Beyond the borders: wildlife conservation in landscapes fragmented by plantation crops in India

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Introduction: conservation and the countryside

Before I built a wall I’d ask to know  
What I was wailing in or wailing out,  
And to whom I was like to give offence.  
Something there is that doesn’t love a wall,  
That wants it down…

~ Robert Frost, Mending Wall

Agricultural expansion has historically been the major global cause for the loss and fragmentation of natural ecosystems, and today remains one of the largest threats to the world’s remaining tropical forests (Achard et al. 2002, Norris 2008). In tropical region, conservation concerns have arisen over the implications of the anticipated increase of as much as 25% in the area under agriculture (Tilman et al. 2002, Balmford et al. 2005, Green et al. 2005). Concomitant with biodiversity loss due to extinctions (Laurance 2007, Bradshaw et al. 2009), the loss of tropical forests may lead to decrease in ecosystem services of great value to humanity such as carbon storage in biomass and soils, watershed regulation and rainfall, modulation of climate and river flows, amelioration of infectious disease and human – wildlife conflicts (Millenium Ecosystem Assessment 2005-6, Foley et al. 2005, 2007).

In response to such trends, the primary strategy for conservation of threatened ecosystems and species has been the creation of protected areas such as national parks, sanctuaries, nature preserves, and areas set-aside with some form of restrictions on resource use. Over 100,000 protected areas covering roughly 18.8 million km² (or 12% of the earth’s surface area) have been set aside by governments around the world as means to preserve natural areas under various management categories (Chape et al. 2003, 2005). Still, protected areas continue to face a multitude of internal and external threats and are susceptible to influences from surrounding landscapes (Terborgh et al. 2002, Laurance et al. 2012). The effectiveness of protected areas to stave off threats has been variable. A study of 93 protected areas across 22 tropical countries showed that protected areas have been reasonably successful in preventing further land clearing, but less effective with threats of hunting, logging, fire, and grazing (Bruner et al. 2001). Even when deforestation within protected areas is curtailed, surrounding areas continue to face forest loss and conversion, further isolating these parks and highlighting the need for a broader conservation approach that considers surrounding landscapes, poverty and livelihoods, and unsustainable land-uses (Naughton-Treves et al. 2005, Laurance et al. 2012).

Considerable biological diversity also exists outside the boundaries of designated conservation areas in man-modified habitats and secondary forests. Therefore, conservationists are increasingly looking at wider landscapes and at measures such as increasing landscape-level connectivity of patches, and restoring degraded areas, including productive areas with people and agriculture, to complement traditional efforts such as the establishment of protected areas (Laurance and Bierregaard 1997, Koh and Gardner 2010). The assessment of conservation values and forms or practices of land use that sustain higher levels of native biodiversity in the landscape of productive agriculture and protected or restored natural areas has also been
termed 'countryside biogeography' in recent research (e.g., Daily et al. 2001, 2003, Sutherland 2002, Schroth et al. 2004, Das et al. 2006, Bhagwat et al. 2008). In regions of tropical forest, there is now global interest in bringing conservation efforts outside designated protected areas into the mainstream in landscapes with agricultural production and plantations such as of coffee, cocoa, tea, rubber, oil palm, cardamom, and vanilla. In this paper, we describe the context and challenges of landscape-scale conservation amidst plantations and forests and other tropical ecosystems in the Western Ghats, India.

**Plantations and conservation**

In the context of forests and conservation, the word *plantations* often appears in terms of *plantation forests* established for timber and fuel wood, and *plantation crops* such as tea, coffee, cocoa, rubber, oil palm, and commodities. Plantation forests established through various forestry practices mainly for timber and fuel wood and mostly as monocultures of a small number of alien and native species, occupy some 140 million ha (c. 3.5% of the world forest area) but are increasing annually by about 2–3 million ha (2%), even as world forest cover is in decline (Brockerhoff et al. 2008). Keeping plantation forests outside the scope of the present paper, we examine here some tropical commodity crops in terms of their conservation values relative to unaltered forests in protected areas, potential costs and conflicts, and the accrual or delivery of economic and ecosystem benefits from conservation efforts and better production or cultivation practices.

Tropical plantation crops are globally significant for conservation because of the area they occupy, location in significant biodiversity hotspots, and land-use practices. For instance, globally, around 11 million hectares are under coffee cultivation, almost entirely in tropical forest regions (Clay 2004). With an annual value of over $100 billion, coffee is the second highest traded commodity in international trade after oil, making assessment of its impacts on biodiversity an imperative (Donald 2004). Traditional coffee-growing areas also coincide closely with many of the global biodiversity hotspots (Conservation International, Mittermeier et al. 2004). Tea cultivation spans 2.3 million ha around the world, and is a concern both for being located in key biodiversity areas of forest and grassland, as well as for being usually cultivated as intensive monocultures with concerns over soil erosion and agrochemical inputs (Clay 2004). Similarly, cocoa is grown in over 7.5 million ha worldwide (principally in Africa and Brazil and Meso-America), while cardamom is primarily cultivated in tropical forest areas, with the leading producing countries being Guatemala and India.

A major conservation concern in recent years is the expansion and impact of oil-palm (*Elaeis guineensis* and *E. oleifera*) in tropical forests, especially in south-east Asia. The area under oil-palm cultivation is rapidly increasing, with centres of production in tropical forest regions of high biodiversity, from around 3.6 million ha in 1961 to over 9.7 million ha in 2004 and 13.9 million ha in 2007 (Clay 2004, Wilcove and Koh 2010). By 2010, 2.3 million ha of peat swamp forests were clear-felled in southeast Asia, leading to degradation, loss of between 1% and 12% of biodiversity (local extinctions of bird species), and loss of the forests's carbon sequestration services to the tune of ~660,000 Mg of carbon annually (Koh et al. 2011). Palm oil produced from oil palm is the most important vegetable oil in the world market in terms of production quantity. Planted as intensive monocultures, often associated with extensive forest clearing and burning, oil palm cultivation brings with it a number of serious social and environmental concerns, especially in south-east Asia and south Asia. The deforestation and expansion of oil palm in Indonesia and Malaysia (which account for over 80% of the world's palm oil production), the leading producers in the region, are closely linked to India and China, the largest consumers of palm oil and with rapidly expanding economies and populations.

**Plantations in the Western Ghats**

The Western Ghats, a hill range along India’s west coast, has been recognised along with Sri Lanka as a global biodiversity hotspot (Kumar et al. 2004). Currently around 15% of the land area of the Western Ghats receives some level of protection within 68 wildlife sanctuaries and 20 national parks (Rodgers et al. 2002, Kumar et al. 2004). This region, occupying some 180,000 km², holds about 30% of India's plant and vertebrate species diversity in less than 6% of the area (CEPF 2007).

The Western Ghats faces continued forest loss, degradation, and fragmentation and only around a third of the area contains some form of natural vegetation. Menon and Bawa (1997) estimated that between 1920 and 1990 forest cover in the Western Ghats declined by 40%, resulting in a four-fold increase in the
number of fragments, and an 83% reduction in size of forest patches. Similarly, Jha et al. (2000) estimated that in a 40,000 km² area of the southern Western Ghats, one-fourth (25.6%) of the forest cover had been lost over a period of 22 years from 1973 to 1995, giving an annual deforestation rate of 1.16%. Between 1920 and 1990, 40% of the original natural vegetation was lost or converted to open/cultivated lands, coffee plantations, tea plantations, and hydroelectric reservoirs. Open or cultivated lands accounted for 76% and coffee plantations for 16% of the conversion (Menon and Bawa 1997). It must be noted that large-scale conversion to tea, coffee, and other plantations had already occurred in many areas prior to 1920 (Congreve 1942, Prabhakar and Gadgil 1995).

The substantial (and increasing) area under plantations, especially of crops such as tea, coffee, cardamom, and rubber adjoining key tropical forest conservation areas in the region, is a matter of conservation concern in the Western Ghats (see Box 1). In this hills and plateaus, this includes presently around 120,000 hectares of tea plantations, about 340,000 hectares of coffee, over 73,000 hectares of small cardamom (Tea Board, Coffee Board, and Spices Board 2011 statistics). In the foothills and adjoining plains, there are in addition 615,000 hectares of rubber, 350,000 hectares of arecanut, and around 30,000 hectares of cocoa, besides other plantation crops such as oil palm, coconut, vanilla and pepper (the latter two crops, frequently inter-cropped with other plantations).

Effects of plantations on biodiversity conservation

A number of studies have indicated both the impact on biodiversity and conservation value of such plantations in the Western Ghats (Bhagwat et al. 2005, Raman 2006, Mudappa and Raman 2007, Anand et al. 2008, Dolia et al. 2008). A large number of natural habitat remnants including rainforest fragments, shola-grasslands, and streams exist within these plantations, in crucial conservation areas such as the Anamalai hills and Nilgiris, containing a great diversity of plants and animals including many highly charismatic and globally endangered and endemic wildlife species. Research of various groups in the region indicates that a large number of fragments exist and continue to hold considerable conservation value as refuges of biodiversity including many endemic and endangered species (Ishwar et al. 2003, Mudappa and Raman 2007, Mudappa et al. 2007, Sridhar et al. 2008). The fragments are important also as corridors for wide-ranging species that move between surrounding wildlife sanctuaries across the fragmented landscape (Raman and Mudappa 2003, Kumar et al. 2010).

Linked to the direct loss, conversion, or fragmentation of evergreen forests due to plantations, there is also face degradation to more open, deciduous, or secondary vegetation due to human extraction of firewood and other forest products or the gradual replacement of mature forest and endemic plant species by pioneer, widespread, and common species (Daniels et al. 1995, Muthuramkumar et al. 2006). The occurrence and spread of invasive species is another cause of forest degradation, but remains poorly explored or integrated in protected area management or land-use planning (Hiremath and Sundaram 2005, Prasad 2010, 2012).

Assessing the value of plantations for conservation of biological diversity depends on the taxonomic group under consideration, the habitat attributes and cultivation practices in the plantation, and the landscape context. This is well illustrated by a range of recent research on animal communities, particularly birds and mammals, in plantations and adjoining forest types. We summarise some of key findings and references below, with an emphasis on bird communities and research in the Western Ghats. The importance of these plantations and the remnant forests within them for conservation was also highlighted in a recent review (Anand et al. 2010).

The number of species (species richness) or overall abundance of taxa such as birds and bats usually does not vary much between forests and plantations but there is invariably substantial change in community composition. In fact, one may even find increased diversity in more open and less structurally complex habitats or forest types, contrary to general expectation, in some regions (Daniels et al. 1992). The community composition (identity of species that occur and their abundance) in these modified habitats is, however, usually very different. In a comprehensive review of tropical agroforestry systems (such as coffee, cocoa, forest rubber, and banana) Bhagwat et al. (2008) compared both species richness and compositional similarity with forest using various plant and animal indicator taxa. They report that while the number of species in plantations ranged between 64% and 139% of that in forest reference sites, the compositional similarity with forest was lower at between 25% to 65%. This pattern is essentially due to species of primary and mature forests being replaced by species of disturbed or open-forests in the modified land uses (Daniels

Another pattern of change in biological communities frequently seen accompanying such land-use or habitat alteration is the substitution of more range-restricted or endemic species with species that are more common or widespread across a larger region. This is revealed by studies of the effects of habitat alteration on many tropical forest bird communities (Raman 2001, Waltert et al. 2004, 2005, 2011). In the Western Ghats, the conversion of tropical rainforest into plantations such as tea and coffee, for instance, leads to the entry of many widely distributed and common species typical of the more open tropical deciduous forests in peninsular India. Concomitantly, many sensitive and range-restricted species that are less tolerant of alteration of the dense, closed-canopy environment decline or disappear (Raman 2006).

Thus, from the perspective of conservation of communities typical to particular vegetation types or regions, it is the extent of alteration in animal community composition that is a more relevant concern than change in number of species. The magnitude of alteration in community composition is in turn related to the magnitude of change in the habitat attributes of the plantations in comparison with the natural vegetation (e.g., forest). Most tropical forests tend to have a more complex habitat in terms of vertical profile of foliage, canopy cover and contiguity, and structural development when compared with other land-uses such as plantations that involve intensification of land-use accompanied by structural simplification of habitat (Michon and Mary 1990; Garcia-Fernandez and Casado 2005; Greenberg et al. 2008).

In southern Western Ghats, studies have revealed greater alteration of bird community composition with greater alteration of habitat structure and shade tree diversity. In a study from the Anamalai hills, the proportion of rainforest bird species in the community was found to increase from <43% in the open monoculture tea plantations (Sidhu et al. 2010) to 59% in shade-coffee plantations with moderate tree cover to 90% in rustic cardamom plantations grown under denser shade of native rainforest tree species (Raman 2006). In southern India, tea plantations are dense monocultures of tea bushes, under intensive cultivation operations year-round, with sparse canopy of a single alien tree species planted in rows (silver oak Grevillea robusta, native to Australia) at around 12 m spacing. In relation to other plantations studied thus far in the Western Ghats, tea plantations appear to be the most extreme in terms of alteration of habitat relative to rainforests (Sidhu et al. 2010). In the Western Ghats of Karnataka, Ranganathan et al. (2008) found that 90% of bird species that were associated with regional forests also occurred in arecanut plantations. Cardamom, coffee, and arecanut plantations thus seem to hold more species, partly due to the extensive use of shade trees including native tree species, than is the case in the severely modified land-use represented by tea plantations. However, all such comparisons based on species presence need to be complemented by analysing differences in abundance and breeding to get a more comprehensive picture (Sridhar 2009).

It must be noted that there has been little study of the effects of plantations such as rubber and oil palm on biological diversity in the Western Ghats. A study in Thailand that compared rubber and oil palm plantations with lowland forest (Arartrakorn et al. 2006), showed that both these plantations can have significant detrimental effects on native biological diversity. In that study, bird species richness was 60% lower in oil palm and rubber plantations than in lowland forest areas. Lowland forest was the only habitat in which nearly 60% of the 128 species were found, including 8 highly restricted-range species confined to lowlands and 15 of 16 globally threatened or near-threatened species, all of which disappeared upon conversion to plantations. Oil palm, because of the serious deforestation-related concerns over this crop in south-east Asia, has been the focus of many studies that have established its serious impacts on biological diversity, climate, and social justice (Fitzherbert et al. 2008, Sheil et al. 2009, Wilcove and Koh 2010, Koh et al. 2011).

In general, the more structurally and floristically similar plantations are to forests the more similar they are in their community composition with forest (Raman and Sukumar 2002; Raman 2006). Studies in the Western Ghats have emphasised the importance of native shade tree species in coffee and cardamom as they can help support many forest species within plantations as well as by acting as a buffer habitat in the wider landscape context of plantations, habitat remnants and protected areas (Raman 2006; Bali et al. 2007; Mudappa and Raman 2007; Mudappa et al. 2007; Sridhar et al. 2008). Other studies from around the world have shown that more forest species can be supported by a mix of cultivated and native shade trees (Taylor et al. 1993; Thiollay 1995; Estrada et al. 1997; Greenberg et al. 1997a,b; Powell and Bjork 2004; Sekercioglu et al. 2006; Sodhi et al. 2008).

Besides differences in habitat structure or floristics, the landscape context of plantations also matters. For instance, while bird species richness and abundance in coffee plantations in Karnataka does increase
with increase in basal area of native tree species, it also declines with increasing distance of the plantation from contiguous forest (Anand et al. 2008). Similarly, the closer plantations are to intact forest patches at the larger landscape level, the closer the similarity in bird community composition between intact forest and agricultural areas (Ranganathan et al. 2010). In Brazil, bird communities in a landscape dominated by natural forest (~6% under cocoa plantation) were richer than in a landscape dominated by cocoa plantations indicating the landscape-level influence of forest cover and proximity (Faria et al. 2000). Forest patches and plantations may influence each other. Coffee plantations with companion tracts of remnant forest may have enhanced conservation value for taxa such as birds (Bechler et al. 1987, Raman 2006), even as the buffering role of shade-coffee plantations around fragments may enable enhanced persistence of forest bird populations (Shahabuddin 1997, Raman 2006).

The landscape context is even more important for species of wide-ranging habits such as mammals and birds such as hornbills. Forest patches integrated in the production landscape are necessary as they act as refuges for species that are sensitive to changes in land-use (Sekercioglu et al. 2006) or as stepping-stones or corridors for animal movement (Raman and Mudappa 2003, Kumar et al. 2004, Mudappa and Raman 2007, Mudappa et al. 2007). In the Anamalai hills in southern Western Ghats, a survey of protected rainforests in the Anamalai Tiger Reserve and four rainforest fragments in private tea and coffee plantations showed 24 of 28 mammal species to persist in the fragments (Sridhar et al. 2008). Presence of fragments within plantations, control of hunting of wildlife, and ability of many species to use the plantation matrix as habitat or for movement contributes to the conservation of these species. Such persistence may not be a feature of all plantation areas, however, as hunting, landscape alteration due to infrastructure growth, history of disturbance, and distance from continuous and extensive mature forests, and the introduction of alternate or newer plantations such as oil palm can all have serious consequences for conservation and human – wildlife conflict.

Finally, even where plantations support much biodiversity, it is clear that many species are restricted to forests and will survive only if existing remnant forests in the landscape such as Reserved Forests, protected areas, rainforest fragments, and sacred groves are also protected (e.g., Bhagwat et al. 2005; Sridhar et al. 2008; Anand et al. 2010). Thus, besides native shade trees, food resources, habitat and canopy connectivity in plantations, it is important to retain forests in the wider landscape to support large populations of sensitive species and increase the conservation potential of remnant habitats at the landscape level (Laurance et al. 2002; DeFries et al. 2005; Raman 2006; Sekercioglu et al. 2006; Bhagwat et al. 2008).

**Plantations and human – wildlife conflict**

Plantation landscapes in the Western Ghats often adjoin or occur as enclaves within wildlife protected areas such as wildlife sanctuaries and National Parks. This interface brings wide-ranging animals such as Asian elephants (*Elephas maximus*) and leopards (*Panthera pardus*), into greater contact with people and production landscapes following large-scale conversion of forests to monoculture plantations, croplands, and developed areas. Besides directly reducing and fragmenting available habitats, such changes may result in interface between people and wildlife in the adjoining human-dominated landscapes. The occurrence of such species in plantation landscapes in the Western Ghats is pervasive and it is important to note that mere presence of a species does not predicate conflict, unless there is specific damage or threat to the economy, livelihood, and safety of people, or incidents leading to injury or death of wildlife. Then, a proper understanding of the nature of conflict and the species involved can help mitigate conflict and promote coexistence.

In tea and coffee plantation landscapes, conflicts between people and elephants do occur in the form of crop and property damage, injury and loss of lives (Nath and Sukumar 1998, M. A. Kumar et al. 2004, Bal et al. 2011). However, there remains scope for coexistence between elephants and production as shown by studies of elephant movement, habitat use and conflict with people in these landscapes. In the Anamalai hills of the Western Ghats, Kumar et al. (2010) tracked movements of elephant herds through a landscape dominated by tea plantations, with coffee, *Eucalyptus*, and interspersed natural vegetation in the form of rainforest fragments and riparian vegetation. Although these natural vegetation remnants occupied a small fraction (<5%) of the 220 km² landscape, elephants strongly preferred riparian vegetation and rainforest fragments (33% of observed elephant locations). In addition, the data indicated elephant avoidance (in relation to area available) of large tracts of tea monoculture and human settlements, particularly during the day. By night, elephants used tea plantations more to move through tea between natural refuges, but retained
the preference for riparian vegetation and relative avoidance of other habitats including human habitation. Coffee and Eucalyptus were important plantation habitats used by elephants in the wet and dry seasons, respectively. The pervasive presence and use of elephants of the man-modified tea and coffee plantation habitats is despite elephant avoidance of these habitats. In other words, elephants use plantations as habitat but this is not due to preference or attraction, but because plantations do provide some resources and their use is inevitable in a fragmented landscape, especially enclaves within larger conservation reserves. Most conflict in this landscape was in the form of property damage in food storage areas and unexpected accidental encounters between people and elephants, therefore targeted mitigation to improve food storage pattern and protection and early warning systems for local people of elephant movement could help reduce conflict incidents while allowing elephant movement through the larger landscape (M. A. Kumar et al. 2004, 2010).

In the coffee-dominated landscape of Kodagu, Karnataka, area under coffee cultivation doubled over 30 years (Garcia et al. 2007). Conflicts between people and elephants have emerged due to multiple anthropogenic factors including forest fragmentation and degradation due to dams, forest fires, and other disturbances in the wider landscape. Elephants may also enter coffee estates due to presence of palatable food such as rice paddies and fruit trees, and perennial water sources including artificial water bodies (Nath and Sukumar 1998, Kulkarni et al. 2007, Bal et al. 2011). Bal et al. (2011) argue that conflict mitigation must be based on stakeholders' awareness of the true nature of the problem. Failing which efforts to ‘tame’ the problem may fail and local people become increasingly disheartened leading to mistrust among stakeholders. They suggest that human – elephant coexistence requires a combination of adaptive management strategies based on three elements: (1) the ecology and behaviour of elephants, (2) site-specific spatial and temporal determinants of conflict, and (3) the human socio-political and economic environments. In addition, they call for better transparency in decision-making and solutions that increase public tolerance of elephants, possibly through provision of direct benefits, in such plantations. Ninan and Sathyapalan (2005) have noted that smallholders face higher costs and disincentives in connection with conflict in this landscape, but nevertheless there is still considerable positive attitude among local people for biodiversity conservation and willingness of people to engage in participatory efforts and with more decentralised government institutions.

In the case of leopards, an adaptable carnivore that is also known to use man-modified habitats, a different approach may be required. A study in the plantation-dominated Valparai plateau landscape surrounded by protected areas, showed that large carnivores (mainly leopards) predominantly preyed upon available wild prey (Sidhu et al. 2011). In a landscape with around 90,000 people and around 2,000 livestock (cattle and goats), 32 head of livestock (cow, buffalo, and goat) were reported by respondents as lost to carnivore depredation (economic loss averaging INR 9732 or ~USD 216 per incident) over a 3-year period (2008 – 2010). Over the same period, there were eight attacks on people, resulting in three fatalities (all children). Conflicts in the form of livestock depredation was perceived to cause an estimated loss to those households that kept livestock (<5% of total households) amounting 13% of the annual household income. Colonies with more livestock had more depredation events, but distance to protected area and number of people in a colony also influenced the number of depredation events in a colony. Monetary losses to large predators were found to have no significant effect on people's attitudes toward leopards. However, in colonies where people were injured or died due to leopards, more people had negative attitude towards the species. The study proposed management measures that consider leopard biology and proactive measures such as improved livestock corrals, managing waste disposal, and basic safety precautions for people, especially young children.

Involving plantations in conservation

In the absence of adequate recognition, protection, or habitat restoration, areas of conservation value in and around plantations continue to face threats, degradation, and several other problems common to fragmented tropical landscapes (Laurance and Bierregaard 1997, Mudappa and Raman 2007). Despite their considerable extent, these plantation landscapes have seldom been directly incorporated in conservation policy and management in the Western Ghats. In the Western Ghats, considerable areas of conservation value exist outside the present protected area network within the commercial plantations occupying over 10,000 km². The extent of abandoned plantation areas and degraded habitat remnants within such plantations, although currently unknown, would probably be at least 1,000 km² (Mudappa and Raman 2007). If extended to include areas in northern and eastern India and the Andaman and Nicobar Islands, and to other countries of
tropical Asia, there is clearly substantial areas of conservation value.

The extent of these areas should be seen against the wide variety of approaches being evolved to address the challenges of extending conservation to non-traditional arenas and production landscapes. These include approaches such as conservation easements, direct payments or credits for biodiversity services, carbon sequestration and trading, purchase of lands, conservation certification of commodities and produce, mitigation banking or compensatory mitigation, corporate social responsibility initiatives, and voluntary efforts (Heal 2000, Swingland 2002, Pagiola et al. 2004, Ginn 2005). Such initiatives have scarcely been tried in tropical Asia, particularly in India, where the mainstream conservation movement is still focussed on protected areas (Wildlife Sanctuaries, National Parks, Tiger Reserves) under a protectionist paradigm (Madhusudan and Raman 2003). Evidence globally on the economic value of biodiversity and forests to plantations mediated by ecosystem services such as pollination, carbon sequestration, and watershed benefits, also suggests that such landscape-scale conservation can bring direct benefits to production, businesses, and local people (Millennium Ecosystem Assessment 2006).

Fostering sustainable plantations: does certification provide a way forward?

Although the efforts to mainstream conservation in plantations proceed from diverse angles, in connection with commodity crops they may be seen within the broader movement towards sustainability in agriculture and business. The idea of sustainability, or sustainable development, received impetus following the report of the Brundtland Commission and its publication of Our Common Future (WCED 1987), further developed in the landmark United Nations Earth Summit at Rio de Janeiro in June 1992. Sustainable development often defined as that which "meets the needs of the present without compromising the ability of future generations to meet their own needs" received a firm place in The Rio Declaration and Agenda 21, which articulated this as a form of development that gave environmental protection an integral part with human beings at the centre. Growing awareness began to influence various entities—nation states and private companies to civil society groups and individual consumers—to incorporate concerns of sustainability in principle and practice. Sustainable development, or sustainability, began to represent a triple bottom-line approach that aimed to meld social, environmental, and economic concerns, or in more catchy terms: people, planet, and profit.

In the context of tropical plantations, how can businesses and smaller farmers become involved in conservation and sustainability? Potential initiatives include voluntary ones such as corporate social responsibility efforts (aimed at greater brand acceptance but with persistent risk of a 'greenwashing' tag) and monetary incentives in the form of direct payments such as for ecosystem services or carbon sequestration (which has been both promoted as attractive and criticised for its further commodification of nature). A sort of intermediate approach is that of certification of plantation business and produce, linked to the growing market for ethically and sustainably produced commodities. Certification has also been criticised for the standards that it uses (or fails to use), the reliability of the independent third-party audit systems, as a form of non-tariff trade barrier, and over its cost to producers, but nevertheless remains the most extensive approach in vogue to incentivise the adoption of more sustainable practices in the plantation sector.

A variety of certification schemes are available, each with their own focus or emphasis, and limitations. The well-established organic agriculture movement (and organic certification as overseen by the IFOAM—the International Federation of Organic Agriculture Movements) has a primary focus on avoidance of chemical inputs for health and environmental reasons. In contrast, Fair Trade certification lays emphasis on social issues related to worker welfare and safety. The Utz Cofee certification aims to drive a balance between social and environmental concerns, but is lax in strict or well-defined criteria. Others such as the Ethical Tea Partnership for tea, and Starbucks's Cafe Practices and the 4C Code of Conduct in coffee have varied norms evaluated on farms from self-assessment questionnaires or possibly third-party 'verification', but are generally weak on environment and wildlife criteria. The Smithsonian Bird-Friendly Coffee Certification is strong on stipulating organic agriculture and specific conditions related to shade tree cover, but ignores other aspects of sustainability (e.g., hunting of wildlife, social welfare). Rainforest Alliance (RA) certification, perhaps the largest certification programme in tea and coffee plantations currently, attempts to encompass social, environmental, and economic criteria. RA certification is based on a set of standards developed by a network on non-profit organizations, called the Sustainable Agriculture Network (SAN), of which RA is a member and implementing partner. The SAN Standards and RA certification, were developed and implemented initially in Central and South America, for crops such as banana, coffee, and cacao.

Presently, the SAN standards that apply for farms are the SAN Sustainable Agriculture Standard
(July 2010) and the periodically updated SAN List of Prohibited Pesticides (last updated November 2011). Although the standards do not stipulate organic cultivation, the list of prohibited pesticides ensures that the worst agrochemicals, internationally screened and prohibited, are not used for cultivation and additionally that chemicals falling within the highest toxicity classes are gradually reduced and replaced. Farmers groups and cooperatives will have to meet additional criteria specified in standards documents applicable for groups. The full version of the standards are available at: http://www.sanstandards.org and http://ecoagriculture.in/home/?page_id=182. Farms that meet requirements based on screening by third-party auditors can become Rainforest Alliance Certified™ and may apply for use of the 'frog' seal on packets and bags to market their produce. As of May 2012, Rainforest Alliance certification based on the SAN Standard was implemented across over 1.8 million hectares (over 1 million hectares in production) across 38 countries and 25 crops, especially in cocoa, coffee, and tea, besides fruits (bananas, pineapple), and other crops such as flowers.

**Sustainable agriculture certification in Indian tea and coffee plantations**

The global standard developed by the Sustainable Agriculture Network (SAN) primarily based on the experiences in the neotropics has lacunae in application in local contexts in Asia and Africa. In the environmental context, for instance, are issues related to conservation of large wildlife species like elephants, human – wildlife conflicts and animal corridors. Many farms in Africa and Asia are also much older, traditional plantations, and a need to integrate traditional practices (such as retaining native shade trees in traditional coffee estates, sacred groves) and knowledge of local communities is another relevant issue. Since 2007 the authors therefore engaged with Rainforest Alliance (RA)—and from 2009 also as a member of SAN—to work towards integrating conservation and other concerns relevant to the Indian context into the SAN Sustainable Agriculture Standard that serves as the basis for RA certification.

In a joint project with Rainforest Alliance (2009 – 2012), we worked to raise awareness on better social, environmental, and land-use practices, especially ecosystems, wildlife, soil and water, based on adoption of the SAN Sustainable Agriculture Standard. The different types of natural ecosystems in tea and coffee plantations, threatened and endangered wildlife species, and issues such as animal corridors and mitigation of wildlife – human conflicts, were projected and discussed in virtually all training events, workshops, presentations, and outputs, thereby directly reaching hundreds of stakeholders in the plantation sector. We highlighted the role of plantations for conservation and the benefits that accrue to the plantations due to conservation, as evidenced from recent research in the coffee sector (see Box 2). This was all linked to opportunities for Rainforest Alliance certification that could bring market benefits to producers (Aerts et al. 2010).

Introducing and fostering adoption of sustainable agriculture practices among Indian tea and coffee plantations threw up many challenges on social, environmental, and economic fronts. Social concerns in the plantation sector involve issues such as payment of minimum or living wages, provision of housing and education, prevention of discrimination and harassment, occupational safety and welfare of workers, good working conditions, prevention of bonded labour, freedom to organise and seek representation, and good relations with the larger local community. In India, many of these concerns are sought to be addressed by legislation, particularly the Plantation Labour Act 1951 (amendments up to 2010), Minimum Wages Act 1948, and Factories Act 1948. Despite the legislation, a number of vital social concerns remain on all these issues in plantations such as tea and coffee, as is clear from a number of recent reports, but these are outside the scope of the present paper.

Concerns over environmental sustainability arose from many of the present production practices in plantations. Threats to biodiversity include hunting of wildlife and land clearing leading to habitat fragments such as forests, grasslands, and wetlands in plantations being degraded or converted to land uses that cannot sustain endemic species. Examples include clearing forest and second growth to establish monocultures of tea, the planting of alien tree species such as *Eucalyptus* in grasslands, swamps, and along streams, and draining of swamps or overuse of water or pollution of wetlands. The spread of invasive alien species introduced in plantation areas (e.g., as crops or cover crops, or for biological control), or which have established following disturbances is another serious concern with spillover effects in surrounding landscapes. A key issue in agroforestry plantations such as coffee and cardamom, where shade trees are integrated in the production area, is the intensification of production accompanied by removal of shade trees or the gradual replacement of diverse native shade trees with fewer or single tree species, often alien species.
such as silver oak *Grevillea robusta* or *Eucalyptus* or *Maesopsis eminii*. Recent research indicates that some native tree species may be superior to the alien silver oak *Grevillea robusta* as shade in coffee in southern India (Nath et al. 2011). Water conservation and pollution is another key issue. Waste water run-off into fresh water sources from coffee wet-pulping or from washing of tea factories, especially the former, can be a significant source of water pollution. Groundwater use and surface water diversion and overuse, for irrigation, sprinkling, and washing are also concerns from environmental as well as social (community relations) perspectives. Opportunities for improving water use efficiency, reducing wastage, water reuse, rainwater harvesting, and better treatment systems were some of the aspects highlighted during the project.

The (over)use or dependence on agrochemicals is also a major concern from environmental, economic (integrated farm management), and social (toxicity, health) perspectives. Agrochemicals include pesticides (insecticides, acaricides, fungicides, herbicides), plant growth promoters, manures and fertilizers. The use of pesticides is regulated by the Insecticide Act and Rules, but rather inadequately in comparison with international standards. For instance, paraquat (gramoxone), a herbicide on the dirty dozen list of the Pesticide Action Network (http://www.pesticideinfo.org) is approved within India and widely used in tea and coffee plantations. Chemicals such as endosulfan are also widely used in plantations, especially in rubber and cocoa, with the manufacture and use of this chemical prohibited by the Supreme Court only in 2011. Monocrotophos (toxic organophosphate) and carbofuran (furadan) are still recommended for use in cardamom plantations under conventional practices, to name just a few examples.

Economic concerns at the farm-level, especially when viewed in terms of long-term sustainability rather than exclusively on annual bottom-lines, also predicate the need to adopt extensive ecological solutions to issues rather than intensive engineering solutions. The adoption of integrated farm management can increase the economic efficiency of many plantations, such as use of regular soil testing to determine exact fertiliser requirements, regulated and targeted spraying of pesticides on pest attack rather than pre-emptive spraying of entire fields, use of alternatives such as pheromone and sticky traps rather than expensive chemicals, proper assessment of social and environmental impact and suitability of new crops and new production areas before planting, use of appropriate soil cover, mulching, and shading to address erosion, soil health, and weeds rather than concrete revetments, artificial fertilizers, and chemical herbicides.

In addition, we developed through a consultative process with stakeholders, including tea and coffee producers, a detailed local interpretation guidelines document and annexures including suitable native shade tree species, which are likely to be of value to bring about further sectoral change. We also developed a comprehensive website on sustainable agriculture with useful resources and a photographic visual guide for tea and coffee plantations in India. The website, Ecoagriculture India (http://ecoagriculture.in) and associated social network sites are a resource to help foster conservation in plantations in the region, especially for producers who wish to know more about sustainable agriculture or prepare for certification. As a result of the work, some plantations are also reaching out to regional civil society organisations for aspects such as wildlife inventory, ecosystems protection, and sourcing seedlings of native shade tree species—partnerships that can extend in the future. Such consultations with local NGOs as resource persons (e.g., Keystone Foundation in the Nilgiris, Ecosystems India, Assam, others involved in waste management and health), were very helpful. Finally, by on-site training in farms for management and workers, and assistance through diagnostic audits and outreach, several estates moved to apply for certification, underwent certification or re-certification audits, and some achieved first certification within the project period itself.

In India, due to commitments of global buyers such as Unilever, Tetley, Tata Global Beverages, and Kraft, there has been a growing market for Rainforest Alliance certified tea and coffee, and a number of tea and coffee estates, groups, and farms in southern India and eastern India have been certified since 2008 onwards. Overall, for the producers, benefits are emerging as they are already linked to the rapidly growing market of Rainforest Alliance Certified (tm) produce and export opportunities and the number of interested producers and market scope seems to be expanding. As of May 2012, the certified operations had expanded to include 33 farms and 24 groups occupying 68,000 ha (c. 50,000 ha in actual production), primarily tea and coffee plantations and limited pepper and cardamom, in southern and eastern India.

Lasting change, if it is to come to Indian plantations, cannot come from just the companies or farmers alone, or by means such as certification taken in isolation. A farmer primarily concerned with profit or yield or a company mainly concerned about an annual bottomline often allots little time or resource to finding and applying the various changes in land-use and business practices, consumer awareness and market linkages, that the mainstreaming of conservation concerns and sustainability entails. As the issues are multifaceted, it requires the inputs and engagement of a wide variety of stakeholders from farmers and worker,
local communities and civil society organisations, to industry bodies and government. We review briefly some of the major stakeholders and the kind of engagement that will be beneficial in this context in a SLOT Table (Appendix).

Although certified produce from these farms have started appearing in foreign markets at the time of writing, the effects of changes made by farms for certification on conservation at the ground level remain to be seen. There have been no targeted studies so far exploring the economic or ecological benefits from certification in Indian farms. Also, as a large volume of Indian tea and coffee is sold for domestic consumption, often in auctions, certification is of little interest to many companies, particularly in southern India, due to lack of domestic awareness of the sustainability issues or demand for certified produce.

Finally, we also note that, although rarely discussed, a deeper, more substantive approach to sustainability is for businesses or farmers to adopt better land-use practices based on their own growing awareness of the imperatives of conservation and benefits from the services (e.g., watershed, pollination) provided by natural ecosystems, along with their skill in mitigating the impact of plantations on people and the environment without compromising long-term productive capacity of land. As Aldo Leopold wrote in a prescient essay titled The Farmer as Conservationist in 1939: “Subsidies and propaganda may evoke the farmer's acquiescence, but only enthusiasm and affection will evoke his skill. It takes something more than a little 'bait' to succeed in conservation.”

Conclusion

Better land-use practice guidelines and plans addressing issues such as water and soil conservation, ecosystems and wildlife protection, and worker welfare and community relations are sorely needed for Indian commodity plantations such as tea and coffee. Yet, there has been little effort to minimise negative impacts and enhance beneficial aspects of plantations for conservation through appropriate landscape- and farm-level management and agricultural practices in regions of high conservation importance such as the Western Ghats. A mix of approaches is the need of the hour, which includes legal requirements and sanctions, certification-based incentives, continuous civil-society engagement to evolve better land-use practices and act as watchdogs, and increased R & D in sustainability by plantation industry associations, boards, and research institutions. This is needed to meet conservation goals such as effective wildlife conservation at the landscape level, minimising conflicts and costs associated with ecologically insensitive land-use, and to sustain businesses and livelihoods profitably in the long haul.

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Tea plantations, occupy a total area of over 119,740 hectares in southern India in 2007, having increased in coverage by around 6,280 hectares (5.5%) in the period between 2000 and 2007, despite a downturn in the industry for much of that period (Tea Board statistics, http://teaboard.gov.in/pdf/stat/Growers%20&%20Area %20under%20Tea.pdf). This is a matter of high environmental concern as tea plantations are grown as intensive monocultures, with no native shade tree cover and only very sparse shade represented by planted and annually-lopped Australian silver oak (Grevillea robusta) trees. Tea thus represents more extreme habitat modification from natural forests of the region, than is the case for plantations that normally have higher shade tree cover including native tree species such as coffee and cardamom.

Coffee plantations in India span at least 341,518 hectares having increased from around 270,821 ha in 1990 – 91 to span over 400,000 ha in 2010 – 11, of which 85% of the production area lies in and adjoining the Western Ghats of Karnataka, Kerala, and Tamil Nadu (Coffee Board database, http://indiacoffee.org/userfiles/DATABASEJune11_1(1).pdf). While part of the increase in coffee production area is due to increase in coffee-growing in non-traditional areas, such as Andhra Pradesh, Orissa, and Eastern India, even in traditional areas in southern India there has been increase in coffee, often accompanied by loss of forest cover. The loss or gradual conversion of private forests or sacred groves, some in degraded stages, into plantations may account for some of the recent increase in coffee area as well. For instance, Kodagu, Karnataka, one of the major coffee-growing districts in India, lost an estimated 30% of its forest cover between 1977 and 1997, primarily due to coffee cultivation (Garcia et al. 2010). Over the same period, the area under coffee almost doubled and expanded from being limited to the low-elevation moist deciduous forest to evergreen forests towards the west. Coffee plantations now abut all protected areas in the district, but forest loss seems to have stabilized in recent times due to a combination of lack of land availability as well as forest laws. Among coffee areas, over half is under Robusta coffee (Coffee canephora) a species that is grown under less shade and is known to have lower biodiversity conservation value and higher invasive potential than shade-grown Arabica coffee (Coffea arabica, Raman 2006, Joshi et al. 2009).

Small cardamom (Elettaria cardamomum) is mainly grown in the three southern states of Tamil Nadu, Kerala, and Karnataka, where it spans over 73,228 ha (2011 Spices Board data, http://www.indianspices.com/pdf/spice-state-arprd.xls). Small cardamom, a native plant of the Western Ghats now cultivated as several varieties in the region, requires denser shade for cultivation and offers opportunity for mixed native tree species agroforestry in the region. On the other hand, conventional cultivation requires high inputs of toxic agrochemicals in cardamom, which is a serious concern.

While tea, coffee, and cardamom plantations are the major plantations in the middle and higher elevations of the Western Ghats, considerable expanse of other plantations occur in the lower elevations, foothills, and adjoining plains. Important among these are plantations of rubber (Hevea brasiliensis), arecanut (Areca catechu), and cocoa (Theobroma cacao). Rubber plantations occupy over 615,000 ha in India, mainly in southern India (around three-fourths of the area is in the State of Kerala alone). India is the world's leading producer of arecanut, cultivated over an area of 354,000 ha, mainly in the states of Karnataka (leading producer), Kerala, Assam, Tamil Nadu, Meghalaya and Maharashtra. Cocoa plantations occupy over 32,000 ha (2007), primarily in the states of Kerala, Karnataka, and Andhra Pradesh. These are sometimes grown with arecanut as a shade crop as well as in home gardens, especially in Kerala and Karnataka along the western aspect of the Western Ghats and Malabar coast. Other cultivated plantation crops in the region include coconut (Cocos nucifera), vanilla (Vanilla sp.), and pepper (Piper nigrum), the latter usually intercropped in coffee, cardamom and other plantations and home gardens.

Oil-palm cultivation in India spanned about 53,161 hectares in 2004, of which oil fruits production area was about 40,650 hectares (Manoharan 2007). It is cultivated mainly in the States of Andhra Pradesh, Karnataka, Tamil Nadu, Kerala, and Maharashtra, with smaller areas in Orissa, Gujarat, Tripura, Mizoram, and Andaman and Nicobar Islands. While the crop failed to gain initial acceptance by farmers (with substantial areas under oil palm being uprooted by farmers between 2001 – 2003 due to poor prices and other factors), there is a push to increase the area under oil palm in India, partly to reduce the growing dependency on imports. The Government of India has however identified as around 796,000 ha as suitable for oil palm. In the Western Ghats, some of this increase is likely to occupy locations within or adjoining tropical forest areas in Kerala, Karnataka, and Tamil Nadu. Cultivation of oil palm is already seen in landscapes adjoining protected areas in many districts of southern Karnataka (e.g., Mysore: Bandipur TR, Kodagu: Nagarahole NP), Kerala (e.g., Wynnad: Wayanad WLS, Trichur: Parambikulam TR).

BOX 1. Plantations in southern India: area, growth, and conservation concerns
BOX 2: Coffee plantations and conservation

How coffee can benefit conservation

Among the various plantations in the Western Ghats, crops such as coffee and cardamom, being traditionally grown under the shade of trees occupy a special place. In some parts of the Western Ghats, such as the Anamalai hills, where there is little hunting of wildlife, one can walk into coffee plantations and see even endangered or endemic species such as Great Hornbills (Buceros bicornis), lion-tailed macaques (Macaca silenus), and Nilgiri langur (Trachypithecus johnii). A large body of research from around the world has established that shade-coffee plantations can support many forest species, including birds, arboreal mammals, invertebrates such as ants and bees, and native trees and epiphytic plants (e.g., Greenberg et al. 1997a,b; Perfecto and Vandermeer 2002; Perfecto et al. 2003, 2005; Tejeda-Cruz and Sutherland 2004, Komar 2006, Jha and Vandermeer 2010). Similar results have been obtained from many studies from the Anamalais, Palnis, Chikmagalur, and Nilgiris – Kodagu in the Western Ghats (Shahabuddin 1997; Raman 2006, Bali et al. 2007, Mudappa and Raman 2007; Anand et al. 2008; Doria et al. 2008).

Two aspects are important to remember when one considers the value of shade-coffee for biodiversity. First, although coffee plantations can support much biodiversity (Bhagwat et al. 2008), many species are restricted to forests and will survive only if existing remnant forests in the landscape such as Reserved Forests, rainforest fragments, and sacred groves are also protected (e.g., Bhagwat et al. 2005; Sridhar et al. 2008; Anand et al. 2010). Second, like the various brews of coffee, there are various brews of coffee estate when it comes to shade and farms that excessively rely on few or just single species of tree for shade, particularly alien (exotic) species such as the silver oak Grevillea robusta, provide poorer habitat than farms that include a diversity of native species as shade (Komar 2006; Raman 2006; Anand et al. 2008). Third, many endangered and wide-ranging animal species such as Asian elephants (Elephas maximus) use plantations as part of their seasonal ranging or migration. Plantations may require to take larger landscape-view of the location in relation to surrounding protected areas and forests and work to both prevent hunting of species seen on the farm as well as allow their safe passage through the farm while implementing appropriate response procedures for safety of workers and property. These aspects, the protection of remnant forests, diversification of native shade, prevention of hunting, and allowing animal movement through the landscape are therefore emphasised by conservation-oriented certification programs like Rainforest Alliance.

Again, here Indian coffee plantations have a window of opportunity. Unlike recently-expanding coffee areas like Vietnam and Sumatra that are being established through deforestation, much of Indian coffee represents decades-old, well-established plantations, grown traditionally under shade of native tree species, with Reserved Forests and sacred groves integrated within the landscape. There has been a worrying trend in recent times of the loss of these traditional practices, leading to degradation of forest cover, and over-reliance on alien (exotic) tree species, particularly silver oak Grevillea robusta (native to Australia) and Maesopsis eminii (native to Africa). Some of these negative trends were partly induced by pressures on farmers in years of low prices (forcing felling of trees for timber) or a short-term view of cultivation (rapidly establish shade using convenient alien species). There has also been a proliferation of the use of power fences around private estates, creating barriers to animal movement. Fences may reduce conflict if implemented in a participatory manner around specific property or crop fields, but may be ineffective or exacerbate conflict if used to fence off large areas such as large private holdings. Proper deployment of fences for protection leaving spaces for animal movement and access to water bodies would help in reducing costs and inefficiency (associated with long fences), mitigating conflicts better, and support the conservation of large landscape species. The judicious revival of traditional practices related to native shade trees, sacred groves, and forest protection, along with adoption of no-hunting policy and measures to facilitate animal movement can convincingly project the conservation significance of Indian coffee to the world.

How conservation can benefit coffee

There is also increasing interest and evidence globally on the economic value of biodiversity and forests to plantations. These values may accrue directly through ecosystem services such as pollination, carbon sequestration, and watershed benefits for farms. A pioneering study in Costa Rica demonstrated that coffee estates that were near forests benefited from better pollination (Ricketts 2004). In the same 1065 ha farm, experiments showed that pollination by bees from nearby forests increased yield of Arabica coffee by 20%
and improved coffee quality (Ricketts et al. 2004). The study estimated that the two patches of forest (46 ha and 111 ha) near the Costa Rican farm directly contributed to an economic benefit of USD 60,000 per year (or roughly USD 60 / ha per year) through pollination services, bringing to light an aspect that had remained invisible and unmeasured.

Similarly, a study on pollination in Robusta coffee in Sulawesi, Indonesia, concluded that retaining forest patches near coffee estates and adoption of other good practices related to diversifying shade and reducing herbicide use, could support better bee populations (Klein et al. 2003). In this study, a bee community of 20 species or more led to a higher fruit set (95%) than a species-poor bee community of six species (70% fruit set). In the landscape of Kodagu District in southern India, a study has recently demonstrated the importance of cross-pollination for crop production in Robusta coffee (C. canephora), traditionally believed to be wind pollinated (Krishnan et al. 2012). The importance of pollinating insects to coffee production, and the benefits brought by retaining relatively large forest fragments within the landscape to support the insect pollinators is another noteworthy aspect in this research. Retaining remnant forest patches has also been shown to be useful in promoting pollination and pollinator abundance is linked to fruit set in coffee in the same landscape (Boreux et al. in press).

Likewise, other benefits of biodiversity for coffee are being described. Studies have shown that while better and more diverse shade can support greater diversity of birds, the birds in turn may play a significant role in reducing insect pest attack on coffee (Greenberg et al. 2000, Johnson et al. 2010). Shade management, is often considered only in relation to yield of coffee; however, many other benefits may accrue from shade including higher coffee quality, lower berry fall and transpiration stress (Vaast et al. 2006), better organic matter accumulation and reduction in nematode and berry disease (Beer et al. 1998; Bedimo et al. 2008). Shade can also help reduce coffee stem and berry borer infestations, especially given the prospect of climate change (Jaramillo et al. 2009), while sustaining or enhancing quality and profitability (Muschler 2001; Gordon et al. 2007).

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SLOT Table of various stakeholders to achieve goals of conservation and sustainability in plantations in the region

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Strength</th>
<th>Limitations</th>
<th>Opportunities</th>
<th>Threats/costs</th>
<th>Required changes</th>
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<tbody>
<tr>
<td>Producers/ farmers</td>
<td>Well-organised sector with capacity to adopt and implement better practices if they desire</td>
<td>Supported by Government, Boards, and agricultural research institutions Close relationship with land</td>
<td>History and colonial legacy of practices and inertia Poor awareness of ecosystems and wildlife issues, animal corridors Dominant/unidimensional focus on intensification and yield/ha Dependence on agrochemicals</td>
<td>Access to new and growing markets of informed consumers via certification Ethical positioning More stable market linkages Better relations with local community and workers</td>
<td>Resistance to change, including organised Perverse subsidies to intensify improver land-use Conflicts with wildlife Financial costs of compliance, audit, and improvement</td>
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<tr>
<td>Producer associations and cooperatives</td>
<td>Well-placed, strong voice and influence with Government and planter communities Represents huge worker population acting as social capital Negotiating powers with unions and State on wages</td>
<td>Often biased towards larger estates and influential companies Representation of entrenched vested interests, especially over land and natural resources Lobbying for subsidies, exemptions, often on basis of worker population</td>
<td>Bringing industry-wide changes in practices to leverage emerging market opportunities Sustainability and geographical branding and positioning Increased domestic markets for sustainable produce</td>
<td>View of worker welfare costs primarily as a liability rather than as social capital Lobbying with Government to increase subsidy and reduce interventions Negative attitude towards conservation due to inability to deal effectively with conflicts</td>
<td>Move members towards sustainability and show top management commitment Lobby not only for subsidies or sharing of labour &quot;burdens&quot; by State but for better R &amp; D support related to sustainability Take pro-active stance towards enhancing worker welfare and dignity to counteract labour shortage</td>
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<td>Govt. Boards and industry research institutions</td>
<td>Financially supported Well-equipped and staffed Excellent access to wide variety of plantations and landscapes across India</td>
<td>Very poor engagement on social sustainability issues, such as household energy needs, agrochemical impacts on worker health and soils Almost lacking in wildlife research, and ecosystem services and impacts studies Limited engagement with organic and sustainable agriculture and over-reliance on engineering techno-fixes and agrochemical solutions</td>
<td>Exceptional native biological diversity may hold species of value for shade, pest management, cover crops and others Boards under Ministry of Commerce can incentivise adoption of good land-use (e.g., linking subsidy or tax/customs exemptions to adoption of sustainable practices) Foster domestic markets and labelling for sustainably produced commodities</td>
<td>Industry membership-based ones have more unidimensional focus on yields and chemical inputs Paradigmatic approach to mode of intensive industrial agriculture Costs of broadening research capacity in the institutions to include social and environmental sciences</td>
<td>Rethink and remove perverse subsidies that cause more land clearing, introduce inappropriate new crops, or foster unsustainable land-use intensification Enhance research capacity and agenda to include environmental concerns (agrochemical impacts and alternatives, wildlife and ecosystems research) Develop effective solutions for worker health and safety, (e.g., fuel-efficient safer fuels/stoves, personal protective equipment)</td>
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<tr>
<td>Stakeholder</td>
<td>Strength</td>
<td>Limitations</td>
<td>Opportunities</td>
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<td>NGOs, civil society, and independent research institutions</td>
<td>Large number of independent and credible institutions in the region. Wide experience in issues such as wildlife and ecosystems, social and welfare, development alternative, waste management, native plant and animal species</td>
<td>Constrained by funding. Poor leverage with industry bodies and Boards. Lack of access to plantations to carry out enabling research, often due to mistrust by planters.</td>
<td>Contribute to conservation across a larger landscape. Research to foster native species use and minimise aliens and invasives. Enhance worker welfare and dignity and reduce impacts on natural areas. Identify animal corridors and minimise conflicts.</td>
<td>Reluctance to engage with plantations, seen as a damaging sector. Maintaining independence and credibility in working with corporates and businesses.</td>
<td>Carry out ecosystems and wildlife studies, surveys, and identification of suitable native plant species useful in farms. Form partnerships with planters for habitat restoration and mapping animal movement routes. Help develop locally appropriate guidelines and best practices. Play watchdog role on issues such as land clearing, encroachments. Create better awareness among producers, consumers and local communities.</td>
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<td>Forest and Environment Department</td>
<td>Strong supporting legislation on forest and wildlife conservation. Widespread presence in plantation landscapes that are also biodiversity-rich.</td>
<td>Failure to integrate larger landscapes outside protected areas in conservation. Widespread perception of corruption. Legislation inhibits private efforts at conservation (e.g., growing and managing native shade trees).</td>
<td>As forests are a State subject, site-specific solutions may be evolved. Expertise can be shared and local partnerships created to engage with plantations. Can assist in mitigating wildlife – human conflict in private lands.</td>
<td>Tendency to see private owners as adversaries and to be suspicious of private initiatives. Inability to understand and foster better land-use practices. Delays in wildlife compensation payments.</td>
<td>Taking a larger landscape view, including collaboration with local stakeholders. Training officers and field staff to better deal with production sector, conflict management. Change from a focus on booking offences to also supporting positive changes.</td>
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<td>Workers and local people</td>
<td>Large number of people, resident in the region, often for generations. Being a vulnerable segment as changes in land-use practices and working conditions affect them directly, they are sensitive to these changes and more open to adoption of sustainable practices. Often intrinsically tolerant of wildlife and nature conservation.</td>
<td>Usually lack decision-making powers. Significant migrant and temporary worker population, often with limited capacity, vulnerable to exploitation. Lack of training or capacity-building opportunities to deal with skilled tasks or adopt newer sustainable practices.</td>
<td>Potential for empowerment through education, health, and community efforts and civil society involvement. Greater awareness of rights coupled with continued high dependence of plantations on labour is leveraging improvements in housing and working conditions (can benefit from certification). Rights for collective bargaining agreements and labour unions.</td>
<td>Limited understanding of wildlife and conservation issues and optimal approach to conflict avoidance. Improvements in housing, sanitation (toilets), and safety necessitates significant financial cost (investment).</td>
<td>Closer involvement in decisions related to working and living conditions and wages. Constant and continuous training, using appropriate language and material, in sustainable practices and wildlife conservation. Pro-active measures for better safety and emergency response procedures in areas with large wildlife species.</td>
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