental justice. Dakshin adopts interdisciplinary and transdisciplinary approaches in research and conservation. Dakshin's goal is to promote ecologically and socially appropriate approaches to conservation and management in coastal, marine, island and mountain ecosystems in India. For details, visit www.dakshin.org

CRITICAL ECOSYSTEM PARTNERSHIP FUND
dakshin
ATREE