

Chapter 15

Biodiversity Conservation and Sustainable Livelihoods in Tropical Forest Landscapes

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Abstract In developing countries, much remains to be done to truly integrate the livelihoods of rural people and biodiversity conservation into land use decision-making and management processes. Yet, research institutions can support informed landscape management decisions by communities, conservation agencies and policy-makers. This can be accomplished by developing methods and instruments that facilitate coherent linkages between stakeholders across various spatial and decisional scales. Researchers need to facilitate equitable participation in the planning processes and provide information on the options that best integrate biodiversity conservation and livelihoods. This chapter aims to analyse how research has contributed to this objective and how it could be designed for future integrative activities at the landscape level. It identifies lessons from case studies that combine biodiversity conservation and livelihood aims in tropical regions and reviews methodological issues relevant to transdisciplinary research. In addition to the critical elements emerging from case studies, the article highlights the crucial role of institutions in helping to bridge the gaps between science, planning, decision-making and effective management. Finally, it describes an approach that two international research organizations are developing to promote the sustainable use of forests and trees and biodiversity conservation in fragmented tropical forest landscapes.

15.1 Introduction

Biodiversity faces severe threats in many tropical developing countries and hotspots (Chapin et al. 2000). Tropical forests are still being converted (Chomitz 2006) and socio-economic disparities keep increasing to the detriment of rural areas (Kanbur and Venables 2005). Over the last few decades, forest landscapes have become

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increasingly fragmented (Koehler et al. 2003). The resulting mosaic landscapes that have fragments of natural or semi-natural habitats have long been poorly valued in terms of biodiversity conservation (Hanski 2005). At the same time, many national parks and reserves are deteriorating (Jepson et al. 2001) and in some cases, probably do not have the optimal governance structure for biodiversity conservation (Hayes 2006). Even when conservation bodies recognize that protected areas need to be managed as a part of their surrounding bio-cultural matrix (IUCN 2003), conflicting opinions often persist between local people and land use planners. Thus, tradeoffs must be negotiated between local and external interests. In most developing tropical countries, much remains to be done to truly integrate both the livelihoods of rural people and biodiversity conservation into land use decision-making and natural resource management planning (Naughton-Treves et al. 2006). Demographic trends and responses to market demands remain major drivers of long-term land use choices. Depending on the various combinations of agricultural intensification, extensification and migration (Zeller et al. 2000), patterns of land use changes and the potential for biodiversity conservation differ from place to place. Locally, trends are generally guided by concerns over livelihood security and social organization and are externally influenced by policy decisions (Lambin et al. 2003). In deforested environments, communities may restore landscapes to enhance their own livelihoods (for example, in Tanzania; Lamb and Gilmour 2003). However, conservation around large forest areas remains a complex challenge because in the short term, natural resources may seem sufficient for all. Unfortunately, our understanding of conservation in complex mosaics outside protected areas remains limited and local conservation efforts have rarely been truly supported in fragmented landscapes that are likely to support sizeable human populations. This paper explores the challenges research is facing in combining conservation and livelihood aims and identifies opportunities for researchers to improve this situation. We give an overview of the state of knowledge and experience in integrated research and development in order to promote this approach in linking biodiversity and livelihood issues. This paper draws on several types of information in addressing these questions. A systematic literature review supports several sections of this paper. Firstly, it gives an overview of the state of knowledge on applied conservation strategies. Secondly, it provides information on the relationships between integrated and disciplinary science. Finally, it provides the basis for discussion of integrative and transdisciplinary research and how transdisciplinary research results can be used in governance and management. The gaps that appeared in the literature review were addressed in semi-structured interviews. These discussed the engagement of various disciplines and project objectives in real-life situations. The final types of information presented are the results of a focused discussion by a large group of experienced professionals from the field, gathered in a workshop situation. This provides the basis for a proposed new approach that is aimed at addressing the key issues of integrating conservation and development and emphasizing development partnerships and transdisciplinary approaches.

15.2 Methods

The approach for the project called ‘landscape mosaics’ described in this paper was initiated at a workshop held in Bogor, Indonesia by 30 scientists from CIFOR (Center for International Forestry Research) and ICRAF (World Agroforestry Centre) (Pfund et al. 2006). The workshop underlined the need for multidisciplinary as well as applied research to catalyze the development of new thinking, approaches to the practice of biodiversity conservation and the sustainable use of multifunctional landscapes. This workshop was followed by a systematic literature review to gain an understanding of how researchers report in scientific journals of our domain focusing on integration of landscape ecological science into conservation and development activities. We concentrated on tropical landscapes and used very general ecological terms as an entry point for the search. In the Web of Science and CAB abstract databases, we searched with the following combination of words: (Landscape and tropic* and (biodiversity or conservation) and (patch or forest fragment* or matrix* or corridor or connectivity)) AND ((English) in LANGUAGE). In Web of Science, we searched within the items TS (topic) and TI (title) and in CAB, searched the whole article. In Google Scholar, we had to use a slightly different (but comparable) search, only in titles, given the large number of articles. The search string was ‘all in title: landscape (AND) tropical (AND) biodiversity OR conservation OR patch OR forest OR fragment* OR matrix OR corridor OR agroforest’. To evaluate the level of integration of social and ecological disciplines as well as the expressed links between research and development initiatives in the resultant set of papers, we analyzed the articles on the basis of their abstracts. We decided that signs of multidisciplinary were (i) a report from researchers that they had used assessment methods from different disciplines (or the article itself was a multidisciplinary literature review), (ii) researchers conducted the analyses in an integrated manner, i.e., they combined data from diverse disciplines or (iii) there was a substantial participatory aspect in an otherwise traditional biophysical survey. Only those articles that reported that the integration had started *from the beginning* or, that this, was planned to be an essential part of the study, were considered to be integrated. Thus, we did not accept as integrated articles those that later extrapolated strict ecological findings to broader contexts. In response to the lack of development-oriented journal articles emerging from the literature review, we conducted interviews with experienced practitioners of applied research. Appendix provides the list of questions used for these semi-structured interviews.

15.3 Context of Biodiversity Conservation at Landscape Level: From National Parks to Collaborative Management of Landscape Mosaics

The 20th Century was the era of the National Park. The realization that habitat loss is a major cause of extinction followed after the industrialization and widespread

deforestation of western countries. After the creation of Yellowstone National Park in 1872, the park model was applied across the globe, including in tropical colonies, where it has sometimes been interpreted as a strategy of land appropriation or expropriation of hunting resources (Adams 1995). In many cases, areas selected for reservation were inhabited and therefore, local people were displaced and lost the means to meet their livelihood needs (Peluso 1993). By the end of the 20th Century, this strategy had been broadly criticized due to its insensitivity to human needs, while some also claimed that it was inherently ineffective and politically infeasible (Brandon and Wells 1994; Wells et al. 1999; Naughton-Treves et al. 2006). Since the 1970s, the industrial reforestation movement in tropical countries has faced similar criticism (Gerber and Steppacher 2007) so that neither conservation nor intensification were convincing as 'people friendly' forest management approaches. Following the more recent increased understanding of global biodiversity patterns and the consideration of multifunctionality at broader landscape levels, the reserves that had carried the conservation banner for the past 80 years were still considered necessary but no longer sufficient. New paradigms of protecting biodiversity beyond National Parks emerged. These generally tried to combine ecosystem protection, active management of natural resources and even restoration through an integrated and participatory approach to the planning and implementation of conservation within priority landscapes (Dudley and Aldrich 2007). For the past 30 years, habitat loss and fragmentation have largely been studied within the framework of two key theories: the theory of island biogeography (MacArthur and Wilson 1967) and the metapopulation concept (Levins 1969; Hanski and Ovaskainen 2000). However, applications or recommendations for conservation were not straightforward. Difficulties in conserving reserves as well as the need to better consider their spatial arrangement led to a reconsideration of approach. While the metapopulation concept is particularly suitable in highly fragmented landscapes and with habitat specialists, the corridor-patch-matrix model (Forman 1995) acknowledges the need to manage 'areas between' for effective conservation. Both have raised interest in investigating how characteristics and structure of the entire landscape affect the viability of populations.

Landscape ecology provides conservation biologists with tools to address issues such as how habitat loss and fragmentation affect population viability. Within landscape ecology, landscape metrics is a quantitative approach for spatial pattern analysis that has been used extensively (Turner 2005). In addition to this type of structural landscape assessment, new conservation approaches try to better reflect the dynamic nature of populations with local extinctions and colonization of new habitats (Hanski 1999; Siitonen 2003). At the same time, they aim to address the dynamic landscape itself with habitat patches changing due to factors such as human influence and natural succession changing the rates of isolation, attrition and edge-interior relations (Hanski 1999). Besides structural assessment, functional landscape ecological assessment has proven to be a valuable approach to better understand the processes at a landscape level (e.g., Clergue et al. 2005). Unfortunately, spatial landscape pattern analysis is often difficult to link with biophysical or socio-economic factors or processes (Imbernon and Branthomme 2001; Li and Wu 2004). Plans for

landscape management are still often based on assumptions while more function and process-oriented understanding of landscapes is needed for theory to be truly integrated into planning (Chen and Saunders 2006). There have been ongoing debates over theories on spatial priorities of conservation design such as 'SLOSS' (single large or several small) and 'integrate-separate' conservation and production areas. However, the need to halt biodiversity loss, coupled with problematic social situations around many protected areas, has required management decisions to be made before the resolution of these debates. To overcome the practical limitations of conceptual models like the landscape continuum (McIntyre and Hobbs 1999) and the corridor-patch-matrix (Forman 1995), Lindenmayer and Franklin (2002; Lindenmayer et al. 2006) proposed, for instance, the use of five general principles to address biodiversity conservation in forest management: connectivity, landscape heterogeneity, stand structural complexity, integrity of aquatic systems and risk-spreading ('don't do the same thing everywhere'). Through such simple general guidelines, biodiversity values are actively integrated into operational management of timber production systems (Brown et al. 2006; Marjokorpi 2006). Practical experience has also sharpened the focus on tradeoffs: between species, land uses and between conservation and people. Conservation landscape approaches with more prominent elements of stakeholder engagement and negotiation have also been developed by international organizations for tropical countries where poverty alleviation is a major goal (see Loucks et al. 2004 for WWF; Brown et al. 2005 for IUCN). According to Ahern (2004), under the sustainability paradigm, sectoral planning is being replaced with multipurpose planning that explicitly acknowledges the integrated continuum of abiotic, biotic and cultural resource goals. Conservation organizations are coming closer to forestry institutions, bringing a wider (landscape) focus to forest issues (Mansourian et al. 2005). Thus, the general trend over the past three decades has been to widen the conservation focus from static reserves, such as national parks, to more dynamic reserves, such as large conservation landscapes (Bengtsson et al. 2003). Further, there has been a change to more active, adaptive and collaborative management for multiple values (Colfer 2005; Carey 2006).

15.4 Scientific and Applied Approaches to Conservation and Development

15.4.1 Integration of Conservation and Development Themes in Scientific Journal Articles

Since 1992, there has been a rapid increase in articles on the ecology of tropical landscapes. However, there is no observable trend toward integration between disciplines of research and development goals (Fig. 15.1). The number of integrated articles (44 of 375 reviewed) occurred in similar proportions of those articles reviewed from each database: Google Scholar 15% (4 of 37 articles), CAB 13% (16 of 122) and Web of Science 11% (24 of 216).

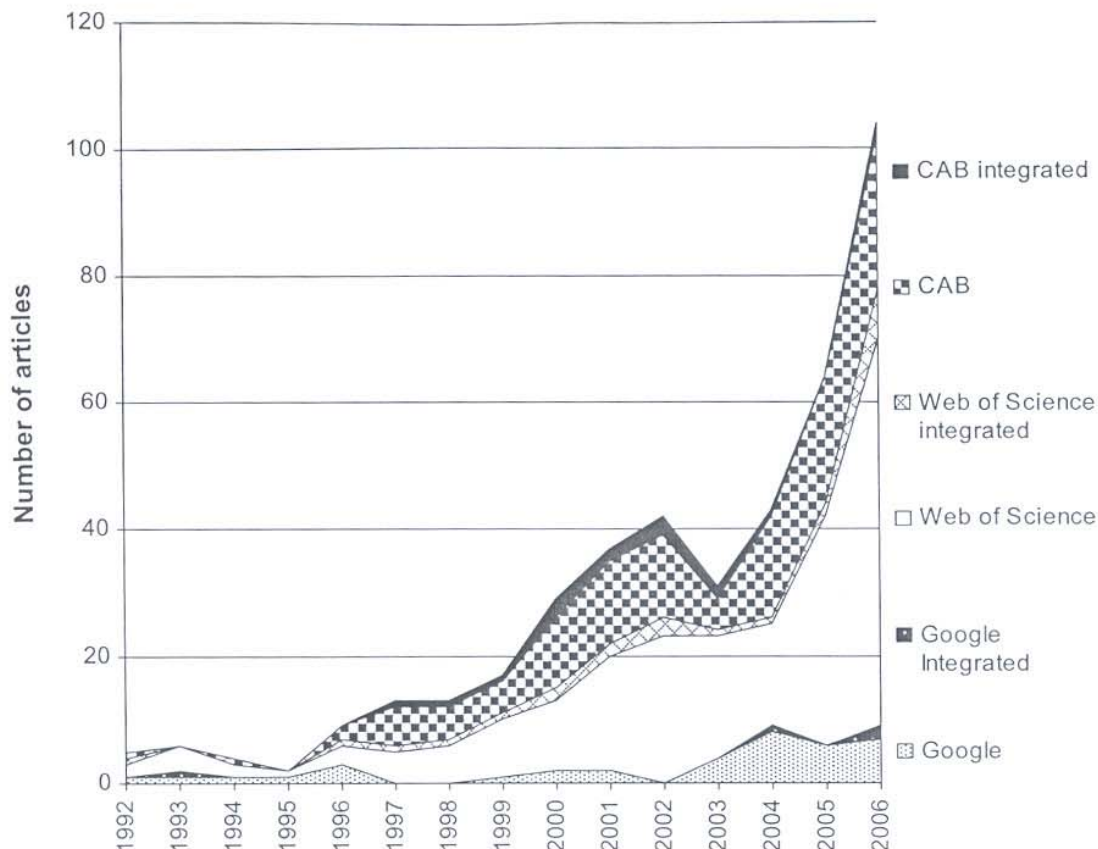


Fig. 15.1 Trend in the number of published articles that can be retrieved from three databases (CAB abstracts, Web of Science and Google Scholar) for journal articles published between 1992 and 2006 with a combination of landscape ecology and biodiversity conservation related keywords; 'integrated' articles include both conservation and development aspects

15.4.2 Issues Encountered in Practice – Lessons Learnt from Case Studies

The interviews conducted after the literature review yielded elements of practical lessons learned from nine sites. In the following section, we will focus on elements that contributed to the strategy of integrating conservation with development in these case studies. The source of statements presented in the text is indicated by the case study and interviewed experts' numbers: 1: Nepal, East Midhills (Laxman Joshi), 2: Indonesia, Sumba Island (Pete Wood and Syarif Indra), 3: Indonesia, Jambi Province (Tom Tomich), 4: Indonesia, Tanimbar Island (Yves Laumonier), 5: Indonesia, Central Sulawesi (Charles Palmer), 6: India, Western Ghats (Gladwin Joseph), 7: Madagascar, Menabe (Clémence Dirac and Lanto Andrimabelo), 8: Brazil, Zona da Mata (Irene Cardoso), 9: Ecuador, Loja (Els Bognetteau).

15.4.2.1 Knowledge on Landscape Patterns and Processes

Landscape mosaics reflect the past drivers of change, history of land uses and accessibility of landscapes. Access to markets, commonly via roads and rivers, influences

fragmentation and potential overexploitation of marketable species (3, 4). Interviewed experts agreed that in undertaking conservation projects, past trends must be understood and action tailored to actual threats and opportunities. They acknowledged that biodiversity resource assessments and threat analysis at landscape levels are necessary. Nevertheless, most experts also recognized the insufficient financial resources to fully engage with ecological theory and research while promoting conservation (1, 2, 3, 4, 8). Where social, capital and local readiness to negotiate land use agreements exist, there may be prospects for natural resource-based enterprises. Where protection is urgent and land use planners are interested in collaboration, 'action research' intended to support multi-stakeholder negotiations on land access may be more relevant initiatives for conservation than isolated scientific studies (3, 4).

Topography and relief play a central role in influencing spatial patterns and it is common that in mountainous areas such as the Western Ghats, Nepal, Jambi and Central Sulawesi, well-connected forests occur at higher elevations, whereas lower elevation forests are in isolated fragments (1, 3, 5, 6). Interestingly, Jambi's formerly most intensively used areas, the riverine agroforests, are now important in providing connectivity between patches of forest and it seems that at least long-distance dispersing plants benefit from these 'stepping stones' (3). Studies of bird life and soil macrofauna in Jambi and invertebrates in Nepal show that as intermediate land types, agroforests are not perfect systems but provide important habitats for many organisms (1, 3). Unfortunately, it is still difficult to know if they will be sufficient for the survival of forest interior species in the long term. In India, ATREE has been helping local Non-Government Organizations (NGOs) to identify where to buy land to maximize critical forest connections (6). The installation of corridors for biodiversity conservation is supported by scientific results in some circumstances (Damschen et al. 2006). However, they are not often implemented in the tropics, perhaps because of the uncertainties in designing them and handling the competition with other land uses. Another reason for the limited support of restoration or conservation of fragments and corridors might be the complexity of comparing different landscape situations and various efficiencies of corridor types in assisting the movement of seeds, wildlife or genes. To enable comparisons between landscapes in terms of performance and to facilitate spatial planning, there is a need for a clearer tropical landscape typology (3).

15.4.2.2 Informed and Capable Actors

Better understanding of the various values and motivations to use or conserve biodiversity and environmental services is required. Also, better communication: Sheil et al. (2006) argue that the preferences and perceptions of local stakeholders often remain hidden when conventional biodiversity surveys are conducted and that misunderstandings may lead to irrelevant or short-term decisions. Surveys from Lore Lindu suggest that biodiversity is not very relevant *per se* to local people, especially for those who are poor (5), but that they use environmental services that can rely on

biodiversity conservation. In Madagascar, biodiversity resource assessments, even at the landscape or ecoregional level, only partially represent the relevant conservation issues. Further, they should always be linked with solid assessments of the villagers' needs (7). A utilitarian view of biodiversity seems to be common among all case studies. Local people may have detailed knowledge of fodder systems including animal preferences and seasonality as well as tree-crop interactions, as in the Nepal case, or a thorough understanding of the species they harvest, as in Sumba and Tanimbar (1, 2, 4). Yet despite this traditional knowledge, overharvesting may still be a problem. Species such as dugong are locally extinct even in Tanimbar, which is generally recognized as having a 'conservationist' population due to their communal ban of forest access by logging companies (4). In some cases, an unsustainable use of resources can be explained by a lack of internal cohesion, caused, for example, by migration processes (3, 7). In Lore Lindu, migrants coming from recent resettlements lack a strong attachment to the land and local rules (5). In the Central Menabe case, internal movement has led to mixed populations in the villages: natives and migrants often do not share the same understanding of the value of the biodiversity (7, Cabalzar 1996).

In Sumba, BirdLife focused on endemic birds and attempted to raise local pride and responsibility regarding these species. The traditionally strong respect for law in that society has assisted messages about the illegality of hunting the endemic Sulphur-crested Cockatoo subspecies (*Cacatua sulphurea citrinocristata*). BirdLife has also linked the conservation of cockatoos to broader issues of forest ecology and preservation of water sources to give it more immediate appeal to the community (2). In Tanimbar, the unusual success of the awareness program was explained by the many months spent by the socialization team, going between villages to make sure that local people understood what the project was about and its relevance to them (4). This introductory process enhanced the ongoing communication between all of the relevant stakeholders, giving, for the first time an opportunity for local people to have their voices heard. Awareness-raising activities may also be directed at managers and Government decision-makers; Alternatives to Slash and Burn (ASB) program's research in Jambi showing that intermediate land uses may be rich as habitats has had an influence on official perceptions, adding recognition of the value of traditionally managed systems and giving more options for improving biodiversity values at the landscape level (3).

Local empowerment: Poor rural communities may be insufficiently empowered to negotiate with incoming stakeholders such as resource extraction companies (3, 6). There is a need for public advocacy to provide communities with basic information about their options and how arrangements with outside players will work. Similarly, in the Western Ghats, communities need assistance in negotiation. Indeed, the resource companies there are also using NGO consultants for negotiations, as they are not confident of breaching the social divide (6). For many reasons, local people are not in a position to negotiate even with State Forest Service representatives, as in Madagascar. NGOs or private negotiators can play a very positive role but they must be skilled not only in technical matters but also in communication (7). In contrast, in the northern Nepal case, local people