Strategies for biodiversity conservation in the Lower Mekong

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Front cover photo: Seima Biodiversity Conservation Area, Cambodia (© Luke Preece)

Abstract

Globally, conservation organisations apply several different approaches to slow the loss of biodiversity and improve local livelihoods, but the results of these efforts continue to be challenged by an array of factors at multiple scales. The primary aim of this thesis is to explore the nature of conservation and development interventions and the factors influencing these interventions in forest conservation areas of three countries in the Lower Mekong region, Cambodia, Laos and Vietnam. Two key methods are used to explore four aspects of forest conservation. The first method develops and analyses 164 variables capturing the context and management of 15 conservation areas to explore the factors influencing conservation at the landscape and national scales, the threats to forest biodiversity and implementation strategies of conservation organisations. The second method uses a systems dynamic model to explore the effect of different environmental and development scenarios on biodiversity and livelihoods at one site, Cat Tien National Park in Vietnam. The results of this research demonstrate that conservation in the Lower Mekong is influenced by a variety of factors at multiple scales, but with marked differences among countries. As a result of environmental, social, historical and political context, diverse and pragmatic strategies are employed by conservation organisations, which make clear choices and compromises between conservation and development. Biodiversity conservation is particularly constrained by economic development imperatives, which cause multiple threats to forest areas, and several governance influences, including weak laws, low financial resources, poor transparency and insecure tenure, that limit the effectiveness of interventions. To

improve biodiversity conservation outcomes, strategies require a greater understanding of local-level context and wider societal influences. Working with multiple actors to build consensus for the management of conservation areas can enhance conservation outcomes, especially by employing adaptive management frameworks and forming partnerships.

Author's Declaration

I hereby declare that the work herein, now submitted as a thesis for the degree of Doctor of Philosophy of the Charles Darwin University, is the result of my own investigations, and all references to ideas and work of other researchers have been specifically acknowledged. I herby certify that the work embodied in this thesis has not already been accepted in substance for any degree, and is not being currently submitted in candidature for any other degree.

Luke Daniel Preece

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Acronyms

BAU (scenario) – Business as usual

BCA – biodiversity conservation area

BCI – Biodiversity Corridors Initiative (specifically refers to the corridor between Dong Hoa Sao and Xe Pian National Protected Areas), Laos

BMNP – Bach Ma National Park, Vietnam

BNR – Bokeo Nature Reserve, Laos

CBD – Convention in Biological Diversity

CCPF – Central Cardamom Protected Forest, Cambodia

CIFOR – Center for International Forestry Research

CITES – Convention on International Trade in Endangered Species of Wild Fauna and Flora

CO_2-e – Carbon dioxide equivalents

CTNP – Cat Tien National Park, Vietnam

Dev (scenario) – more emphasis on developmental goals

E&D (scenario) – trying to balance environmental and developmental goals

Env (scenario) – more emphasis on environmental goals

F (interviews) – interviews with farmers or commune leaders in Cat Tien National Park buffer zone

FFI – Fauna & Flora International

FLEG – Forest Law Enforcement and Governance

G (interviews) – Forest guards

GD (interviews) – Group discussions

GTZ – Deutsche Gesellschaft für Technische Zusammenarbeit

I (interviews) – Intervention staff, including government officials and managers

ICD – Integrated conservation and development

ICDP – Integrating conservation and development project

IUCN – International Union for the Conservation of Nature

MARD – Ministry of Agriculture and Rural Development, Vietnam

MDG – Millennium Development Goals

MPF – Mondulkiri Protected Forest, Cambodia

NEPL – Nam Et-Phou Louey National Protected Area, Laos

NGO – non-government organisation

NKD – Nam Kading National Protected Area, Laos

NNT – Nakai-Nam Theun National Protected Area, Laos

NP – National Park

NP (interviews) – Interviews with staff at Cat Tien National Park

NPA – National Protected Area

NR – Nature Reserve

NTFP – Non-timber forest product

O (interviews) – Other organisations staff

PCA – principal components analysis

PES – Payments for Environmental Services

PSWS – Phnom Samkos Wildlife Sanctuary, Cambodia

REDD or REDD+ – Reduced Emissions from Deforestation and Degradation

SBCA – Seima Biodiversity Conservation Area, Cambodia

SFE – State Forest Enterprise (Vietnam)

SFE (interviews) – Interviews with staff at State Forest Enterprises near Cat Tien National Park

SNV – Netherlands Development Organisation

STNR – Song Thanh Nature Reserve, Vietnam

TDNP – Tam Dao National Park, Vietnam

USD – United States Dollar (2007 value)

V (interviews) – Villagers

VBNR – Van Ban Nature Reserve, Vietnam

VNP – Virachey National Park, Cambodia

WCS – Wildlife Conservation Society

WMPA – Watershed Management and Protection Authority (for Nam Theun 2, Laos)

WS – wildlife sanctuary

WWF – World Wide Fund for Nature

Publications derived from this thesis

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Chapter 1 Introduction

1.1 Key ideas on integrated conservation and development

The practice of conservation from a Western perspective has evolved over the past one and a half centuries, from its origins in America and Europe through the establishment of hunting reserves, to the current global phenomenon that involves multilateral agreements, powerful international conservation organisations and governments in every region of the world (Adams 2004). This phenomenon is largely driven by the realisation that the global rate of biodiversity[1] loss is increasing (CBD 2010c), driven by human actions such as unsustainable extraction and uncontrolled development in natural areas (Naughton-Treves *et al.* 2005; Agrawal & Redford 2006; Pressey & Bottrill 2008; Nijman 2010). In an attempt to curb the loss of biodiversity, conservation actors, those individuals or entities that have an interest in conservation,[2] are striving to protect biological resources from degradation and overexploitation. This is done at the national and international levels by establishing various strategies, approaches, policies and laws about who can use resources, where, when and how (Adams & Hutton 2007).

Country governments are increasingly involved in conservation, as indicated by the 193 signatories to the Convention on Biological Diversity (CBD 2010d) and 175 signatories to the Convention on International Trade in Endangered Species of

[1] Biodiversity was defined at the United Nations Conference on Environment and Development as "variability among living organisms […]; this includes diversity within species, between species and of ecosystems" (United Nations 1993, page 146).

[2] The term 'actors' in this thesis relates to individuals or entities, at multiple scales, that have an interest or play a role in the management of forests within conservation areas. They can include direct actors, such as local people, non-government organisations and government departments, who implement activities within the conservation areas. There are also indirect actors or outsiders (people from outside the conservation areas) who also have an influence over the decisions and actions at conservation areas, but are based elsewhere. Indirect actors include international donors and organisations (including international conservation organisations, such as Conservation International, and secretariats, such as for the Convention on Biological Diversity; CBD), enterprise (such as gold mining or timber harvesting industries), national governments and people from other provinces. For more of a discussion on the actors involved in conservation, see Wells 1998.

Wild Fauna and Flora (CITES 2010). In 2002, the CBD initiated the 2010 Biodiversity Target – to significantly reduce biodiversity loss at global, regional and local scales (CBD 2010a). In a recent article published in the journal *Science*, the authors claim, however, that despite a significant increase in national interest and international investment into conservation over the past 40 years, biodiversity conservation efforts are still inadequate (Butchart *et al.* 2010) and global indicators of the state of biodiversity are showing continuing declines (Butchart *et al.* 2010; Mace *et al.* 2010).

In this chapter, I explore some of the current tenets and strategies for conservation of biodiversity around the world. I start by exploring four of the dominant strategies: 1) protectionist approaches; 2) integrated conservation and development (ICD) approaches; 3) landscape approaches and the recognition of trade-offs between conservation and development; and 4) more recent market-based approaches to conservation. Following this, I present the objectives and justification of this research and outline the structure of the thesis.

1.1.1 Protectionist approaches

In the late 19th century in America and the early 20th century in Africa, protected areas were designated for conserving game species (Adams 2004). Nowadays, protected areas and other types of areas designated for conservation are sometimes viewed as the last safe havens for tropical biodiversity and draw the most attention from donors and non-government organisations (NGOs) for conservation activities around the globe (Wilshusen *et al.* 2002; Naughton-Treves *et al.* 2005; Adams & Hutton 2007). The number of protected areas has increased dramatically over the past 30 years, from fewer than 30 000 in 1980 (Naughton-Treves *et al.*

2005) to over 110 000 in 2007 (Coad *et al.* 2009), and the global network of protected areas now covers 12.2% of the world's terrestrial area (Coad *et al.* 2009).

Several international conservation organisations have categorised important areas requiring attention from conservation interventions. Conservation International identifies biodiversity hotspots to prioritise threatened and biologically diverse regions for conservation interventions (Rodríguez *et al.* 2007). The World Wildlife Fund for Nature (WWF) uses Global 200 ecoregion categories in an attempt to represent all ecosystem and habitat types around the world (Olson & Dinerstein 1998). The Wildlife Conservation Society's (WCS) approach is 'Living Landscapes', which recognises high biodiversity areas and takes into account the wider societal influences when considering the management aspects of conservation (WCS 2010b). BirdLife International has identified Important Bird Areas that contain several threatened species, range-restricted species or migratory species, which help BirdLife to set priorities for action (Birdlife International 2010). In all of these areas, actions to protect biodiversity have been substantial - 10% of the forests within Conservation International's Biodiversity Hotspots and 12% of the forests within WWF's Global 200 Ecoregions are classified as Categories I-IV of the International Union for the Conservation of Nature's (IUCN) protected area management categories (Schmitt *et al.* 2009), which are the highest levels of protection.

Protectionist approaches to conservation in protected areas attempt to regulate human activity and support interventions that directly protect biodiversity. Such strategies involve reducing habitation by, and agricultural activities of, local people, law enforcement strategies to stop illegal activities and the regulation of the trade in forest products, including hunting and logging (Hughes & Flintan 2001; Kiss

2004; Wunder 2006). Protectionist approaches can succeed if there is a moral imperative to protect biodiversity and if initiatives are well-resourced and managed effectively (Adams & Hutton 2007). Protected areas in tropical countries are an effective approach to conservation, but require increased technical, financial and institutional[3] support to achieve biodiversity conservation outcomes (Bruner *et al.* 2001, Laurance *et al.* 2012).

Many critics have questioned the effectiveness and negative social effects of protectionist approaches (Brosius 2004; Brockington *et al.* 2006; West & Brockington 2006; Adams & Hutton 2007; Haller & Galvin 2008), including displacement of local people (Redford & Fearn 2007), increasing incidence of conflicts over land-use (Haller & Galvin 2008) and the overall lack of success in conserving biodiversity (Barrett & Arcese 1995; West & Brockington 2006; Butchart *et al.* 2010). Opportunity costs are borne by local communities, such as loss of incomes (for example, from crop raiding by wild animals or a loss of access to natural resources under protection), rent seeking by park staff and population displacement (Adams & Hutton 2007). Furthermore, any economic benefits that accrue are often unequally distributed at the local level and are more often realised by the global community (Chan *et al.* 2007).

1.1.2 Integrated conservation and development approaches

It is widely recognised that forest areas overlap with areas of high rates of poverty (Adams *et al.* 2004; Sunderlin *et al.* 2005). The requirement to integrate conservation and development in forest areas is becoming more important as the loss

[3] The concept of 'institution' is used in diverse ways, but in this thesis I use the term to denote rules, regulations, rights, policies and norms of behaviour.

of natural habitats increases globally and as the interest of donors, non-government organisations (NGOs) and governments is focussed on development and poverty alleviation (Barrett & Arcese 1995; Hughes & Flintan 2001; Adams *et al.* 2004; Kiss 2004; Sunderlin *et al.* 2005; United Nations 2005). Integrated conservation and development projects (ICDPs) are implemented in and around protected forest areas (Hughes & Flintan 2001) and address both goals of biodiversity conservation and local livelihood development. ICDPs are based on the assumption that poverty is a cause for degradation of natural areas and poverty alleviation will benefit biodiversity conservation (Hughes & Flintan 2001; Wunder 2006), and hence linking the goals of biodiversity conservation and livelihood development can provide socio-economic benefits to local people and improve natural resource management (Sayer & Campbell 2004; Frost *et al.* 2006; Garnett *et al.* 2007; Springer 2007). The strategies of conservation agencies before the advent of ICDPs were to strengthen park protection and manage renewable resources, but ICDPs subsequently targeted local people and local threats through attempts at poverty alleviation, education, promotion of local institutions, capacity building, empowerment and participation of local people in decision making (Salafsky *et al.* 2002; Robinson & Redford 2004; Koziell & Inoue 2006).

Over the past two decades, however, conservation academics and practitioners have questioned the effectiveness in achieving the integration of conservation and development in protected areas (Barrett & Arcese 1995; Hughes & Flintan 2001; Wilshusen *et al.* 2002; Adams *et al.* 2004; Kiss 2004; Naughton-Treves *et al.* 2005; Agrawal & Redford 2006). Both conservation and poverty outcomes are difficult to measure across a landscape scale (Agrawal & Redford 2006), and assumptions behind ICDPs are often unclear and unrealistic (McShane &

Newby 2004; McShane & O'Connor 2007). Furthermore, the complexity of factors these projects are required to address also increases the chance of failure (Barrett & Arcese 1995).

There is still considerable debate over what strategies are best employed to achieve optimum conservation <u>and</u> development outcomes (Wilshusen *et al.* 2002; McShane & Wells 2004; Sayer *et al.* 2007; Sayer 2009). Some believe that the big issue is not whether to integrate conservation and development, but how; essentially what strategies to choose under which circumstances (Robinson & Redford 2004; Sayer 2009). According to Sanjayan *et al.* (1997), ICDPs are only able to be implemented when certain conditions are met (such as adequate financing and forest protection measures); they should be aimed at the medium-term, to be replaced by longer-term commitment by government and other appropriate institutional arrangements that can produce beneficial conservation and development outcomes (Barrett & Arcese 1995).

1.1.3 Moving beyond boundaries: landscape approaches and trade-offs

As the effectiveness of ICDPs have been increasingly questioned, recommendations by academics and practitioners have argued for the expansion of the spatial extent of interventions to the landscape scale, acknowledgement of trade-offs, respect of local context, promotion of social learning, engagement with stakeholders, implementation of adaptive management, and a focus on outcomes (Robinson & Redford 2004; Sunderland *et al.* 2008; Grantham *et al.* 2009; Sayer 2009). Expanding the spatial extent of interventions takes into account driving forces and policies at multiple levels (Blench 1998; Sayer & Campbell 2004; Fisher *et al.* 2005; Sunderlin *et al.* 2005; Buscher & Whande 2007). Conservation also has to be understood in the context of the wider political and social structure (Wells 1998; Brockington *et al.* 2006; Adams & Hutton 2007; Buscher & Whande 2007), where multiple policy instruments and institutions can be implemented to conserve the multiple aspects of biodiversity through motivational, voluntary, price-based, property right, and regulatory policies (Young & Gunningham 1996). Economic development imperatives are important, since conservation takes place against a backdrop of processes such as industrialisation, urbanisation, pollution, conversion of forests to other economical land-uses (Adams & Hutton 2007; Ellis *et al.* 2010) and, in some countries, the transition from a centrally planned to a market economy (Buscher & Whande 2007). Good governance[4] is required to set high standards of management of natural resources at the national and sub-national levels, hence strong local and national institutions are crucial for conservation, but tropical countries tend to have weak institutions (Wells 1998; Barrett *et al.* 2001; Oldekop *et al.* 2010). Not only is the acknowledgement of contextual issues by conservation organisations necessary for developing programmes to improve conservation practice, understanding context is also important to ensure negotiations among actors are equitable and ultimately accepted by multiple stakeholders (McShane & O'Connor 2007; Dahlberg & Burlando 2009).

Landscape scale approaches, including areas such as biosphere reserves and Megaconservancy Networks (Rouget *et al.* 2006), are suggested by conservation academics as a way to account for the complexity of communities, by negotiating

[4] Swiderska (2008) describes governance as about who decides (whether the decisions are from government or local community groups) and how (such as through the development of formal regulations or agreements), which encompasses policies, institutions, processes and power. There are several principles of good governance - some of the principles include stakeholder participation, equity of decision-making processes, accountability, transparency, decentralisation, efficiency, effectiveness and learning from experience (Swiderska *et al.* 2008).

trade-offs between different interest groups to improve conservation and livelihood outcomes (Brown 2002; McShane & Newby 2004; Fisher *et al.* 2005; Sunderlin *et al.* 2005; McShane & O'Connor 2007; Sunderland *et al.* 2008). Trade-offs, in this sense, are "management choices that intentionally or otherwise change the diversity, functioning and services provided by ecosystems over space and time" (McShane & O'Connor 2007, p. 147). They can occur across geographic and social scales, among competing interests of different groups of actors and between different time-horizons (McShane & O'Connor 2007). For instance, trade-offs might involve a management choice that influences whether habitats or species are compromised at the expense of people's livelihoods and development activities or, alternatively, whether people are restricted in their activities to make way for conservation of the forest resources they previously relied upon. By recognising the variety of interests of multiple stakeholders, desired livelihood and conservation outcomes can be negotiated to produce positive benefits for both (Brown 2002; Fisher *et al.* 2005; Haller & Galvin 2008).

One issue with trade-off thinking is that it assumes all stakeholders have a choice in decision-making (McShane & O'Connor 2007), but this is not often the case (Springer 2009). Tension exists among actors at local, national and international scales (Wells 1998). Relative power often determines the outcome of relationships among actors; the resulting decisions influencing the interest, rights and responsibilities of other groups (Adams & Hutton 2007). Powerful interest groups, such as industry, government and even conservation organisations, for instance, often marginalise local stakeholders (Swiderska *et al.* 2008). These powerful interest groups assume responsibility to decide on the best use for particular areas, whether for economic or environmental benefits; decisions that are ostensibly made for the greater good of society. The costs imposed upon the less-powerful stakeholders must, however, be taken into account in these decision-making processes, and any decision must generally be accepted as fair and just by the majority to increase the chance that the resulting decisions will survive the long-term (Dahlberg & Burlando 2009).

Landscape approaches are, then, attempting to understand the social and environmental context of conservation areas at the local and larger scales. By understanding the drivers of trade-offs at a larger scale, such as Laos' national policies for transforming shifting agriculture to sedentary agriculture (as discussed in Chapter 3; Robichaud *et al.* 2009), conservation organisations can then work with national actors to revise policies and work with local farmers to enhance agricultural production. The current strategies of systematic conservation planning (Rouget *et al*. 2006; Pressey *et al.* 2007; Pressey & Bottrill 2008) that involve understanding and mapping threats at multiple scale, with local involvement, are assisting to target the trade-offs at the landscape scale and improve conservation and livelihood outcomes.

1.1.4 Market-based approaches

The inequitable outcomes for local people in the implementation of protected area strategies have provided moral grounds for the global community to improve conservation practice (du Toit *et al.* 2004; Adams & Hutton 2007), including through the expansion of market approaches and policies that play a positive role in conservation (Brown 2002), within the framework of neoliberalism[5] (Buscher & Whande 2007; Igoe & Brockington 2007). Market-based approaches to conservation

[5] Neoliberalism can be described as part of a bundle of processes that deregulate states for the promotion of free trade, free assembly, free speech and free press (Igoe & Brockington 2007).

can inject new resources into biodiversity conservation, and promise increased participation, better property rights, green business practices and to promote environmental awareness (Igoe & Brockington 2007).

Two key market-based approaches have recently emerged around the globe that have implications for conservation: payments for environmental services (PES) (Wunder 2006; Chan *et al.* 2007; Tallis *et al.* 2008; Sommerville *et al.* 2009; Tallis *et al.* 2009), and reduced emissions from deforestation and forest degradation (REDD or REDD+) (Wunder 2006; Adams & Hutton 2007; Buscher & Whande 2007; Chan *et al.* 2007; Angelsen 2008b; Tallis *et al.* 2008). PES is a scheme in which a voluntary transaction is used to buy environmental services (such as water, carbon or landscape beauty) from a provider who secures the environmental services (Wunder 2006). Countries such as Costa Rica and Vietnam are pioneers in establishing legal frameworks for PES and are developing PES or government-led 'PES-like' schemes in forest areas (Chomitz *et al.* 1999; Pham *et al.* 2008; Angelsen *et al.* 2009).

REDD+ is a developing scheme to reward individuals, communities, projects or countries for the reduction of carbon emissions from forests by slowing deforestation and degradation, or enhancing carbon stocks through afforestation (Angelsen 2008a; Angelsen *et al.* 2009). REDD+ has emerged from the international concern over climate change and mitigation, because the forestry sector, globally, accounts for approximately 20% of greenhouse gas emissions each year (Houghton 2003; Baumert *et al.* 2005). The forestry sector can potentially contribute to mitigating climate change through carbon trading (Strassburg *et al.* 2010). The implementation of REDD+ could generate increased funds for conservation if implemented in natural forest areas, but the schemes might not necessarily be beneficial to local people in areas where governments have control of the land (Angelsen 2008a; Angelsen *et al.* 2009).

To be effective and equitable, both of these market mechanisms require good governance (Chomitz *et al.* 1999; Angelsen *et al.* 2009). In most countries, however, the necessary institutions have not yet been established (Adams & Hutton 2007). Further monitoring of resources and evaluation of projects are needed to clarify the impact of PES and REDD schemes on the environment and people (Tallis *et al.* 2008; Tallis *et al.* 2009), particularly to reveal the potential benefits to local livelihoods and biodiversity. Wunder (2008) notes that PES has been scrutinized for its potential to contribute to poverty reduction, and he concludes that this is partly due to insecure land tenure and high transaction costs.

1.2 Aim of this research

The primary aim of this thesis is to explore the nature of conservation and development interventions and the factors influencing these interventions in 15 forest conservation areas of three Lower Mekong countries – Laos, Cambodia and Vietnam. The Lower Mekong region (including Laos, Cambodia, Vietnam and Thailand) is considered to be part of a valuable 'biodiversity hotspot' in Asia (Myers *et al.* 2000). Conservation of biodiversity is identified as a priority of the governments of the Lower Mekong countries (ICEM 2003d), but governments around the world, including those of the Lower Mekong countries, often face weak enforcement mechanisms, low capacity and unclear laws and regulations (Barrett *et al.* 2001; Brown 2002). Governments also require support and partnerships from other actors to reduce the threats to conservation areas. In these countries, funding from donors is often dispersed to organisations that implement individual or multiple projects, often at different scales. In this thesis I look at the entire suite of conservation and development interventions at each of the 15 forest conservation sites in the Lower Mekong. Interventions are defined here as an individual project or a composition of multiple projects operating in a single conservation area, which have objectives for biodiversity conservation or livelihood development, and which might be operated by a government department, an NGO or a government-NGO partnership.

Four key questions address the research aim:

Q1 What are the key economic and governance factors that influence conservation actions in the Lower Mekong countries?

Q2 What are the causes and drivers of the threats to biodiversity in the Lower Mekong countries and how do conservation interventions attempt to mitigate these threats?

Q3 What strategies are employed by interventions to achieve both forest conservation and local livelihood development and how do strategies affect intervention performance?

Q4 How do alternate environment and development scenarios affect biodiversity, livelihoods and future conservation strategies?

As discussed above, biodiversity conservation needs to be understood in the context of the wider society and take into account driving forces of economic development and policies at multiple scales (Blench 1998; Wells 1998; Sayer & Campbell 2004; Fisher *et al.* 2005; Sunderlin *et al.* 2005; Brockington *et al.* 2006; Adams & Hutton 2007; Buscher & Whande 2007; Ellis *et al.* 2010). For this reason, Question 1 considers the wider political, economic and governance influences on conservation actions in the Lower Mekong. This first requires an understanding of the history and development of the conservation sectors in each of the countries. This background of the context then leads to an appraisal of two key influences on the implementation of biodiversity conservation in forest areas: 1) national economic development imperatives, including widespread threats such as hydropower, mining, timber extraction, plantations and agriculture; 2) natural resource governance issues that affect the actions of conservation, including land-tenure arrangement, finances for management of conservation areas, technical capacity of government staff, conservation-related laws, transparency, collaboration within governments and differences in values for nature among actors in conservation areas. Addressing Question 1 will help to provide grounding for understanding the issues facing conservation actions that are addressed by the other three questions.

Question 2 addresses two important issues in conservation – threats to biodiversity and conservation actions (Spangenberg 2007; Pressey & Bottrill 2008). Despite the interest and investment in conservation in the Lower Mekong, populations of many native species have continued to decline, including many of those on the IUCN Red List of Threatened Species – wildlife such as the tiger (*Pantera tigris*) and Asiatic black bear (*Ursus thibetanus*) and many plant species (Traffic 2008), especially timbers such as rosewood (*Dalbergia* sp.) and several *Dipterocarpus* species (EIA & Telapak 2008). Much attention from research and advocacy organisations has focused on logging and deforestation in the Lower Mekong (Chanthirath 1998; Phat *et al.* 1998; De Koninck 1999; Hirsch 1999; Lang 2001; Global Witness 2002; Kim *et al.* 2005; Global Witness 2007; EIA & Telapak 2008; Meyfroidt & Lambin 2008; To & Sikor 2008) but many other threats also prevail in forest conservation areas. There are also calls in the conservation literature to better understand how conservation interventions are attempting to reduce the causes and drivers of threats to biodiversity (Hughes & Flintan 2001; Redford & Sanjayan 2003; Pressey & Bottrill 2008; Sunderland *et al.* 2008). Therefore, the intention of Question 2 is, through an empirical analysis, to provide a more holistic exploration of threats to forest conservation areas and explicate the conservation actions used to militate against the threats.

Conservation organisations are under pressure to fulfil multiple objectives in conserving biodiversity. Environmental education, local livelihood development activities and institutional reform[6] are employed by conservation organisations as tools to achieve their objectives (Alpert 1996; Salafsky *et al.* 2002; Koziell & Inoue 2006). There is, however, little understanding of how organisations choose between these options and there is much debate over the factors influencing the success of interventions. Defining 'success' itself is problematic since the definitions and perceptions of success are diverse (Axford *et al.* 2008), and measuring it is challenging (Agrawal & Redford 2006), not least of all because the effectiveness of outcomes is rarely assessed (Brooks *et al.* 2006; Sayer *et al.* 2007).

Question 3 will thus investigate how organisations choose between different options through a comparison of the multiple types of conservation and development interventions in conservation areas. Addressing Question 3 also explores whether the development of partnerships, site-level negotiations and implementing multiple different activities has an effect on organisations' performance, by analysing a measure of 'progress' towards objectives of conservation interventions.

[6] Governments have already established institutions, but the reform of these institutions is one strategy to improve the governance and outcomes of conservation.

One of the challenges of implementing conservation interventions amid many uncertainties is to choose a strategy that gains the best possible outcomes. The previous questions focus on 15 sites in the Lower Mekong, but given the necessary volume of information that is needed to develop a systems dynamic model, Question 4 is examined through a single case study. The case study is on Cat Tien National Park (CTNP) in southern Vietnam, one of the 15 sites, chosen because of its importance as an internationally recognised area for wetlands, world heritage and biodiversity. Question 4 examines alternate strategies for CTNP and how they are likely to play out on the ground in terms of outcomes. I analyse four possible scenarios of environment and development processes over the next 20 years that are likely to influence biodiversity and local livelihoods. The scenarios include conservation strategies of strict protection and integrated conservation and development with the recent market-based mechanisms of PES and REDD+. I then investigate the feasibility of implementing each option. Addressing this question also provides some insight into the potential for PES and REDD+ in the Lower Mekong countries.

1.3 Collaboration with a CIFOR project

This research was conducted as part of a research project implemented by the Center for International Forestry Research (CIFOR), entitled ‘Losing less and winning more: Building capacity to go beyond the trade-offs between conservation and development’, funded by the John D. and Catherine T. MacArthur Foundation, from June 2006 to June 2010. CIFOR’s project aimed to address the trade-offs between conservation and development with the purpose of building capacity in personnel in conservation organisations of the Lower Mekong to plan better on-ground interventions, and to learn from cross-site experiences. As part of this research, I undertook a study of 15 designated conservation areas, commencing in January 2007, to provide a systematic analysis of the conservation areas and the conservation and development interventions at those areas.

1.4 Justification for this research

At the global level, there remains much uncertainty about what strategies to use to conserve biodiversity in forest conservation areas, which has led to calls for systematic comparisons of conservation interventions (Robinson & Redford 2004; Agrawal & Redford 2006; Ferraro & Pattanayak 2006; Sunderland *et al.* 2008). Case comparisons, such as those presented in this thesis, can provide a detailed understanding of the influences on conservation and development interventions, can help to clarify the performance factors that make successful strategies and, ultimately, aid in developing appropriate approaches. This will not only help to clarify the issues that conservation organisations regularly face but will also clarify some of the choices and trade-offs involved in decision-making.

This research is also important for the Lower Mekong sub-region. In the Lower Mekong, government and civil society (including donors and NGOs) play an important role in improving management practices for conservation (Global Witness 2004; Davis 2005; To & Sikor 2008). Many local, national and international organisations are attempting to implement ICD interventions to protect biodiversity at the landscape scale. These interventions include regional initiatives that attempt to link large natural areas across country borders (such as the Asian Development Bank's Biodiversity Corridors Initiative), interventions that focus on large natural landscapes bordering other protected areas (such as the work of the Wildlife

Conservation Society in Seima Biodiversity Conservation Area in Cambodia), and smaller-scale projects working in isolated landscapes (such as the Gibbon Experience in Bokeo Nature Reserve in Laos). By systematically comparing disparate interventions, this research will highlight the key strategies used and draw links between the strategies used by organisations at the various sites and countries.

Answering Question 1 (Chapter 3) makes a distinct contribution to understanding forest conservation and management in the Lower Mekong, followed by addressing Questions 2, 3 and 4 (Chapters 4, 5 and 6), which contribute more specifically to the scientific literature and theory of forest conservation strategies globally. The importance of Question 1 is that it discusses several pertinent issues that largely take place outside the conservation areas, in particular, the economic development and governance constraints to biodiversity conservation. Addressing Question 2 will provide a better understanding of threats and how they are managed, which can provide a basis for a more informed conservation strategy. Answering Question 3 clarifies how partnerships and site-level stakeholder involvement aid in achieving objectives, which could lead me to provide recommendations to improve organisations' desired outcomes. Addressing Question 4 makes the trade-offs between conservation and development explicit, providing information that can be used in management decisions in Cat Tien National Park, but more generally, clarifying how trade-offs can be analysed, and how the different scenarios play out in terms of conservation and development outcomes. Question 4 will also provide some clarity about how PES and REDD+ mechanisms measure up against competing land-use options, or if they help in providing finances to conservation interventions.

By addressing the research questions through empirical analysis, this research will fill a gap on knowledge about the strategies of conservation on the ground. The research results will have implications for conservation practice in the Lower Mekong and elsewhere, by providing recommendations on what strategies to choose under which circumstances, and recommend improvements to government policies for conservation in Laos, Cambodia and Vietnam. The analysis will also provide more clarity about the challenges and opportunities for conservation and communicate information to practitioners about the strategies conducted elsewhere in the Lower Mekong region. This region encapsulates many of the circumstances that are currently playing out globally.

1.5 Structure of thesis

This thesis is divided into seven chapters.

Chapter 2 presents the methods and sites used in this research. Section 2.2 presents the criteria used in selecting the 15 sites. Section 2.3 describes the methods used for the case comparisons in Chapters 3, 4 and 5, including a critical analysis of the methods. Section 2.4 provides a brief justification of the methods used in Chapter 6. Section 2.5 presents a profile of the 15 sites selected in Cambodia, Laos and Vietnam.

Chapter 3 addresses Question 1, beginning with the historical context and development of the forest conservation sectors in the Lower Mekong countries (Section 3.3). The chapter then explores the challenges facing conservation from two aspects: national economic development imperatives arising from the policies and actions and government and industry (Section 3.4) and natural resource governance, including land-tenure arrangements, finances for management of conservation areas, technical capacity of government officials, conservation-related laws, transparency, collaboration within governments and differences in values for nature (Section 3.5). This chapter places the conservation efforts of the Lower Mekong in a historical and global context and sets the scene for the discussions in the following chapters.

Chapter 4 focuses on Question 2, providing insight into the relationship between different threats and how conservation interventions are targeting these threats in the Lower Mekong region. The chapter commences with an introduction to the threats to biodiversity and conservation actions, and the aims and scope of the study (Section 4.1). Section 4.1.1 elaborates on the context of threats by discussing the history of processes affecting forest areas and the history and current situation of threats to forests. Section 4.2 describes the methods used to compare threats and management. The results section (Section 4.3) presents the human and environmental context of the sites and reports the results from the analysis of threats and conservation interventions at the 15 sites. The chapter finishes with a discussion on the implications of the findings (Section 4.4) and presents conclusions (Section 4.5).

Chapter 5 focuses on Question 3 and explores what strategies are employed by organisations in forest conservation initiatives in the Lower Mekong, and how partnerships and negotiations affect these strategies. The introduction describes the mandate of conservation interventions and the influences on conservation actions (Section 5.1). Following this, the methods describe data collection and analysis of 43 interventions in the 15 forest conservation sites (Section 5.2). The results present the activities, strategies and focus of conservation and development interventions (Section 5.3). The chapter ends with a discussion on partnerships, participatory approaches and the performance of conservation interventions (Sections 5.4 and 5.5).

Chapter 6 focuses on Question 4, presenting four possible environment and development scenarios, through the application of systems dynamic modelling at Cat Tien National Park. The chapter commences with an introduction to conservation options and the emerging mechanisms of PES and REDD+ in Vietnam (Section 6.1). The next section describes the context of Cat Tien National Park (Section 6.2). The methods describe the modelling process, scenarios and data collection for the model (Section 6.3). The results section (Section 6.4) shows the influence of each scenario on the biodiversity and livelihoods indicators, and the results from interviews on the implementation of policies under each scenario. The final sections (6.5 and 6.6) discusses the costs and benefits of the scenarios, highlights the explicit trade-offs between conservation and development and explores the feasibility of implementing activities under the scenario, especially in implementing a REDD+ policy.

Chapter 7 concludes, provides recommendations, discusses the policy implications and limitations of the research and suggests future research directions. Appendix 1 presents the variables used in data collection for Chapters 3, 4 and 5. Appendix 2 provides details of a STELLA model for Chapter 6.

Chapter 2 Methods for research and profile of sites

Part of the section on methods for the case comparison (Section 2.3) has been sourced from Barbara Herrero Cangas, B.; Preece, L.; Achdiawan, R.; Sunderland, T.; Ruiz Perez, M. (In Prep.) 'Methods used in a case comparison of integrated conservation and development interventions', CIFOR working paper, Center for International Forestry Research, Bogor.

2.1 Overview of research methods

This research is based on two key methods, 1) a case comparison and 2) scenario modelling.

The first method is a comparison of integrated conservation and development interventions at 15 conservation areas, via multivariate analysis of 164 variables. The sites and interventions were selected based on criteria discussed in Section 2.2 and the methods for the case comparison are described below in Section 2.3. The results from the case comparison were used for supplementary data for discussing the influences on conservation in Chapter 3, the discussion of threats in Chapter 4 and a comparison of conservation and development strategies in Chapters 4 and 5.

The second method, scenario modelling, aimed to explore the effect of conservation and development scenarios on local livelihoods and biodiversity at one site, Cat Tien National Park in southern Vietnam. The method for the modelling procedure is briefly discussed in Section 2.4 and described further in Chapter 6 and Appendix 2.

A profile of each site is presented in Section 2.5. This section provides a brief overview of each site, by describing the location, the environment, the demographics of the local population, livelihoods of local people, the main threats to the biodiversity and the management arrangements of the area.

A literature review was also undertaken to support the collected information and further explore conservation and development issues, especially for Chapter 3. The literature review covered peer-reviewed journals, published reports and Web pages from conservation and development organisations, government reports and policy documents.

This research was approved for ethics clearance by the Charles Darwin Human Research Ethics Committee, reference number H07013. In-country partners, the Wildlife Conservation Society in Cambodia, the Center for International Forestry Research in Laos and the World Agroforestry Centre in Vietnam, supported this research by providing office space and assisting in organising field trips and workshops. Each of the in-country partners also assisted in obtaining research and fieldwork permits, from government offices, to work in the 15 sites across Cambodia, Laos and Vietnam.

2.2 Criteria for site selection

Five conservation areas in each of Laos, Cambodia and Vietnam were selected for comparison. Three main criteria were used for selecting sites and interventions:

a) There had to be one or more conservation and development interventions to manage the forest area and associated buffer zone;

b) The forest conservation area had to be larger than 10 000 hectares; and

c) There had to be intervention activities implemented within the past five years (2003-2007).

The sites were also selected based on access and feasibility of undertaking fieldwork, willingness of the implementing organisations to collaborate, and availability of data. In selecting sites from the pool of possible sites (of which there were over 100), it was also important to have a representative bio-geographic spread across the three countries. Considering the limited resources and time required to collect sufficient information from as many sites as possible, only 15 sites were selected. Most of the sites are protected areas but others include corridors or areas not officially recognised as protected areas, such as forest reserves or biodiversity conservation areas. Site selection began in early 2007, but was not complete until sites were selected for Laos in May 2008. A brief description and comparison of the sites is presented in Table 2-1, including the organisations managing the area, the year established, the area of the core and buffer zones and population of the buffer zone. In the context of this research, buffer zones consist of either a formal designation by the organisation managing the areas or an informal area delineated by a five-kilometre radius from the core zone. The location of the selected sites is presented in Figure 2-1.

Figure 2-1 Location of the Lower Mekong study sites. Core and buffer zones are not delineated, only core zones are shown.

Table 2-1 Sites, management arrangements and physical attributes.

	Site name	Organisation in charge of managing the protected landscape	Current technical assistance (2007/2008)	Year established[a]	Core Zone area ($x10^3$ ha)	Buffer Zone area ($x10^3$ ha)	Population in Buffer Zone ($x10^3$ people)
Cambodia	Central Cardamom Protected Forest (CCPF)	Forestry Administration	Conservation International	2001	401	300	4
	Mondulkiri Protected Forest (MPF)	Forestry Administration	WWF Cambodia	2002	300	73	17
	Phnom Samkos Wildlife Sanctuary (PSWS)	PSWS Management Board	Fauna & Flora International	2001	293	39	20
	Seima Biodiversity Conservation Area (SBCA)	Forestry Administration	Wildlife Conservation Society	2001	156	148	8
	Virachey National Park (VNP)	Biodiversity and Protected Areas Management Project	None	2000	323	200	15
Laos	Bokeo Nature Reserve (BNR)	Provincial Agriculture and Forestry Office	The Gibbon Experience	2003	75	145	4
	Dong Hoa Sao-Xe Pian Biodiversity Conservation Corridor (BCI Corridor)	Provincial Agriculture and Forestry Office	WWF & Asian Development Bank Biodiversity Corridors Initiative	2006	11	22	20
	Nakai-Nam Theun National Protected Area (NNT NPA)	Nam Theun 2 Watershed Management and Protection Authority	None	2004	409	136	23
	Nam Et-Phou Louey National Protected Area (NEPL NPA)	Provincial Agriculture and Forestry Office	Wildlife Conservation Society	2002	300	295	30
	Nam Kading National Protected Area (NK NPA)	Provincial Agriculture and Forestry Office	Wildlife Conservation Society	2002	160	89	25
Vietnam	Cat Tien National Park (CTNP)	CTNP Management Board	None	1991	72	251	230
	Song Thanh Nature Reserve (STNR)	STNR Management Board	WWF Quang Nam	2000	85	108	40
	Bach Ma National Park (BMNP)	BMNP Management Board	None	1990	22	21	61
	Tam Dao National Park (TDNP)	TDNP Management Board	GTZ[b]	2003	37	83	200
	Van Ban Nature Reserve (VBNR)	VBNR Management Board	Fauna & Flora International	2001	26	14	22

[a]The year established is for the site's recent designation (for example, National Park or Nature Reserve). [b]GTZ: Deutsche Gesellschaft für Technische Zusammenarbeit

2.3 Methods for case comparison

A quantitative method (using a set of variables) was developed from September 2006 to May 2008 to systematically compare cases of organisations implementing an integrated conservation and development intervention in and around the 15 forest conservation areas.

The method described here is based on those developed by Ruiz-Pérez and Byron (1999), who used multivariate analysis techniques to compare 60 case studies from around the world of non-timber forest products and the importance of such products to rural and urban livelihoods. These techniques allow, even with a small sample size, to explore relationships between large numbers of attributes. This is especially useful for comparisons at the landscape scale, where many factors can influence the impacts of interventions. Furthermore, this type of analysis can shed light into the interdependence and causal links between the different factors influencing conservation and development issues (Belcher & Ruiz Perez 2001; Kusters *et al.* 2005).

2.3.1 Developing the list of variables

In this research, the attributes - features of context (such as land cover or local incomes) or process (such as environmental threats or conservation activities) that relate to biodiversity conservation and livelihood development portrayed in the interventions and 15 sites - were framed into an initial list of variables. The attributes were first discussed during a process of consultations with 10 CIFOR representatives and 18 partners from multiple conservation and development organisations in the Lower Mekong, during two regional workshops in September 2006, in Cambodia (CIFOR 2006a) and Vietnam (CIFOR 2006b). Eight participants from Cambodia, eight from Vietnam and two from Laos[7] attended the workshops. In both workshops, participants presented a description of the conservation areas where they worked and of ICD interventions. The presentations were followed by group discussions on the key threats to the landscapes in the context of the five capital assets framework under the sustainable livelihoods framework. The capital assets framework identifies the indicators of environmental, human, social, built and financial capitals that relate to the outcomes of conservation and development interventions (Garnett *et al.* 2007; Sayer *et al.* 2007). The discussions yielded sets of attributes relevant to the sites and the ICD interventions, under 15 headings (see Appendix 1).

These attributes were subsequently re-defined from May to September 2007 into a set of 73 variables relevant at the global level, with a description of how to measure each variable. These variables were developed through discussions with T. Sunderland and M. Ruiz-Perez (from CIFOR), and supported by a review of the conservation, ICD and rural development literature (Belcher & Ruiz Perez 2001; Kusters *et al.* 2006; Garnett *et al.* 2007; Hill 2007). This preliminary list of 73 variables was grouped into four categories, discussed in Section 2.3.2, comprising environmental features, socio-economic conditions, the institutional framework and characteristics of the ICD interventions.

A third workshop was held in Cat Tien National Park, Vietnam, on 19-22 September 2007, to gain a better understanding of the issues, synergies and trade-

[7] Due to bureaucratic delays, further partners in Laos could not be involved in the development of the variables until later in April 2008.

offs of conservation and development at landscapes where a biodiversity conservation intervention is implemented (CIFOR 2007b). During the workshop, the initial list of 73 variables was presented and reviewed by the 11 participants from conservation organisations in Vietnam and seven representatives from CIFOR. This was undertaken through group discussions on each of the four categories. During group discussion, some of the variables, such as those relating to corruption, were deemed too sensitive to collect, as they could potentially jeopardize the research process. Variables were added to the initial set to expand each of the categories. Participants examined the descriptions for all the variables, and ambiguous variables were clarified to ensure local relevance. A fifth category was added to capture the 'other' conservation or development interventions active in each of the sites (see Section 2.3.2). In total, 112 variables were agreed on following the third workshop.

The list of 112 variables was field tested in the five sites in Vietnam between September and November 2007 (see Table 2-3 for the dates and locations of each visit[8]). During the field trips, another 11 variables were added to capture the context of the sites and conservation interventions, making a total of 123 variables.

A fourth workshop was held in Phnom Penh, Cambodia, from 20-21 November 2007 (CIFOR 2007a). The 16 participants from conservation and development organisations and five representatives from CIFOR reviewed the set of 123 variables. The process for review was similar to that of the third workshop in Cat Tien National Park. Only minor changes to the variables were made, mainly to clarify the descriptions to accurately measure the variables. Some variables had to be split or disaggregated to cover the complexity of the issues (i.e. the threats to the

[8] Note that while SBCA was visited prior to variable development, the data for variables was compiled after the field trips in Vietnam.

environment). Other variables had to be redefined to reduce their specificity (due to limited local information).

Further revisions to the variables were carried out during the field trips to each of the 15 sites, often by consultations with managers of the conservation areas. Most of these modifications were made while collecting the data, so as to overcome some of the challenges encountered during the data collection process (see Section 2.3.4). Final revisions to the list occurred during data cleaning and the initial stages of the analysis in Bogor, May and June 2008, and in Madrid, July 2008 (see Section 2.3.5), which produced the final set of 164 variables (Appendix 1). The expansion of the variable set from 123 to 164 variables came from the partitioning of variables into more easily measurable units, such as the splitting of environmental threat variables into intensity, threat, rank and source.

2.3.2 The categories of variables

To understand the drivers of ICDP success, besides the nature of the interventions themselves, Wells and McShane (2004) discuss two, often disregarded, critical considerations to take into account. These are 1) the context and 2) the process of designing interventions. The variables used in this study aim to determine precisely this context – the environmental, social, cultural and institutional preconditions – and to determine the strategies that the different ICD interventions are using to facilitate the achievement of the intervention's conservation and development goals. To recognise the synergies and trade-offs between conserving biodiversity while improving local livelihoods, it is crucial not only to understand the ecological processes in the conserved areas, but also to understand the socio-economic factors driving environmental resource use and land use change, and the policies that influence landscape dynamics. These types of variables aim at providing a snapshot of ICD interventions and their landscape contexts, covering a selection of the most important factors described in the literature affecting the processes of conservation and development. This section provides an overview of the rationale for selecting the variables.

The 164 variables are listed under 15 headings in five categories: the first describes the environmental traits of the landscape where the intervention is implemented (Variable 1-54 in Appendix 1, Table A1-1); the second describes the human attributes of the local populations (Variable 55-103 in Appendix 1, Table A1-2); a third category deals with the institutional framework under which the interventions operate (Variable 104-120 in Appendix 1, Table A1-3). The last two categories consider the characteristics of the interventions being implemented in the landscapes. One deals with the landscape-scale ICD interventions managing the conserved landscapes (Variable 121-164 in Appendix 1, Table A1-4). The 'other intervention' category deals with the characteristics of the conservation or development interventions of other non-government organisations active in the landscapes (Variable Var1-Var20 in Appendix 1, Table A1-5). Each of the categories is separated into subgroups of related variables.

2.3.2.1 Environmental conditions

This category describes four groups of the 54 environmental variables for each site: the geographical features, the biodiversity features (those that relate primarily to the conserved area), the land cover and use of the entire landscape and pressures on the conservation area.

The geographical features of an area determine ecological patterns, adaptation capability to environmental changes, and the resilience of the ecosystems. Variables include precipitation (Variable 6), climate zone (Variable 7), average altitude (Variable 8), general landform (Variable 9), and soil quality (Variable 10), which might characterise the types of habitats and species that are encountered at the sites. In a similar way, these same characteristics affect the opportunities of local resource users in terms of what can be produced or extracted in the area, access to markets and the relative remoteness of these rural areas (Garnett *et al.* 2007). The extent of an intervention's influence, for instance, can provide important insights into the feasibility of achieving both conservation and development goals, in which larger areas can allow for a landscape approach that can then lead to better planning for local trade-offs.

Understanding the significance of biodiversity in an area can provide implementing agencies with information on where to focus their conservation management priorities. Measuring biodiversity is, however, not an easy endeavour (Spangenberg 2007) and any measurement is often dependent on the availability of research effort (Agrawal & Redford 2006; Spangenberg 2007). A set of indicators served as proxy of the value of an area for conservation, such as the often-used presence of important species (Variable 12), habitat diversity (Variable 13) and the general integrity of habitats (Variable 15). In combination with these indicators, another proxy used is the measure of threats to biodiversity, which is an easier and more practical approach for assessing conservation because it is based on easily accessible data that can be collected in retrospect, is sensitive to short-term changes and allows for a comparison of interventions in different settings (Salafsky & Margoluis 1999).

The official boundaries (in 'geographical features' group) may also influence an area's management strategies by determining the limits of favourable and unfavourable policies in different districts, provinces and countries. The boundaries restrict the degree of fragmentation and determine the perimeter-to-area ratios of protected areas. Political boundaries can become especially important if policies at either side translate into sharp transitions between different land covers, which can exacerbate the negative impacts of low habitat connectivity (in the group 'land cover and use of the entire landscape'). For instance, an area that is bordering another protected area may have fewer threats than an area that is surrounded by human populations. Conservation strategies need to acknowledge the effects of political boundaries and human impacts to implement systematic planning in an attempt to increase the resilience of a conservation area, especially by improving habitat connectivity and thus increased wildlife movement (Bengtsson *et al.* 2003; Pressey *et al.* 2007). Similarly, the extent and type of land cover, both natural and anthropogenic, are necessary to acknowledge to better target integrated actions that consider trade-offs between conservation and development at a landscape scale (Rodrigues *et al.* 2006; Sunderland *et al.* 2008). To represent the political boundaries, variables were included to capture the perimeter of the core areas that border a country, province (Variable 4) or other conservation area (Variable 5), and included variables that relate to the effect of these boundaries, including fragmentation of habitats (Variable 14), land covers (Variables 16-20), buffer to core land-use transition (Variable 22).

Ten common threats to forest habitats were included in the group of 'pressures on the conserved area'. The threats used in the analysis only relate to the proximate causes of degradation, that is, the human activities that are directly responsible for forest loss; the underlying factors driving them are captured in the remaining sections. This group does, however, explain threats that the local population can be directly accountable for, as well as threats that are mainly influenced by national and international forces. Each threat is detailed in terms of its intensity in the conserved landscape (Variables 23, 28, 31, 34, 37, 40, 43, 46, 49 and 52) its potential effect on the landscape integrity (Variables 24, 28, 32, 35, 38, 41, 44, 47, 50 and 53) and their rank in relation to their relative importance in a given area (Variables 25, 29, 33, 36, 39, 42, 45, 48, 51 and 54). Threats were ranked from 1-10 by the researcher, based on documented information and interviews and the intensity and effect of the threat. Because different landscapes have varying resilience to any one threat, the intensity of a threat is only one factor influencing its effect on forest habitats. For example, with only one dam – low intensity – built in a protected area, the resulting reservoir can have a devastating potential effect on the area, by increasing habitat fragmentation, facilitating access and changing the area's hydrology. Hunting and logging threats are further detailed with a threat actor (Variables 26 and 30) that helps to understand better who is implementing these activities – whether a local villager or someone from another province. Note that the actor of hunting and logging threats refers to the source of the threat, that is, the people implementing an activity in the area, and not to the external drivers of those activities.

2.3.2.2 Socio-economic conditions

Although the main objective of ICD initiatives is the conservation of the environment, the concept is based on the foundation that this can only be achieved if local development is promoted, to relieve local pressures on natural resources through alternative livelihood activities (Wells *et al.* 1992; Hughes & Flintan 2001).

This section of the variables was developed to grasp the links between rural development and biodiversity conservation, and form a detailed understanding of the social and economic condition of the population that is influenced by ICD initiatives.

A set of 49 variables was created to represent the context of the local population, divided into four groups: demographic conditions, the socio-cultural setting, livelihoods and the infrastructure of the area. The aim of the group of demographic conditions is to reflect the human capital of the local population (Kusters *et al.* 2006). This group also includes details on the education (Variables 64 and 65) and health characteristics (Variables 61 and 62) of the population. These measures are normally used as baseline data to direct management.

The second group represents the socio-cultural setting of a community, which can influence the options available for conserving forests. Ingrained cultural values (Variable 74) and newer social standards (Variable 75) attached to the environment influence people's use of forest resources, building the basis of the informal regulatory institutions. Likewise, historical (Variable 73) and current conflicts (Variable 72), whether over natural resources or otherwise, can have a considerable effect on the relationship that people have with their environments.

The third group represents the livelihood of the local populations, which are necessary to understand to achieve effective management of conserved areas (Ellis 2000). In common with biodiversity, poverty (Variable 76) is not an indicator that is easily measured (Agrawal & Redford 2006), but is necessary to understand the relative well-being status of communities near protected areas, compared to the national averages. In addition, a subset of variables described livelihood strategies that include local resource use patterns (such as income distribution, Variables 77-

81). Knowing which natural assets are important safety-net products and which generate disposable income can allow organisations to decide on different management strategies, such as promoting sustainable collection and marketing of certain products, or limiting use and providing alternatives to reduce people's reliance on certain forest resources (Sunderlin 2004).

The fourth group represents the infrastructure of the area. This allows one to understand the access that local people have to products and services. The group also represents the built capital of the area, which might be important for the achievement of development programmes (Garnett *et al.* 2007).

2.3.2.3 Institutional conditions

Any action will necessarily be implemented within a given institutional framework. Conservation interventions are no exception because their design and performance will be affected by this institutional context. These institutions are not only formal (such as laws and policies) but reflect the accountability and transparency of the processes through which they are formulated, and the general operation of good governance mechanisms (Bene & Neiland 2006).

The institutional framework category is composed of three groups: laws and policies, enforcement and civil society. The variables represent the presence and effectiveness of institutions, both formal (Variables 106-108) and customary (Variables 116 and 117), including the different levels of protected area policies affecting each of the landscapes (Variable 106), as these will influence the planning and management of the different interventions (Sayer & Wells 2004). Enforcement is also considered a critical part of the process of protecting forest areas (Wells *et al.* 1992), hence two enforcement variables (Variables 114 and 115) reflect the effectiveness in the implementation of conservation laws and regulations at the sites. The civil society group captures the number of local associations (Variable 118) and non-governmental organisations (Variable 120) and their activity in the landscape (Variable 119). Pretty and Smith (2004) show how these organisations help in building trust, reciprocity and connectedness in groups, and how these are essential in shaping people's actions to achieve positive conservation outcomes.

2.3.2.4 Characteristics of the interventions managing the conserved areas

The way an intervention is designed, implemented and managed plays a critical role in the achievement of positive outcomes (Wells & McShane 2004). This section focuses on the variables for interventions active in the conserved landscapes, divided into six groups: 1) the management features; 2) the activities being implemented; 3) the explicit conservation-development linkages; 4) the extent of collaboration and co-management approaches exercised; 5) the intervention's outcomes and their progress towards achieving their targets and; 6) the outputs achieved (as of 2007/2008) by the intervention.

Management features have an impact on outcomes (Wells & McShane 2004). The common disparity between ICDP's relative large funding and their relative poor performance in providing benefits to local populations and in achieving their conservation outcomes has been the subject of another ongoing debate (Kiss 2004; Sayer & Campbell 2004; Sayer & Wells 2004). The availability of funds (Variables 126-128) is also a determining factor of implementation, particularly affecting the scale at which interventions operate. The proportion of the conserved area targeted for enforcement (Variable 123) and the proportion of communities selected to be involved in the interventions (Variable 124) affect the sustainability and long-term outcomes of conservation and development, as interventions can end up spreading themselves too thin (Wells *et al.* 1992).

The length of an intervention (Variable 125) is also highlighted in the literature as a major factor in the success of ICD approaches. Longer-term interventions have been hypothesised to better achieve the integration of conservation and development, after an initial phase focusing in development activities and an intermediate phase of institutional building (Baral *et al.* 2007). Unrealistically short timeframes of three to five years are not long enough to ensure continuity (Hill 2007) to achieve highly ambitious goals and deal with the sustainability of these high expectations (Kiss 2004; Maginnis *et al.* 2004; McShane & Newby 2004).

Intervention-led research (Variable 136), monitoring of biodiversity and livelihoods and evaluation of achievements (Variable 135) are necessary for any intervention. Intervention-led research can provide baseline data necessary to understand the context of the intervention, and implementing monitoring and evaluation exercises. Research becomes especially influential in measuring and determining outcomes in adaptive management strategies (Wells & McShane 2004). Moreover, the use and incorporation of externally led research into intervention operations also proves useful to develop the understanding of the landscape and can lead to the development of alternate tools of action (Sutherland 2000). Results from monitoring and evaluation can be used as part of reporting mechanisms to external agencies and donors that ensure effective management and timely outputs. They are also useful as internal documentation to inform managers about trends of the environmental, socio-economic and institutional situation, having a considerable influence on outcomes (Sutherland 2000; Ferraro & Pattanayak 2006). But rigorous research and standardised monitoring and evaluation systems are rare, as it is expensive in terms of time and finances, and end up, too often, being disregarded (Kremen *et al.* 1994; Hughes & Flintan 2001; Stem *et al.* 2005; Hill 2007; Tallis *et al.* 2008).

Throughout the years, conservation and development initiatives have used diverse strategies to achieve integration, although with varying degrees of reported success, and no 'model' of integration has been achieved (Brandon & Wells 1992). The 'activities' group includes a range of common activities employed by ICD interventions: research (Variable 138), education and training (Variable 139), local economic initiatives (Variable 140), support and infrastructure development (Variable 141), tourism (Variable 142), land-use planning (Variable 143), institutional development (Variable 144), law enforcement (Variable 145), conservation payments (Variable 146) and any other conservation activities undertaken (Variable 147). These variables attempt to understand which of these practices, or combination of them, work in synergy and which have to be traded-off under different contextual circumstances. The linkages between conservation and development can be made explicit and clear in intervention design and implementation, and is captured in the group of integrated conservation and development activities for the variables of education (Variable 148), income generation (Variable 149) and local participation in enforcement and monitoring (Variable 150). The activity variables will aid in identifying the trade-offs between conservation and development decisions.

Co-management arrangements – consultation (Variable 151), participation (Variable 152) and collaboration (Variable 154) – are important to many of the recommendations provided for environmental management and development interventions (Hughes & Flintan 2001; Russell & Harshbarger 2003; Fisher & Christopher 2007; Hill 2007; Bourdier 2008). By negotiating with local stakeholders through consultation and participation, organisations can gain a greater understanding of the context they are working in and improve attitudes towards the conservation interventions (Schmidt-Soltau 2004; Fisher *et al.* 2005). Furthermore, the inclusion of participatory mechanisms can help ensure activities fit and adapt to the local setting, and that the less powerful have a greater voice in decision-making (Fisher *et al.* 2005). In a context where initiatives directed by external organisations have been often criticised for imposing agendas that are not in tune with local situations, hence variables were included to look at the frequency and quality of consultations with stakeholders and participation of local people in the planning and implementation processes. These variables are used to reflect the shared responsibilities and sense of ownership felt by stakeholders of the intervention (Sayer & Wells 2004), and to assess whether more localised or expert-led agendas achieve better results when dealing with ICD outcomes (Kiss 2004).

Standardised evaluation systems are rare (Stem *et al.* 2005), and interventions rarely quantify the impact of their actions to verify that the ICD intervention yields positive results (Wells *et al.* 1999). Unfortunately, the study design did not allow for an evaluation of the conservation and development outcomes after the conclusion of activities, because most of the initiatives are still ongoing. Three measures of progress as perceived by managers were therefore included in the variables, to measure 1) conservation outcomes (Variable 155), 2) livelihood outcomes (Variable 156) and 3) institutional development outcomes (Variable 157). These indicators were a proxy for the impact of the interventions on the sites, and can also be used to measure how external and internal features of interventions relate to their objectives.

Wells et al. (1999) express in their review of Indonesia's ICD projects that one of the essential features for the success is to place more emphasis on the management of outputs, such as building collaborations (Variable 162) or producing publications (Variable 164), instead of spending so much time trying to plan the inputs and detailed blueprint management designs. Otherwise, too much emphasis may be put in completing activities, without paying attention to the effects of those activities (Sayer & Wells 2004). Furthermore, outputs can be used as measurable indicators of the effectiveness of the chosen activities towards achieving outcomes and impacts.

2.3.2.5 Characteristics of other interventions associated with the conservation area

This category is a subset of 20 variables similar to the site-level interventions, used to characterise the 'other interventions' implemented in an overlapping geographic area to that of the main ICD interventions. These interventions are operated primarily by non-government organisations (Table 2-2). Understanding these two intervention types, especially how they relate to each other, can give useful insights into how different strategies, especially those relating to collaboration and co-management, could create synergies and trade-offs for achieving biodiversity conservation and livelihood development goals (see Chapter 5). The variables here are often less precise than those of the site-level conservation interventions, due to the limited information. For comparison, the scores for the conservation interventions were transformed to the same measurement as the other interventions for use in Chapter 5.

Table 2-2 Other interventions at the 15 sites, identified by their associated organisations.

Organisation/Intervention	Site
Association of Buddhists for the Environment	CCPF
Action Against Hunger	MPF and SBCA
Adventist Development and Relief Agency	PSWS
Anakut Komar	PSWS
Care International	CCPF
Centre d'Etude et de Développement Agricole Cambodgien	CCPF and PSWS
Cambodian Rural Development Team	SBCA
Disadvantaged Cambodians Organisation	CCPF and PSWS
Deutscher Entwicklungsdienst	BMNP
Development and Partnership in Action	SBCA
Fauna & Flora International	CCPF
Free the Bears	BNR
German Agro Action/Deutsche Welt Hunger Hilfe	VNP
Healthnet International	MPF and SBCA
Helvetas	BMNP
Intercooperation Cambodia	SBCA
International Union for Conservation of Nature	STNR
Luxembourg Agency for Development Cooperation	NKD
Nomad Recherche et Soutien International (intervention 1)	MPF
Nomad Recherche et Soutien International (intervention 2)	SBCA
Non-Timber Forest Product Organisation	VNP
Red Cross	SBCA
Save Cambodia's Wildlife	CCPF and PSWS
The Sustainable Forestry and Rural Development Project	BCI
Tropenbos International	BMNP
Wildlife Conservation Society	NNT
World Wildlife Fund	BMNP
Youth with a Mission	VNP

2.3.3 Gathering the data

2.3.3.1 Interviews and secondary data methods

Considering the time frame for this research, from June 2006 to December 2010, the methods used allowed for the comparison of a greater number of cases at the expense of reducing the time spent at each site collecting primary information. Hence, the collection of data mainly relied on secondary information, and most of the necessary information was found in published and unpublished documents. Data collection has to be from the best available information, compiled through the easiest means possible, while remaining thorough and comparable across sites. Interviews and discussions with local people, managers of conservation areas and staff of organisations and government were also used as a means to support and crosscheck the secondary information.

Data collection started in April 2007 and continued to June 2008. The research project was hosted by organisations in Cambodia (the Wildlife Conservation Society) and Vietnam (the World Agroforestry Centre), who provided assistance for office space, workshops, permission letters, field trip logistics and technical support. CIFOR in Laos provided assistance for the workshop and for providing contacts to practitioners in the five conservation areas. I collected data from 13 of the sites in Cambodia, Vietnam and Laos. A second researcher, based at CIFOR and part of the MacArthur project (B. Herrero Cangas), assisted with data collection for all the Laos sites, including joining me on a visit to Nam Et-Phou Louey. Since our time in Laos was limited, B. Herrero Cangas independently ran the field trips to the remaining two sites in Laos, Bokeo Nature Reserve and Nam

Kading National Protected Area. The method B. Herrero Cangas used for collecting information was consistent with the methods I used.

Local research assistants, organisation staff or research partners in each country also assisted in data collection (further details of the field assistants and organisation staff involved in data collection for each site are presented Table 2-3). One main research assistant was hired in each of the countries, by contacting them through the partner organisation networks (WCS Cambodia; the World Agroforestry Centre in Vietnam and CIFOR Laos). The main research assistant for Cambodia was S. Yin, who worked as a translator and assisted in data collection, from April to August 2007, then November 2007 to January 2008. His role was to assist with the review of documents in Khmer and to translate directly between the informants and myself during interviews and group discussions. A research assistant, L.N. Nguyen, was hired in Vietnam to collect data and translate information remotely, using Internet resources and project documents, from February to May 2008. In Laos, T. Sailomyenh was hired for two weeks in April/May 2008, primarily as a translator for the field trips to Nam Et Phou Louey and Nam Kading National Protected Areas. For the remainder of this chapter, ‘we’ refers to B. Herrero Cangas, our field assistants and myself.

Table 2-3 Field trips to each site during 2007 and 2008. I was present for all interviews and discussions apart from those conducted at Bokeo Nature Reserve and Nam Kading, which were conducted by B.Herrero Cangas. [a]The informants mentioned here were those who contributed information for the site or manager of the site, they do not include interviews to collect data for the 'other' interventions. [b]Seima Biodiversity Conservation Area was visited before the variables were developed, as part of another of my research studies, which resulted in Seima being the pilot site for Cambodia. [c]Since I was at the site for over seven weeks, I lost count of the number of discussions that I had with informants. [d]No independent field visit was made to Cat Tien National Park, instead, data for the variables was collected during workshops, where the workshop participants visited villages. [e]B.Herrero Cangas (from CIFOR) and myself ran the field trip to Nam Et-Phou Louey as this was the pilot site for Laos. [f]The field trip to Nakai Nam Theun was not accompanied by a translator, and due to restricted access, the visit was only to the main office at Nakai, to interview staff of the Watershed Management and Protection Authority.

CAMBODIA				
Site	**Dates visited**	**Locations visited**	**Informants**[a]	**Assisted by**
SBCA	28 April – 30 May 2007 11 – 20 June 2007 7 – 16 July 2007[b]	Four villages One forest guard station	17 interviews with villagers 3 group discussions with total of >30 villagers[c] >10 discussions with forest guards[c] >10 discussions with intervention staff[c] 10 interviews with other organisations	Translator (S. Yin)
CCPF	27-29 November 2007 18-20 January 2008	Three villages Two forest guard stations	4 interviews with villagers 6 interviews with forest guards 4 interviews with intervention staff 3 interviews with other organisations	Intervention manager and translator (S. Yin)
VNP	13-18 December 2007	Three villages One forest guard station	7 interviews with villagers 4 interviews with forest guards 5 interviews with intervention staff	Intervention manager and translator (S. Yin)
MPF	8-10 January 2008	Three forest guard stations	1 group discussion with 5 villagers 1 interview with villager 3 interviews with forest guards 5 interviews with intervention staff	Intervention manager and translator (S. Yin)
PSWS	15, 16, 17, 20 January 2008	Three villages One forest guard station	4 interviews with villagers 2 interviews with forest guards 7 interviews with intervention staff 1 interview with another organisation	Ministry of Environment representative and translator (S. Yin)

Table 2-3 (Cont.)

VIETNAM				
Site	**Dates visited**	**Locations visited**	**Informants**[a]	**Assisted by**
CTNP	10-22 September 2007	Two villages Two forest guard stations	2 workshops with intervention staff 4 interviews with villagers 2 interviews with forest guards 2 interviews with intervention staff	Workshop participants[d]
BMNP	16-19 October 2007	Two villages Two forest guard stations	2 interviews with forest guards 3 interviews with intervention staff 4 interviews with other organisation staff	Staff member of Bach Ma
STNR	23-24 October 2007	One village Two forest guard stations	3 interviews with forest guards 3 interviews with intervention staff 1 interview with other organisation staff	Staff member of WWF and representative of the Forest Protection Department
TDNP	5-6 November 2007	Forest guard station Two villages	2 interviews with forest guards 3 interviews with intervention staff	Staff member of Tam Dao
VBNR	1-2 November 2007	Two villages Three forest guard stations	2 interviews with villagers 3 interviews with forest guards 4 interviews with intervention staff	Staff member of Flora and Fauna International

Table 2-3 (Cont.)

LAOS				
Site	**Dates visited**	**Locations visited**	**Informants**[a]	**Assisted by**
NEPL[e]	30 April to 4 May 2008	Three villages Four forest guard stations	1 group discussion with 6 intervention staff 3 group discussion with a total of 15 forest guards 5 interviews with villagers 5 interviews with intervention staff	Translator (T. Sailomyenh)
BNR	6-9 May, 2008	Two Village One forest guard station	3 interviews with villagers 1 interview with forest guards 3 interviews with intervention staff	Private enterprise tour guides
BCI Corridor	7-9 May, 2008	Four villages	2 group discussions with a total of 18 villagers 1 group discussion with 10 intervention staff 4 interviews with intervention staff 2 interviews with other organisation staff	Private enterprise tour guide
NKD	13-15 May, 2008	Two villages One forest guard station	4 interviews with villagers 1 group discussion with 4 forest guards 3 interviews with intervention staff 2 interviews with other organisation staff	Translator (T. Sailomyenh)
NNT	13-14 May, 2008	None[f]	5 interviews with intervention staff 1 group discussion with intervention staff	None[f]

The researchers and research assistants visited each of the 15 sites – usually spending between two and five days at each site (Table 2-3). At the organisations' field offices we were given access to libraries for secondary data collection, ran key informant interviews and, where possible, group discussions. The secondary data were derived from a combination of information consisting of peer-reviewed literature relating to the 15 landscapes, grey literature (such as national government reports and non-government organisation briefs), statistics (such as forest violations, village populations and species populations) and documentation (such as annual reports and field trip reports) from the organisations involved. Some of the grey literature was available through the Internet, but most of the documents were accessed at organisation offices in major cities and at the sites. Information was also collected from national and organisation libraries and databases. Intervention documentation and material relating to the protected areas held by partner organisations provided most of the information required. For non-publicly available information, such as forest violation statistics and draft annual reports, we ensured permission was sought to use the information. Some of these documents were in the national languages (Khmer, Vietnamese or Lao), such that local research assistants summarised and translated them into English. Data at broader scales (such as provincial or national scales) were collected when more local, landscape level information was not obtainable. Where possible, information collected related to the period between 2003 and 2008, to keep the data at a consistent and recent timeframe.

Collection of primary data from key informants during field visits to sites was important to fill in gaps, crosscheck and update data collected from secondary sources. The key contacts within the organisations or government departments working in the conservation areas were contacted through official requests from the project through introduction by CIFOR. The key contacts assisted the researchers by introducing them to potential interviewees, including project officers, forest guards and farmers. The interviewees were made aware of the research being conducted in their area by way of email, phone calls or face-to-face meetings. At face-to-face meetings, the potential interviewees were greeted, informed about the project and their verbal consent was granted if they chose to be interviewed.

We conducted 5-27 semi-structured interviews with key informants at each site (see 'Informants' in Table 2-3), with each interview lasting from 30 minutes to two hours, and group discussions with several informants at several of the sites. Key informants included intervention managers, staff and government officials who are managing the 15 conservation areas (interviews with intervention personnel are coded in the results of Chapter 3 and 4 with an 'I'[9]), forest guards (coded as 'G'), local people (coded as 'V'; including village chiefs, farmers, small traders etc.), and staff from other NGOs in the area that are not managing the 15 conservation areas, such as Red Cross (coded as 'O' – see Table 2-2). Sometimes the interviews were conducted in groups, referred to in Table 2-3 as group discussions (coded as 'GD').

There was substantial variation in the interview structures. Primarily, the variable matrix (Appendix 1) guided the structure of most interviews. Since the main method of collecting data for this research was from secondary information, these interviews were guided by gaps in the variable matrix results and were used to crosscheck the secondary information. Other interviews were specific to the interviewee. Each interview was tailored to the respondent, for example: project

[9] Chapter 6 uses a different interview coding system because the study was not included in the 15-site case comparison and the Cat Tien study was conducted at a later stage.

officers were asked about policies and the project activities; forest guards were asked about hunting and logging trends and day-to-day activities in the forest; villagers were asked about their livelihoods, the education of the villagers and their use of the forest. The guiding questions used during interviews are presented in Appendix 3.

Interview questions were directed to understand the conservation area, the history of the projects, how they were implemented and what positive outcomes came from the projects. Interviews included a range of topics, such as the environmental condition and threats to biodiversity, demographics of the local area population, livelihood activities, the policies and institutions implemented, the management of projects at each site, the relationships among stakeholders and progress and outcomes of projects.

The notes from the interviews were hand-written then typed into a document for further analysis. Once the interviews were complete in each area, the interview results were manually analysed by highlighting themes within the responses. The themes were then further analysed for their contribution to each of the variables. Each variable was then scored based on the interview responses, generally backed up by other interviews from different respondents, and crosschecked against the secondary information. A summary of the history and situation of each site was written up based on the interview results and secondary information. The information collected in the interviews was also used as supporting evidence for the results in Chapters 3, 4 and 6.

To better understand the activities and their context, we visited field offices in all 15 of the sites, villages in 12 of the sites and ranger stations in 13 of the sites. We also travelled to parts of the conservation areas, except for Nakai Nam Theun, to crosscheck information by making observations of the obvious land uses (such as crop and plantation types), village infrastructure and type and quality of the natural forests. Nakai Nam Theun National Protected Area (Laos) could not be visited because of restricted access, but this site has a high level of attention because of the construction of the Nam Theun 2 hydropower dam (for instance, see WMPA 2005; Singh 2009b) and so a large amount of documented literature was available for this site. In most instances, staff members or representatives from each of the organisations managing the areas accompanied us on field trips to villages. A translator was used at most of the sites when interviewing local informants, to translate between English and the national languages (Khmer, Vietnamese or Lao).

2.3.3.2 Framing the variables into the case-study matrices

All fifteen cases were defined by the list of 164 variables characterising the landscapes and ICD strategies, including the 20 variables defining the characteristics of the other interventions (Appendix 1); these were measured with standard criteria and units. We scored each variable by entering a value for each site and intervention that represents the measurement criteria as shown in Appendix 1. The collected primary and secondary information was used to score the values for each variable and enter a description for each data point. We ensured quality of data by making sure that data retrieved conformed to a set of criteria of compatibility, consistency and reliability (see Braissoulis 2001). Data retrieved are supported by a set of qualitative descriptions that help to identify the reliability of the data. These include a short description for the value given to the attribute, the source of the information (including interviews and references to documents when available), and a confidence level. The confidence level provides a measure for the confidence that we have on the information provided and the representativeness of the values given in regards to the whole landscape. Only the numerical values assigned to the attributes are analysed in the research; however, the qualitative descriptions are used to ensure the quality of the conclusions derived from the analysis. Nevertheless, given the multi-national and multi-stakeholder nature of the study, intervention-timeframe constraints and limited resources, some of Briassoulis (2001) practical criteria to ensure a perfect dataset could not be achieved (see Section 2.3.4 for the challenges encountered during the research).

Most of the attributes were designed as ordinal data (measured on a 1-5 scale where possible); some were categorical and a few were measured as continuous data. To give an indication of the scoring, several variables only include descriptions of the low (1), medium (3) and high (5) values, but the results include intermediate measures of ‘2’ and ‘4’. By using ordinal scales, the data’s accuracy is prioritised over the precision of the data. Accuracy is defined as the degree of closeness of a measure to its actual value; precision is the degree to which further measurement shows the same or similar result (Taylor 1999).

The ‘confidence level’ describes how confident we felt that the data values given correspond to the landscape realities, measured on a scale of 1 to 5. This was developed in response to data collection challenges – i.e. patchy availability of information; heterogeneous availability of information across countries and organisations; and possible bias in the information sources. A low score denotes an inability to triangulate the information, which arises when there is only one, potentially biased, source of information. This often meant we used information from another scale to represent the landscape level we work on. If a variable scored low in confidence across a majority of sites, we recommended caution when analysing the data. A high score indicates that the information was accurate, triangulated from various reputable sources and could be considered reliable. The measure of confidence is also used as a control for checking and eliminating variables, based on the consistency and reliability of values scored through the multiple available sources.

Close collaboration between the field researchers and frequent crosschecking of each other's work ensured consistency in assigning values to the variables and guaranteed comparability between the cases. Once all of the data was entered into the variable matrix and cleaned, each dataset of the cases was sent to respective representatives from the sites to check and comment. If necessary, the data was updated and revised accordingly.

2.3.4 Challenges in the case comparison research

As mentioned in the previous sections, the research entailed a number of challenges in acquiring data that was reliable and precise at the landscape scale. One of the main issues arose from an intrinsic feature of the research – working in different countries and partnering with multiple organisations. This character of the research made the availability of and access to information vary greatly between countries and between the partner organisations. In Cambodia, most relevant information was available, but national statistics were often outdated. In Laos, most information was available in published documents, on the Internet or publicly available at the organisation's libraries, however, it was not possible to visit Nakai Nam Theun due to restricted access. In Vietnam, much of government information was unavailable directly to us, so a national research assistant was hired to collect data remotely from February to May 2008. This increase in heterogeneity of the grouped dataset changed the techniques for collecting the data during the study, resulting in the current methods described.

Another issue related to the availability of the data is the difference between Western and Lower Mekong cultures and languages. Milne (2009) discusses this issue in Cambodia, where the divide between Western and Khmer cultures and worldviews meant that the agendas of donors and head-offices of conservation organisation were misinterpreted and transformed into unexpected ways, and that the information acquired by the foreign organisation was restricted. A similar issue was also encountered in our research. The cultural divide and limits of the field assistants to translate between languages meant that questions posed in English were phrased differently in the national languages, and the responses and information received by us may have been inaccurate. Furthermore, documents and data of the organisations working in the sites were sometimes written in the national languages, but our assistants had limited time and ability to gain the optimal amount of information from these documents. The issue of losing information through translation was partly resolved in two ways, 1) in all three countries, a second bilingual person was present in some interviews and so was able to assist with the translations, and 2) in Cambodia, I learnt enough Khmer to understand some of the content of the interviews, and so could revise the questions and clarify the details of the statements from informants. Pilot studies were conducted at the first sites of each country, as noted in Table 2-3. A pilot study was conducted at Seima Biodiversity Conservation Area in Cambodia over several weeks in May-July 2007, as part of the initial field research. A pilot study for Vietnam was conducted at Cat Tien National Park, which included two day-long field trips during a workshop held there. A pilot study was held at Nam Et Phou Louey in Laos with B. Herrero Cangas to ensure the field data collection techniques were aligned. The primary purpose of the pilot studies was to test the interview techniques and data collection methods and to understand the situation of the landscape in the context of the country and national language.

The different country settings also introduced variability in the measurement of variables at different scales. Information for some sites was available at the landscape scale (for instance, socio-economic data from villages), but not available in others, often because of limited information or research effort by the organisations at the sites. This heterogeneous availability of data at the same scales limited the comparability of variables across the 15 landscapes, which meant we had to use information that was aggregated at broader scales (i.e. multi-district, multi-provincial, national). We also managed to reduce the impact of this issue by introducing a qualitative confidence measure, as discussed in the previous section.

Another issue in collecting and entering data into the variable matrix was the inaccuracy of the information. In many cases, collection of information came from multiple sources but these sources contradicted one-another. Even population statistics of an area are not accurate – some national statistics report numbers greatly different from field surveys. Furthermore, the information was sometimes over 10 years old, making it challenging to estimate the current value. While these issues were partially dealt with by crosschecking the information through key interviews, some of the data for some variables remained weak.

A great deal of effort was made to ensure research partners understood the comparative nature of the study, through information briefs, multiple discussions and workshops. Nevertheless, in some instances, intervention managers and staff felt reluctant to provide information they felt could be used to assess their team's performances. As a result, some of the information received for measuring progress variables could be potentially biased towards over-reporting successes and underreporting challenges in achieving targets. Due to our research design, the limited monitoring and evaluations of interventions and, sometimes, short intervention time frames, it was not always possible to triangulate with other sources – interviews were a last resort, normally conducted during short visits to the field sites. This type of information also scored low on our qualitative confidence assessments of the data, and were analysed with caution.

2.3.5 Exploring the data

The data analysis commenced in a 5-day workshop held in Madrid, Spain, in July 2008, bringing together five researchers involved in the CIFOR project – T. Sunderland (project manager), M. Ruiz Perez (project partner and multivariate statistician), R. Achdiawan (statistician), B. Herrero Cangas (research assistant) and myself. A second 3-day workshop was held in Bogor, Indonesia, in October 2008, attended by M. Ruiz Perez, R. Achdiawan, T. Sunderland and myself, to review and revise the results and further explore patterns in the data. Analysis of the data continued between and following these workshops, assisted by R. Achdiawan, M. Ruiz Perez and T. Sunderland. All variables were analysed but only the most relevant results were used for results in the following chapters.

The exploration of the data was done in a stepwise process. The first step in this process was to examine all of the variables individually by applying basic descriptive statistics. This helped to understand the nature of the data and its distribution, and allows for the highlight of the differences across the landscape cases. The basic descriptive analysis was also used to identify how to explore the data further; once this is done, a subset of variables can be singled out to use in further multivariate analysis.

For analysing the relationships between variables, we used the software programmes SPSS v.16 and v.9, Microsoft Office Excel 2003 and Multi-Variate Statistical Package. Ordinal and ratio data were explored through Spearman's Rank correlations and nominal variables through cross-tabulations. The regressions on the data were performed to understand causal relationships between the variables. Multivariate analyses were performed to understand the relationships between the landscape cases and the multiple variables characterizing them. Principal coordinate analysis was applied to explore typology of cases and multidimensional scaling was used to create indices from detailed variables, such as threats. These indices are useful to simplify our understanding of the grouped contribution of related variables.

2.4 Method for scenario modelling at Cat Tien National Park

Chapter 6 explores the effects of different environment and development scenarios on biodiversity and local livelihoods and Cat Tien National Park, Vietnam. Systems dynamic modelling, using the software package STELLA v9.0.3 (Isee-systems 2006), was employed using a participatory modelling approach with local experts to explore four scenarios for Cat Tien National Park: 1) business as usual, 2) more emphasis on developmental goals, 3) trying to balance environmental and developmental goals, and 4) more emphasis on environmental goals. This method was chosen because it effectively identifies and relates information relevant to complex ecological-economic systems, and enables choices among alternative actions for management (Costanza & Ruth 1998). The process also increases communication among stakeholders and raises awareness about important issues that may be obscure at first glance (Sandker *et al.* 2009). The outcomes of a modelling process are useful to many stakeholders, not just the modellers, and can especially aid policy makers to become more responsive to dynamic systems (Sayer & Campbell 2004; van den Belt 2004) and encourage them to consider long-term perspectives (Sandker *et al.* 2009).

A 5-day training workshop, facilitated by M. Sandker (CIFOR) and B. Campbell (CIFOR), was held in Cat Tien National Park in September 2007 to develop a model to explore outcomes from conservation and development scenarios of Cat Tien National Park. Twenty-nine representatives (including myself) from Cat Tien National Park, CIFOR, the International Union for the Conservation of Nature, WWF and Charles Darwin University attended the workshop. A follow-up workshop was held in Bogor over four days in April 2009 to revise the model and further develop the scenarios, attended by six representatives (including myself) from Cat Tien National Park, Nong Lam University in Ho Chi Minh City and CIFOR. Following the workshops, we revised the model and I ran a field trip to Cat Tien National Park to crosscheck and validate the information in the model and understand local conservation and development processes. During this field trip, I conducted a total of 26 interviews and one group discussion via a translator, Bach Thanh Hai, in a range of topics related to local livelihoods and biodiversity conservation at Cat Tien National Park and the buffer zone. I also collected secondary information from maps, data on operations at the national park and state forest enterprises, research reports and publications. The detailed methods for modelling and data collection are discussed further in Chapter 6.

2.5 Profiles of the fifteen sites

All of the sites are established to conserve their valuable biodiversity and habitats; each has thousands of hectares of forest and several threatened species mentioned on the IUCN Red List. Each is under the jurisdiction of a government department, and management of most sites is partnered with international conservation NGOs. Nevertheless, each site is unique in terms of the management, environment and social context. A clear example is the size of the conservation areas, which range from 20 000 to over 400 000 hectares (Table 2-1), with the smaller areas and higher populations in the sites in Vietnam. Conservation areas were also established at different times and often changed status during the past few decades, such as from Nature Reserve to National Park – as in the cases of Bach Ma and Tam Dao in Vietnam.

This section provides a brief overview of each site, by describing the location, management arrangements and conservation values of the area, the demographics of the local population, livelihoods of local people and the main threats to the biodiversity. These profiles were developed from primary and secondary sources described in Section 2.3.3. The information on each site was valid as of January 2009.

2.5.1 Cambodia

2.5.1.1 Central Cardamoms Protected Forest

The Central Cardamoms Protected Forest (CCPF) overlaps the borders between Koh Kong, Pursat and Kampong Speu provinces on the centre of the

Cardamom Mountains, west Cambodia. The CCPF was established by sub-decree from the Royal Government of Cambodia in 2002, under the jurisdiction of the Forestry Administration. While the objectives of CCPF are unclear (mentioned in an interview with a coordinator of the conservation intervention), the sub-decree is for watershed and biodiversity conservation. The Forestry Administration manages the CCPF with the assistance of Conservation International. Conservation International also collaborates with local development and conservation NGOs to implement health, education and natural resource management programmes (ABE 2007).

The conservation value of the Cardamom Mountains has been recognised by international conservation scientists since 2000, when a biological survey was carried out by Fauna & Flora International (FFI) and the Cambodian government, recording over 250 animal species (Appleton *et al.* 2000). The conservation is attributed to a diversity of habitats that support a large number of plant and animal species, some endemic to the area.

Most of the residents of the CCPF are to the south of the core zone, in Thmar Bang district, Koh Kong province. Over half of residents belong to the Por ethnic group, but there are also Sa'och and Samre ethnic minorities and more recent Khmer migrants. Livelihoods are predominantly based on agriculture, including shifting cultivation, rice paddies and livestock, but many of the residents use forest resources for construction of houses and traditional medicines.

According to the interviews with staff of the CCPF (Table 2-3), the main threats to the area are hunting, logging, agricultural encroachment and the establishment of two hydropower dams. Hunting is still a major issue, mostly from outsiders entering from Phnom Aural Wildlife Sanctuary to the east. Logging and deforestation from agriculture practices are also major threats to the area, especially in the east and south.

2.5.1.2 Mondulkiri Protected Forest

Mondulkiri Protected Forest (MPF) is in Mondulkiri Province, east Cambodia, on the border of Vietnam. The area was established by a sub-decree from the Forestry Administration in 2002 for genetic resources of plants and wildlife. The MPF is located in the Eastern Plains Dry Forest Landscape, which is part of the Lower Mekong Dry Forest Ecoregion as identified by WWF. The Forestry Administration is in charge of the MPF, with WWF as an advisor. The stated vision of the area includes protection, management and restoration of habitats and species, socio-economic development of adjacent communities via responsible natural resource management (WWF 2007). The aims of the management of MPF are for improved natural resource management, initiation of ecotourism activities and establish community-based monitoring of species (Maling 2007). Multiple projects also operate in the surrounding villages from various donors and organisations.

The forest supports the livelihoods of eight communes situated in the west, north and south of the MPF. There are 11 ethnic groups in the MPF, the majority being Bunong and Khmer (Maling 2007). Many people in the MPF area were relocated during the Khmer Rouge period and have since migrated back to the area. The majority of the residents of the MPF are reliant on forest resources for food and income as there are insufficient rice yields to support them for a full year.

Collection of the data showed that threats to the MPF are multiple, but most threats are not severe. Many threats come from unsustainable exploitation – hunting, logging and NTFP collection. Other threats include dams and mines, which affect the waterways. Plantation and mining concessions are also a threat to the south of the area, but this is largely in the buffer zones.

2.5.1.3 Phnom Samkos Wildlife Sanctuary

Phnom Samkos Wildlife Sanctuary (PSWS) runs across Battambang, Pursat and Koh Kong provinces in Cambodia, on the border of Thailand. PSWS was an area of intense conflict during the 1980's and 1990's when the Khmer Rouge used the forest as cover in their fight against the Vietnamese incursion. Management of PSWS is the responsibility of the Department of Nature Conservation and Protection, within the Ministry of Environment, in partnership with Fauna & Flora International. Partnerships and collaborations are also common among the multiple organisations working in Pursat province, including the military and district and provincial authorities. The objectives of PSWS are protect and conserve the multiple values of the area while enhancing local community livelihoods through sustainable natural resource management (MoE 2006).

Phnom Samkos is home to the Por ethnic group, who have resided there for the last 500 years (Ironside 2005). The Por traditionally relied on forest resources for their livelihoods. Nevertheless, the population in the area has undergone change over the past 40 years in PSWS and few Por remain, with many of the residents now ex-Khmer Rouge. The current land use by local people is predominantly shifting cultivation and sedentary agriculture, with little use of the forest for resources.

Wildlife was still abundant when the Khmer Rouge-Vietnam conflict ceased in 1998, but the populations of many wildlife species are perceived by forest guards to have since declined, due to the rapid in-migration of people to the area (MoE 2006). As population increases, more land is cleared for settlement, cultivation and infrastructure development. Large-scale infrastructure developments include roads to improve access to the Thai border, the development of a hydropower dam bordering PSWS and the adjacent CCPF, and a mine in part of the core of PSWS.

2.5.1.4 Seima Biodiversity Conservation Area

Seima Biodiversity Conservation Area (SBCA) is located in Mondulkiri and Kratie provinces, east Cambodia, bordering Vietnam. The SBCA was a previous logging concession, but was officially declared as a conservation area by the Ministry of Agriculture, Forestry and Fisheries in August 2002. Forests cover 98% of the area and are home to eight species of cat, including the tiger (*Panthera tigris*). The area is also within two Important Bird Areas, as identified by Birdlife International (WCS 2009a). The Forestry Administration currently operates the SBCA with advice from the Wildlife Conservation Society. Management of the area also includes partnerships with Cambodian Rural Development Team and regular meetings with other NGOs operating in the area. SBCA is managed as a conservation landscape, with goals to integrate with the development needs of local people and national development interests (WCS 2007).

The SBCA consists of 38 administrative villages of 8 districts, with a total of approximately 16 000 people in the core and buffer zones (Evans & Delattre 2005). The main ethnic groups are Bunong (46%), Khmer (43%), Stieng and Cham. People who live in or near the forest are largely dependent on forest resources, including fishing, resin tapping, NTFPs and wildlife for food. Upland rice cultivation is also common and many people have started to grow cashew and cassava in the areas bordering SBCA.

Overharvesting of forest products by local people is a threat to forest biodiversity. Nevertheless, many of the threats come from elsewhere. The national government has interests in developing Mondulkiri's infrastructure, which means habitat is cleared for mining, a major road through the area and plantation concessions in the north east of the area. Outsiders also do land grabbing, hunting and logging.

2.5.1.5 Virachey National Park

Virachey National Park (VNP) is in Ratanakiri and Steung Treng provinces, on the border of Laos and Vietnam. The Ministry of Environment first established the area in 1993, as part of the national protected area system. Much of the forest area is still intact, but there have been recent encroachments at the tri-nation border and Steung Treng provinces. Birdlife International considers Virachey National Park an Important Bird Area. The National Park is managed by a Management Board, which has been the focus of the Biodiversity and Protected Areas Management Project funded by the World Bank, completed at the end of 2007. International conservation organisations were also involved in advising on the management of the protected area, including WWF and Birdlife International. The primary goal of the Biodiversity and Protected Areas Management Project was to develop and test protection and management of biodiversity through institutional building and development. The objectives of the Virachey National Park are to conserve and sustainably manage the natural and cultural resources of the park in partnership with local communities and other stakeholders for the benefit of the people of the local communities and Cambodia (BPAMP 2003).

No villages are within the core zone of the area, but some of the villages control community-protected areas adjacent to the core zone. Ratanakiri and VNP are home to indigenous ethnic groups, the main groups are Krueng, Kavet, Brou, Lao and Lun (BPAMP 2003). These groups have spiritual connections to the forest areas and depend on the forests for non-timber forest products. More recently, however, local people have started to grow upland crops.

There are some threats to the area, the primary issues being hunting, mining and logging. Local people and outsiders commonly hunt for the wildlife trade. In the plans of the Ministry for Infrastructure, Mines and Energy, Virachey NP has been divided up into multiple mining concessions. Logging has recently decreased but remains an issue to some habitats and tree species in Virachey.

2.5.2 Laos

2.5.2.1 Biodiversity Corridor between Dong Hoa Sao National Protected Area and Xe Pian National Protected Areas

WWF, in collaboration with the International Union for the Conservation of Nature (IUCN), established a biodiversity corridor between Xe Pian and Dong Hoa Sao National Protected Areas (BCI) in 2006. This corridor is part of the Asian Development Bank's Biodiversity Corridors Initiative. While the adjacent areas are rich in biodiversity, the corridor forest is lower quality and fragmented. The provincial forestry department, with resources and technical assistance provided by WWF, manages the corridor. Management of the corridor is also supported by an organisation, Sustainable Forestry for Rural Development. The corridor was set up as an effort to alleviate poverty through sustainable natural resource management, conserve remaining habitats and improve the condition of forests and ecosystem services (IUCN 2008; WWF 2008a).

Local livelihoods are partially dependent on forest resources. Nevertheless, the local economy has changed in recent years from being subsistence to a market-based. Livelihoods now mainly depend on agriculture, non-timber forest products (NTFPs) and livestock. Most households collect NTFPs for subsistence or cash income. Products are varied, but include malva nut (*Scaphium macropodum*), cardamom (*Amomum* sp.), other plants for medicinal and construction purposes, wildlife and fish (IUCN 2008).

Interviews with staff[10] suggest that hunting has reduced wildlife populations considerably and overharvesting of NTFPs has damaged populations of multiple plant species. Population growth and this shift in resource use have increased pressure on resources, even causing conflicts between villages for wetland resources. Deforestation is also severe, caused by logging and agriculture from villagers and the construction of roads and transmission lines by state-owned companies.

2.5.2.2 Bokeo Nature Reserve

Bokeo Nature Reserve (BNR) is part of the Nam Kan Provincial Protected Area, Bokeo Province, in northern Laos. The Nam Kan Provincial Protected Area was delineated in 1993 and the Bokeo Nature Reserve was established as an ecotourism concession in 1996 for The Gibbon Experience operation. In 2009 the status of the Provincial Protected Area was upgraded to National Protected Area. The high quality forest areas are known for the presence of the Laotian black crested gibbon (*Nomascus concolor lu*). The Provincial Forestry Department manages the

[10] Interviews: I1, I3, GD1

Bokeo Nature Reserve, with the assistance of The Gibbon Experience ecotourism operation. The area was primarily established as a destination for ecotourism, but the revenue from the operation is used for the conservation of the reserve and benefit of local residents (GE 2010).

In four villages of the BNR, the dominant ethnic groups are Khmu, H'mong and Lamet. Some of the cash incomes to the local residents come from ecotourism from The Gibbon Experience. Nevertheless, much of the livelihoods are derived from subsistence upland agriculture and non-timber forest products.

The primary threats to the gibbons and forest area are hunting, logging and development of a road. Local residents and outsides hunt for food and trade. Sawmills are established in the area, operated by outsiders but employing local people. A new road has been established in the south of the reserve as part of the Asian Development Bank's Northern Economic Corridor.

2.5.2.3 Nakai Nam Theun National Protected Area

Nakai Nam Theun (NNT) National Protected Area (NPA) is the largest protected area in Laos, located in Khammouane province on the border of Vietnam. The management of the area is for protection of the watershed, biodiversity conservation and sustainable development of local communities. Prime Ministerial Decree established the National Protected Area in 1993 through the national protected area system. The NNT stretches from the Annamite Mountains to the Nakai Plateau, which is now the site of a reservoir for the Nam Theun 2 hydropower plant. The NNT is recognised for it cultural and biodiversity values, and also for its function as a watershed (WMPA 2005).

Many villages are present on the Nakai Plateau (to the west of the protected area) and have been resettled as part of the development of the hydropower dam. There are, however, many villages within the NPA, consisting of approximately 6000 individuals and consisting of at least 28 linguistic groups. As the villages within the NPA are surrounded by forest, livelihoods of these people are predominantly based on shifting agriculture, livestock and forest products (including hunting and fishing).

The main threats to the area are hunting, infrastructure (especially for the hydropower dam) and logging. Hunting is a constant threat, as many of the wildlife populations are relatively low, and this threat may increase from the establishment of the reservoir. The establishment of the dam is itself a major issue because the required infrastructure reduces the habitats in the waterways and increases access to the core zone. Logging was recently a major issue because of the rosewood (*Dalbergia* spp.) trade to Vietnam.

Management of the area is currently under the Watershed Management and Protection Authority, who have been granted $1 million[11] per year for a 30-year period, in service of the Nam Theun 2 hydropower dam. Development NGOs, such as Care International, are assisting the recently relocated villages on the Nakai Plateau through health care and livelihood support.

2.5.2.4 Nam Et-Phou Louey National Protected Area

Nam Et-Phou Louey (NEPL) National Protected Area is on the border of three provinces, Luang Phrabang, Houaphan and Xieng Khuang, in northern Laos. Prime Ministerial Decree established NEPL in 1993, as two contiguous conservation

[11] In this thesis, all dollar values are expressed as United States dollars value in 2007.

areas. The area is recognised primarily for its population of tigers. The area is managed by the Department of Forestry, in collaboration with the Wildlife Conservation Society, who started operating a project in the area in 2003. The main goal of the conservation project is to protect and increase the populations of tigers (Lynam *et al.* 2006). Partnerships with development NGOs have also facilitated improvement in management practices, such as livestock rearing in the villages (interviews with NEPL staff[12]).

The 98 villages of the NEPL are in the management zone and bordering the protected area. The population is largely made up of three linguistic groups, the Tai Kadai, the Mon Khmer and the Hmong Mien. Livelihoods are largely dependent on shifting agriculture for rice and livestock, but residents also use forest resources extensively for food and trade.

Hunting is the main threat to tigers and their prey, done for both consumption and trade. Other threats to the area include overexploitation of forest resources, agriculture encroachment and fire. Agricultural encroachment is a particularly prominent threat in the region because of the use of slash-and-burn agriculture in the buffer and core zones.

2.5.2.5 Nam Kading National Protected Area

Nam Kading National Protected Area (NKD) is located in the foothills of the Annamite Mountains in Bolikhamxay province, central Laos. The protected area was established in 1993 through the national system of protected areas. The rugged site is important for its wildlife, especially the high diversity of fish, and subtropical broadleaf forests. The National Protected Area is managed by a partnership between

[12] Interviews: I2, I3

the Provincial Agriculture and Forestry Office and the Wildlife Conservation Society. In 2005, a donor funded project started in the area, the Integrated Ecosystem and Wildlife Management Project. The main aim is to conserve the globally important biodiversity of Bolikhamxay province to contribute to livelihoods of rural residents and the national economy (personal communication with the technical advisor to the project). Prior to the project in 2005, no previous conservation projects operated in the area.

The Bolikhamxay province has 33 different ethnic minority populations. The majority of the 25 000 people around Nam Kading are Muey. NTFPs and fishing constitute the major component of local people's livelihoods, as well as production of rice.

Local villagers prefer fish and wild meat as a source of protein rather than raising livestock, but these methods are often destructive and unsustainable. One of the other major threats comes from the Nam Theun 1 hydropower dam, currently under construction. This will flood approximately 10 000 ha, severely threaten aquatic wildlife and improve access to the area (WCS 2006).

2.5.3 Vietnam

2.5.3.1 Bach Ma National Park

Bach Ma National Park (BMNP) is on the border of Thua Tien Hue and Quang Nam provinces, central Vietnam. The area has a long history. It was established as a forest reserve in 1934 by the French administration, upgraded to a protected area, connected with Hai Van, in 1962 by the South Vietnamese

Government, and then Bach Ma-Hai Van was designated as a National Park in 1986 by the Council of Ministers. Bach Ma National Park was separated from Hai Van in 1991 and then the area was extended by 18 000 hectares in 2008. The area is preserved for its aesthetic beauty, and still boasts a high diversity of animals and plants due to its unique topography and climate on the coast of Vietnam (BirdLife 2004).

Local people in the buffer zone are mostly Kinh people, but there are also small populations of ethnic minority groups, the Ka Tu, Van Kieu and Muong. There are approximately 60 000 residents living in the buffer zone, some relying on forest resources in the buffer zone, but many undertaking agriculture and non-farm work, including tourism.

There are few threats to Bach Ma National Park, but issues of hunting and logging remain. Local residents hunt and log for subsistence use, but these activities have decreased in recent years. Infrastructure and agricultural encroachment are also considered minor threats to the area.

The objective of the National Park, managed by the Bach Ma National Park Management Board, under the Ministry of Agriculture and Rural Development, is to protect the biodiversity (interview with the head of the education section of the Management Board). In accordance with this objective, the National Park also aims to educate the wider community about conservation, promote tourism and enhance community development prospects. Multiple collaborations occur between the management board and NGOs, including Tropenbos, Deutscher Entwicklungsdienst, WWF, Helvetas and SNV (the Netherlands Development Organisation).

2.5.3.2 Cat Tien National Park

Cat Tien National Park is located in the provinces of Dong Nai, Binh Phuoc and Lam Dong in the south of Vietnam. During the Vietnam War the forest of Cat Tien was sprayed intensively with Agent Orange and subsequently logged. It was first established as a protected area in 1978, changed to a nature reserve in 1986 and then officially declared as a national park in 1998. Cat Tien National Park is a combination of three separate protected areas: Nam Cat Tien National Park, Tay Cat Tien and Cat Loc Rhinoceros Sanctuary. The Cat Tien Management Board, first established in 1992, operates the national park with the objective of conserving the local ecosystem and watershed of Tri An Reservoir and to provide opportunities for research and tourism (Morris & Polet 2004). The board is funded by Ministry of Agriculture and Rural Development (MARD) but also receives funds and collaborates with other government departments and international conservation organisations (including WWF and Winrock International).

As well as forests, which cover 86% of the area, Cat Tien also includes an extensive wetland, one of the last remaining natural wetlands in Vietnam. CTNP is recognised for the presence of the Javanese Rhinoceros, *Rhinoceros sondaicus annamiticus* (WWF 2005a).

Eleven ethnic groups live in and around CTNP. The majority group are is Kinh, and there are two indigenous minorities groups, Chau Ma and Stieng, and recent migrants (during the 1990's) from Northern Vietnam, including H'Mong, Hoa, Tay and Nung peoples. Indigenous people in the area have a long tradition of shifting cultivation, which involve mainly slash and burn and livestock rearing. The new migrants also fish and hunt, but concentrate more on farming. Other agriculture activities include growing cashews, maize, cassava and coffee.

Multiple pressures threaten CTNP, mainly driven from the population pressures in and surrounding the core zone, which has increased the demand for agricultural land. Hunting is an issue because of the high demand for luxury wild meats. Invasive species of plants (such as *Mimosa pigra*) and animals (such as the rhesus macaque *Macaca mulatta*) is also a threat to habitats and species (Polet & Ling 2004).

2.5.3.3 Song Thanh Nature Reserve

Song Thanh Nature Reserve (STNR) is on the border of Laos, central Vietnam, in Quang Nam province. The People's Committee of Quang Nam established the area in 2000. The conservation area has been recognised for the recent discoveries of Saola (*Pseudoryx nghetinhensis*) and is part of the Truong Son Ecosystem, as identified by WWF (2010c). Management of STNR is by a management board, through the Forest Protection Department of Quang Nam. WWF collaborates with the management board for improving conservation of tigers and wildlife. The main aim of conservation is to protect flora and fauna, enhance the socio-economic development of residents and protect cultural traditions (WWF 2005b). The IUCN also works in Song Thanh to improve the community-based natural resource management by people living adjacent to the core zone.

While few people live in the core zone, the population in the buffer zone is approximately 40 000 people. The main ethnic group is Kinh, but there are also other minorities including Ka Tu, Mo Nong, and Gie Trieng. Their livelihoods are based on agriculture and forestry in the buffer zone, including the collection of NTFPs such as rattan. Residents also undertake non-farm activities, including trade and gold mining.

There are multiple threats to STNR, the primary ones being hunting, logging, dams and mining. Hunting is commonly conducted for trade in wildlife, but local residents also hunt for food. Logging is a threat to some timber species but is not so damaging to habitats. Gold mining in the forest areas is an issue because of siltation and water pollution, thus threatening fish species. Two dams have been planned on the edges of the core zones, flooding the biodiversity-rich forests.

2.5.3.4 Tam Dao National Park

Tam Dao National Park is located on the Tam Dao mountain range, in northern Vietnam, on the borders of Vinh Phuc, Thai Nguyen and Tuyen Quang provinces. Tam Dao was established in 1977 as a nature reserve by Prime Ministerial Decision, and in 1996 was established as a national park by the Ministry of Agriculture and Rural Development. Tam Dao's unique location highlights its importance as a destination for domestic tourists, especially those from Hanoi, approximately 50 km south of Tam Dao. The Tam Dao National Park Management Board is in control of the area, but a conservation project has been operating since 2003 in partnership with Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ). The main aim of the management of Tam Dao is biodiversity conservation, education and improvement of local livelihoods (interview with technical advisor to GTZ). Other NGOs also operate in the area, including Education for Nature Vietnam for capacity building in conservation efforts, and development NGOs in the towns of the buffer zones.

The population of the area is large, with approximately 200 000 people living in the towns surrounding the park. The livelihoods of these residents, however, are based on agriculture and industry in the buffer zone, with little reliance on forest resources. Plantations of tree species, *Acacia* spp. and *Eucalyptus* spp., are also a source of income for many of the residents of the area.

The main threats to Tam Dao are fire, exploitation of forest resources and infrastructure. Fires occur every year and the mountain is susceptible to the rapid spread of fires. NTFP collection is a threat, with some of the residents going for medicines and other purposes, but logging has decreased recently. Hunting is still an issue, especially since populations of animals have greatly reduced in numbers over the past couple of decades. One of the main threats in the area comes from tourism infrastructure development, especially the recent plans of Tam Dao 2, a tourist town, which will clear 200 hectares of forest in the core zone.

2.5.3.5 Van Ban Nature Reserve

Hoang Lien - Van Ban Nature Reserve (VBNR) is located in Van Ban district, Lao Cai Province, in the northwest of Vietnam. VBNR situated in the contiguous stretch of protected areas along Hoang Lien Mountains. The reserve was recently established in 2007 to protect biodiversity, including the black crested gibbon (*Nomascus concolor*). The primary objectives of the reserve are to conserve biodiversity, wildlife and genetic resources, protect water resources and provide support to local people for livelihoods and awareness-raising of conservation (Tran *et al.* 2007). Up until the end of 2007, Fauna & Flora International provided support for planning and management of the reserve. A management board in the Forest Protection Department now manages the reserve.

Most of the population here are ethnic minority groups, including H'mong, Dao and Tay, who migrated to the area in the 1940's and a small minority of recently migrated Kinh people. Livelihoods of people are typical of northern upland Vietnam, including cultivation of cassava, maize, upland rice and livestock rearing. Local farmers also use the shade of the forest to grow cardamom (*Amomum aromaticum*).

Due to the small size of the forest, many of the local people's activities threaten the conserved area. Local people mainly hunt common animals for food, but outsiders also enter the area to hunt. Swidden agriculture and selective logging previously damaged the forest, but these threats are now diminished. Nevertheless, the cultivation of cardamom, which requires clearing the undergrowth, is considered a key threat to the area.

Chapter 3 Factors influencing conservation action

Part of the information referred to in the discussion of the conservation landscape (Section 3.3) and natural resource governance issues (Section 3.5) is sourced from a book chapter: Mai, Y. H., L. P. Preece, C. Colfer, L. N. Nguyen (2013) 'A review of conservation area governance in Cambodia, Laos and Vietnam' in: Sunderland, T., Minh-Ha, H. and Sayer, J. (eds.), 'Evidence-based conservation: lessons from the Lower Mekong', Earthscan, London.

3.1 Introduction

Biodiversity conservation is not an isolated field of practice. As discussed in Chapter 1, conservation actions operate within an historical, economic, social and political setting that has direct impact on conservation outcomes.[13] Of the wider societal issues influencing the implementation of conservation that are beyond the boundaries of conservation areas, economic development and natural resource governance are two primary challenges facing biodiversity conservation globally, identified by conservation scholars (Blench 1998; Sayer & Campbell 2004; Fisher *et al.* 2005; Sunderlin *et al.* 2005; Brockington *et al.* 2006; Adams & Hutton 2007; Buscher & Whande 2007; Ellis *et al.* 2010). In this chapter, I explore these two issues in relation to the forest conservation areas of the Lower Mekong countries.

Integrated conservation and development approaches generally attempt to implement sustainable resource development activities that will reduce overexploitation of resources by local residents through improvements to resource management practices (Hughes & Flintan 2001). Large-scale economic development arising from external actors can have a negative influence on conservation efforts. One of the most obvious direct impacts on conservation areas is from habitat change from industrial activities, such as mining, dams and other infrastructure developments (Millennium Ecosystem Assessment 2005). Large-scale economic development is driven by government and industry at the national level, and so is not easily addressed by ICDP approaches at the local level in conservation areas.

[13] Salafsky (2008, p. 99) defines conservation actions as “interventions undertaken by project staff or partners designed to reach the project’s objectives and ultimate conservation goals.”

A second factor that affects conservation is governance. Natural resource governance is defined by the International Union for the Conservation of Nature as "the interactions among structures, processes and traditions that determine how power and responsibilities are exercised, how decisions are taken, and how citizens or other stakeholders have their say in the management of natural resources – including biodiversity conservation" (Resolution 3.012 - IUCN 2005, p. 11). Conservation organisations globally use several types of governance strategies, such as regulatory tools to restrict the use of a resource or implement adaptive management (using a structured and iterative process of monitoring to enable projects to learn through experience), to benefit conservation outcomes (Lemos & Agrawal 2006; Kenward *et al.* 2011). Poor governance, such as through weak law enforcement (which leads to further degradation of habitats), weak property rights (which restricts the ability of local people to access resources), and corruption (which wastes the already limited financial resources), restricts the effectiveness of conservation (Swiderska *et al.* 2008).

These complex contextual issues are no less pertinent in the Lower Mekong countries. This chapter seeks to address the question, "What are the key economic and governance factors that influence conservation actions in the Lower Mekong countries?" This chapter sets the scene for the examination of conservation actions in the Lower Mekong and allows for exploration of the strategies of conservation and development interventions covered in the following chapters. Activities of conservation organisations are discussed further in Chapters 4 and 5 in relation to the threats to biodiversity and organisational strategies and partnerships. This chapter places the forest conservation efforts of government and non-government organisations in the wider historical, economic, political and social context of the Lower Mekong countries.

This chapter has six sections. Section 3.2 describes the methods used in this chapter. Section 3.3 describes the conservation sector of Cambodia, Laos and Vietnam, including the history of the Protected Area system, important ecosystems, government and non-government conservation actors and institutions (particularly the laws and multilateral environmental agreements). Section 3.4 examines the challenges to biodiversity conservation from major economic developments, including hydropower, mining, timber extraction, plantations and agriculture. Section 3.5 discusses the main constraints to effective governance of natural resources in the Lower Mekong states. Section 3.6 summarises and concludes about the status of conservation in the Lower Mekong countries and the constraints to the effective implementation of conservation interventions.

3.2 Methods

This chapter analyses some of the data from the variables of the 15 sites (see Appendix 1), qualitative results from the interviews and discussions from the field trips (as described in Chapter 2) and a review of the literature on the Lower Mekong within the broad areas of environmental management, environmental policies and large-scale economic development.

The topics of governance and economic development and impacts on biodiversity conservation discussed in this chapter arose from the process of developing the variables, particularly during the workshops in each of the countries, and my experiences in the field (the workshops, variable development and field trips are described in detail in Chapter 2). Throughout the workshops, conservation area managers mentioned several challenges that influenced the operation of their projects. These included conflicts among stakeholders (such as clashes between cultures of indigenous ethnic minorities and majority ethnic groups, and conflicts among government ministries), external threats from infrastructure development and weaknesses of local land tenure and law enforcement. Several issues were also identified during field trips and the review of literature, particularly the vagueness of the legal system, such as unclear and contradictory legislation, and the current problems with governance arrangements for conservation, such as disputes over the jurisdiction and responsibilities of ministries involved in environmental management.

In this chapter, I examine 10 variables related to economic development and governance for the 15 sites (Table 3-1; variables are described in Tables A1-1 to A1-5 of Appendix 1). Scoring for the ordinal variables was based on a 1-5 scale, with 1 indicating a low score and 5 indicating a high score. The score is supported by qualitative descriptors for each site and intervention. The scores are based on available information from interviews and documents at each of the 15 sites, and crosschecked with each other (as described in Section 2.3.3).

Qualitative results came from interviews at the sites, organisation and government staff. Between five to twenty-seven semi-structured interviews were conducted at each of the 15 sites during 2007 and 2008, each lasting between 30 minutes and two hours. Informants interviewed included government staff from the departments operating the conservation areas, staff from international conservation organisations, forest guards and local residents working or living in forest conservation areas. The interview results used in this chapter are coded by site and status of the informant (see Table 2-3 and methods for data collection in Section 2.3.3.1).[14]

The literature review on the environmental, historical and political context and evolution of the conservation sectors in the Lower Mekong covered peer-reviewed journals, published reports from organisations, organisation web pages, project and government reports, general statistics and policy documents up to the end of 2010. The main sources of project reports, government reports and statistics were from libraries in the main offices and field offices of the organisations and government departments in each country.

Additional information came from a draft paper by Y. H. Mai, L. D. Preece, C. Colfer, and L. N. Nguyen (2012) at CIFOR, entitled 'A review of conservation area governance in Cambodia, Laos and Vietnam,' and personal communications with R. Oberndorf, T. Sikor and K. Marion Suiseeya, who reviewed the draft of that paper.

3.3 Environmental, historical and political context of conservation

In the early 20th century, Cambodia, Laos and Vietnam were part of the French territories of Indochina (roughly the same geographic area as the Lower Mekong). Under French occupation, forest services were set up in Vietnam (the territories of Tonkin, Cochinchina and Annam) in 1901 and 1903, and in Cambodia in 1903 (Cleary 2005). By 1920, forest reserves covered approximately 1.3 million

[14] Interview codes begin with a site name, followed by the status of the interviewee (I = staff member or manager of the conservation organisation; O = staff member of another organisation in the conservation area; V = resident of local village or commune; G = forest guard working in the conservation area; GD = group discussion with multiple informants) and a number. For example: SBCA I1 is an interview with the first staff member of the Wildlife Conservation Society, which is managing the Seima Biodiversity Conservation Area.

hectares of the 25 million hectares of forest in Indochina. The forest reserves were set up for ecological and economic reasons, primarily to preserve the environmental role of the forest cover for watersheds and for the management of several economically valuable forest products (including timber), but also to exclude the indigenous people who used the forest areas for shifting cultivation (Cleary 2005). Since decolonisation in the 1950's, conservation imperatives have continued to be a priority in the agenda of national governments of the Lower Mekong states and both government and non-government environmental agencies have grown to become powerful actors in the conservation sectors, as described in the following sections.

Conservation in the Lower Mekong region involves multiple actors, including the central government (with its line ministries and local authorities), civil society (including NGOs and donors), the private sector (business and industry) and local communities. Many local, national and international organisations have implemented conservation interventions in the Lower Mekong, often combined with the aim of local livelihood development (following the trend of the ICDP discourse, discussed in Chapter 1) or at least to mitigate the impact of conservation on the people living in or adjacent to these areas (Robichaud *et al.* 2001; Sage & Nguyen 2001; ICEM 2003a; Brooks 2006). Governments are key decision-makers in conservation practice, as power is centralised both politically and fiscally (Eng & Craig 2009; Milne 2009; Singh 2009a; Pham *et al.* 2010), but international conservation organisations also have considerable power in decision-making, where they influence the governments' actions through technical advice, finances and on-the-ground human resources (personal observations and consistently repeated in interviews with many staff members of the organisations managing 14 sites[15]). International conservation organisations also have the skills to improve the government capacity to implement conservation policies and assist the government in adhering to Multilateral Environment Agreements (Steiner *et al.* 2003), hence collaborations between government and NGOs are thus one of the key tools to implement conservation interventions (see Chapter 5).

In the following sections I describe the conservation sectors of each country, including the history of protected area establishment, the key organisational actors involved in biodiversity conservation and management, and the national laws, conventions and policies related to conservation in the Lower Mekong.

3.3.1 Cambodia

In 1925, Cambodia was the first country in Southeast Asia to identify a protected area, the 10 800 ha Angkor Temple complex (ICEM 2003c). Between 1864 and 1953, the French administration developed 173 forest reserves for future timber production (Milne 2009). The trend continued following independence, and in 1969, six national parks were established covering 2.2 million ha (12% of the country's total area – ICEM 2003c). In November 1993, His Majesty King Norodom Sihanouk designated 23 areas forming the National Protected Area System (which include national parks, wildlife sanctuaries, protected landscapes and multiple-use areas) through the *Royal Decree on the Creation and Designation of Protected Areas 1993* (Miller & Shields 2004).

[15]Interviews: SBCA I1, I2; CCPF I1; VNP I1; MPF I5; PSWS I5, I6; BNP I1, O1; STNR I2; TDNP I2; VBNR I1; NEPL I1; BNR I3; BCI I1; NKD I1; NNT I1, I2.

The total area of national parks covers 3.3 million ha (18% of the country's land area), according to International Union for the Conservation of Nature Categories I-IV (Miller & Shields 2004). In addition to this, eight protected forests were established between 1996 and 2004 (Milne 2009) as part of the permanent forest reserve system, bringing the coverage of conservation areas to 4.6 million hectares, or 25% of Cambodia, in 2004 (Milne 2009). One more protection forest was added to this system in 2009, the Seima Protection Forest, covering 292 000 ha (WCS 2009b).

Forest cover estimates of Cambodia over the past eight years are estimated at between 58% and 63% (ICEM 2003c; TWGFE 2006; FA 2008). The majority of forests are dominated by the Dipterocarpaceae, and are classed as deciduous (46%), followed by evergreen (36%) and semi-evergreen (14%; FA 2008). One of the most iconic areas of Cambodia is the Tonle Sap lake, which holds valuable flooded forests that are protected by a Multiple-Use Area of 316 250 ha, also recognised by the United Nations Education, Scientific and Cultural Organisation as a Biosphere Reserve (ICEM 2003c). The Lower Mekong Dry Forest in the north and east of Cambodia covers an area of 6.25 million ha, which is one of WWF's Terrestrial Global 200 Ecoregions and is recognised for its high diversity of large mammals (WWF 2010b). Another key area for natural habitats is the Cardamom Mountains, an area of over 1 000 000 ha in the southwest of Cambodia that boasts a high diversity of habitats and fauna (FFI 2010). Cambodia also contains over 200 species on the IUCN Red List (WWF 2010b), including 45 mammal, 46 bird and 17 reptile species (Clements *et al.* 2009).

Cambodia has been through a period of intense internal turmoil, especially during the Khmer Rouge regime from 1975 to 1978, from which it has slowly recovered with international support and governance reforms. Since the early 1990's, the country has undergone rapid integration into a market economy, which involved reinforcing elite power, facilitating foreign investment and elevating the role of NGOs (Milne 2009). The number of non-government organisations in the country increased dramatically over the past 20 years, from the first local NGOs in 1992 to over 1000 local and international NGOs in 2009 (CCC 2009). In 1999, the International Monetary Fund provided USD $82 million to assist the country to protect macroeconomic sustainability and improve the economy, including poverty reduction (IMF 1999).

In accordance with the Millennium Development Goals (MDGs), Cambodia set out a set of goals for poverty reduction and human development in its National Strategic Development Plan 2006-2010 (GoC 2006). This plan incorporated the previous two strategies, the first called the 'Triangle Strategy', from 2001-2005, of peace, stability and security, and the second called the 'Rectangle Strategy', adopted in 2004, of growth, employment, equity and efficiency (GoC 2006). These strategies included a key goal for improved forest management through reform of the forestry sector, which has had some success in strengthening forest law enforcement and governance (Pescott *et al.* 2010).

Cambodia has ratified several multilateral environmental agreements, including the Convention Concerning the Protection of the World Cultural and Natural Heritage (the World Heritage Convention) in 1991, the CBD in 1995 (CBD 2010d), CITES in 1997 (CITES 2010) and the Convention on Wetlands of International Importance (the Ramsar Convention) in 1999 (Ramsar 2010b). Since the establishment of the National Protected Area System in 1993, Cambodia has developed and revised a series of laws and policies related to forest conservation

(Miller & Shields 2004). The *Law on Environmental Protection and Natural Resources Management 1996* was developed to protect, conserve and manage natural environments, and prevailed over previous laws. The government also passed the *Land Law 2002, National Forest Policy 2002*, the *Forestry Law 2002* (Miller & Shields 2004) and the *Community Forestry Sub-Decree 2003* (Sunderlin 2006). The most recent law concerning conservation is the *Protected Areas Law 2008* (Ramony 2009).

Currently, the Ministry of Environment and the Ministry of Agriculture, Forestry and Fisheries are the two main government sections that are officially responsible for the forestry sector (Luttrell 2007). The Ministry of Environment has the mandate to protect Cambodia's natural resources and prevent environmental degradation. Within the Ministry of Environment, the Department of Nature Conservation and Protection is responsible for the management of protected areas and wildlife sanctuaries at the provincial level (Hobley 2004a). The Ministry of Agriculture, Forestry and Fisheries has responsibility for the major productive resources in the rural economy (Hobley 2004a), but also has a mandate to develop community forestry. At the provincial level, the Forestry Administration, part of the Ministry of Agriculture, Forestry and Fisheries, is responsible for the management of the system of permanent forest reserves, including Protected Forests and Biodiversity Conservation Areas (Miller & Shields 2004). There are also three other ministries that affect conservation-related activities: the Ministry of Land Management Urban Planning and Construction, which governs land-use across the country; the Department of Mineral Resources within the Ministry of Industry, Mines and Energy, which authorises mineral exploitation within conservation areas

(Shields *et al.* 2004); and the Ministry of Water Resources and Meteorology, which leads hydropower development in the country (R. Oberndorf pers. comm., 11/2009).

Part of the operational responsibility for implementing conservation falls on NGOs, with the Department of Nature Conservation and Protection and Forestry Administration staff seconded to work with conservation NGOs (Hobley 2004b), such as Fauna and Flora International (FFI) in Phnom Samkos Wildlife Sanctuary and Wildlife Conservation Society (WCS) in Seima Biodiversity Conservation Area. Some of the responsibility of conservation NGOs, including WCS, FFI, Conservation International, and the World Wildlife Fund for Nature (WWF), is to advise the government in drafting laws, through consultation, and assist in the socio-economic development of the poor, through integrated conservation and development projects. International conservation organisations are also instrumental in providing technical assistance for the management and protection of forest areas. A considerable proportion of the millions of dollars worth of funding for forest conservation come from donor assistance through these organisations and others, such as the Mekong River Commission, Deutsche Gesellschaft für Technische Zusammenarbeit GmbH (German society for technical cooperation - GTZ) and the Danish International Development Agency. The activities of NGOs and government at the site level are discussed further in Chapter 5.

3.3.2 Laos

The National Protected Area system of Laos was a relatively recent development, first proposed in the late 1980s (Robichaud *et al.* 2001). Eighteen areas were established following the 1992 Rio Earth Summit, by the promulgation of *Prime Minister's Decree 164 1993* (Robichaud *et al.* 2001; Bugna 2002b). Two more protected areas were established in 1996, and another in 2008, which then increased the coverage of protected areas to 14.9% of Laos, including two biodiversity corridors (Chanthakoummane & Tsechalicha 2008). In addition to these areas, there are also approximately 80 provincial conservation and protection forests and 196 district conservation and protection forests (MAF & STEA 2003). In all, the total conservation land covers over 23% of the country (MAF & STEA 2003).

The forest cover estimates of Laos are between 30% and 40% (Singh 2009a). One of the most important geographic features of Laos is the Mekong River, which flows from north to south of the country. The Mekong river supports much of the livelihoods of the Lao people and contributes to 52% of the Gross Domestic Product of Laos (MAF & STEA 2003). Robichaud (2001) reports that apart from the Mekong River, there are five areas with habitats of international significance, including the Annamite Mountains forests, Central Indochina limestone karst, the Mekong Plain dry Dipterocarpaceae forests, the Bolavens Plateau and the Northern Highlands. Four of WWF's Global 200 ecoregions are also within Laos. The country is home to 166 species of reptiles and amphibians, 700 species of birds, over 100 species of large mammals, and between 8000 and 11000 plant species (STEA 2004). Much of the region's 87 families of fish are found in Laos (MAF & STEA 2003). Also, the IUCN Red List (2010) reports 129 threatened species in Laos, including 45 mammal, 21 bird, 11 reptile and 21 plant species.

Although less tumultuous than Cambodia, Laos has also been through periods of conflict, first following its independence in 1954, then during the Vietnam-America war (1955 to 1975; also referred to as the Second Indochina War) when Laos was heavily bombed, and then subsequently in 1975 with the revolution from kingdom to republic, which removed 90% of the educated classes in Laos

(Stuart-Fox 2006). Prior to 1975, the impact from resource use was relatively low. During the late 1970's and 1980's, however, the forests were heavily logged and poorly managed (Manivong & Sophathilath 2007).

The government of Laos has implemented the National Environmental Action Plan to 2010 and a National Biodiversity Strategy to 2020, which was endorsed in 2004 (STEA 2004). Similar to Cambodia, Laos has ratified the CBD in 1996 (CBD 2010d), World Heritage Convention in 1995 (Robichaud *et al.* 2001) and became a member of CITES in 2004 (CITES 2010). Most recently, Laos has acceded to the Convention on Wetlands of International Importance for two wetlands in the south of Laos, which came into effect in September 2010 (Ramsar 2010c), after a seven year dialogue at the national level (WWF 2010b). The Laos government also developed its sixth National Socio-Economic Development Plan 2006-2010, which has targets that coincide with the MDGs. The plan also includes the goals from the national environment strategy, which, in accordance with the sustainable development of the country, has the overall aim to improve sustainable use of natural resources and protect and conserve the environment (GoL 2006).

The first conservation-related regulation was established in 1979 (*Instruction on Forest Management and Protection 1979*), which was replaced with a *Decree on Management and Use of Forest and Forest Lands 1989* (Manivong & Sophathilath 2007). The management of forests has continued to change as the legal system has been developed over the past 20 years (Robichaud *et al.* 2001). More advanced forestry institutions were initiated during the National Forestry Conference in 1989, which led to the Tropical Forestry Action Plan in 1990 and the National Environmental Action Plan in 1994 (Robichaud *et al.* 2001). Following Decree 164 which was enacted to establish the National Protected Area system in 1993, the first law related to conservation, the *Forestry Law 1996*, followed by the *Environmental Protection Law 1999* (STEA 2004) were enacted. The *Forestry Law 1996* has recently been updated in 2007, along with the establishment of a new *Wildlife and Aquatic Life Law 2008* (Boungnakeo 2008; Pescott *et al.* 2010).

In Laos, the main forest and land management responsibilities lie with the Ministry of Agriculture and Forestry (Manivong & Sophathilath 2007). There are several other government agencies under the Ministry of Agriculture and Forestry. The Department of Forestry focuses on policy development and legislation, as well as monitoring and macro-level assessments. The National Agriculture and Forestry Research Institute and the National Agriculture and Forestry Extension Service address implementation of government policies at the local level, working with Provincial Agriculture and Forestry Offices and District Agriculture and Forestry Extension Offices (Fitriana et al. 2009). Other government actors include: 1) the Science, Technology and Environment Agency, which is the manager, monitor and coordinator of environmental projects and policies at the national level; 2) the National Tourism Authority, which has an interest in tourism enterprises within the National Protected Areas; 3) the Hydropower Planning Office, which is cooperating with environmental departments to plan the commitment of resources for hydropower; 4) the Customs Department, under the Ministry of Finance, which is responsible for regulating trade across the borders; 5) the Ministry of Education, which is in charge of environmental education programs and the National University of Laos that delivers courses in conservation and forestry; and 6) Ministry of Defence, which manages Phou Khao Khoay, one of the national protected areas (Robichaud et al. 2001; Manivong & Sophathilath 2007; World Bank 2005). The new Department of Forest Inspection has the responsibility to monitor and investigate illegal activities, including the authority to make arrests, but also collaborates with the private sector and civil society in efforts to improve law enforcement (Boungnakeo 2008).

Donors, international organisations and international NGOs are important for the implementation of conservation in Laos, where civil society and government capacity is weak (Manivong & Sophathilath 2007). Over the past 20 years, Laos has received increased international support for conservation, including from organisations that have funded projects and programs with technical and financial support for the development of models on forest management and species conservation. In particular, the Lao-Swedish Forestry Programme and the IUCN were instrumental in funding and initiating conservation actions, including the development of laws and regulations (Robichaud *et al.* 2001). They have also supported the forestry action plans of the government (Fujita 2004), tested and developed a legal framework, and contributed to human resource development in the country (Rafiqui 2007). The Swedish International Development Agency is assisting the Laotian Government in institutional development for environmental management through two major projects, the Lao Swedish Upland Agriculture and Forestry Research Programme and the Strengthening Environmental Management project (Rafiqui 2007). Other intergovernmental organisations and donors provide experience and training for conservation efforts and biodiversity research and support community based management of forests in Laos. Support agencies include the World Bank, Finnish International Development Agencies, the Asian Development Bank, Japanese Bank for International Development Cooperation, IUCN, the Netherlands Development Organisation (SNV), Food and Agriculture

Organisation and International Development Research Centre (Manivong & Sophathilath 2007).

In the 1990's, 18 out of 20 National Biodiversity Conservation Areas (now National Protected Areas) received international investment (Fujita 2004). Currently, an internet listing of NGOs in Laos recorded 67 organisations and 237 projects, 38 projects which were concerned with natural resources and ecology (NGOs 2010). International organisations supporting conservation include WWF (which is leading several projects through the Biodiversity Corridors Initiative), WCS (involved in the management of Nam Et-Phou Louey National Protected Area), SNV and the Global Association for People and the Environment.

3.3.3 Vietnam

Vietnam has a long history of protected areas, with the first proposal to create a national park in Bach Ma – Hai Van in 1925 (although Bach Ma National Park was finally established in 1991; Fife 2009). Ho Chi Minh established the first protected area, Cuc Phuong Protected Forest, in 1962, which in 1966 became the first national park. Following this, in 1986, 73 new special-use forests were established through a Prime Ministerial decision. Then in 1991, seven national parks were established across the country (Tran 2006; Pham *et al.* 2008). Vietnam currently has 126 protected areas under the nationally defined category of 'Special Use Forests', including 26 national parks, two Ramsar Convention sites and four biosphere reserves. The protected areas cover a total of 7.6% of the land area (CBD 2010b).

Some of Vietnam's important ecological features are as a result of its wide range of latitudes and altitudes, and a long coastline with a variety of marine and coastal habitats (Zingerli 2005; Sterling *et al.* 2006). Due to the diverse geographies, forest types range from mangrove on the coasts and in the Mekong Delta, wetlands, such as in Cat Tien National Park, and dry dipterocarp, evergreen, temperate, pine and montane forests. Vietnam also has 15 terrestrial and 3 marine eco-regions (CBD 2010b). Although there are differences in the actual numbers reported in the literature, Vietnam is likely to hold over 15 000 plant, 310 mammal, 840 bird, 260 reptile and 120 amphibian species (Earth Trends 2003; Le 2004; CBD 2010b). The Northern highlands boast a high diversity of birds, amphibians and plants, and the Western Black Crested Gibbon, *Nomascus concolor* (Swan & O'Reilly 2004). The central highlands are another important area for biodiversity, with the presence of the recently discovered Saola, *Pseudoryx nghetinhensis* (WWF 2010c), and in the south, the Javan Rhinoceros *Rhinoceros sondaicus annamiticus* (WWF 2010a).

One of the most important recent events in Vietnam's history was its war with America from 1955 to 1975. During this time, herbicides (Agent Orange[16]) devastated the forest areas, and a large volume of forest timber was used for military operations (De Koninck 1999). In the 1980's, deforestation increased as government reforms shifted people from lowland areas to forested mountain regions in an attempt to improve the economy (Meyfroidt & Lambin 2008). As a result of the post-war economic development initiatives and government policies of the 1980's, much of the forests were cleared and the forest cover dropped to 25% in the early 1990's (Meyfroidt & Lambin 2008). Vietnam's environmental strategies, including the establishment of Special Use forests, were developed from the mid 1980's in collaboration with the IUCN (Fife 2009). In the mid 1990's the government established tree planting campaigns, through *Decree 327 1992*, followed by the Five

[16] Agent Orange is mixture of equal parts 2,4-dichlorophenoxyacetic acid and 2,4,5-trichlorophenoxyacetic acid.

Million Hectare Reforestation Program (Decision No. 661) in 1998, with the aim of increasing forest cover to 43%, albeit with few, mostly exotic, species planted (Meyfroidt & Lambin 2008). During the same period (1980's and 1990's), Vietnam's economy grew rapidly, which had an effect on the reduction of poverty.

Hundreds of laws and regulations and a series of policies related to the environment and conservation have been enacted in Vietnam since 1991, when Vietnam established its national park system (UNEP 2001). The *Law on Forest Protection and Development 1991* detailed three management categories of forest-land: production, protection and special use (ICEM 2003e), which was subsequently revised in 2004, with increased attention on community forest management (Nguyen 2008). Also in 1991, the first National Plan on Environment and Sustainable Development, 1991-2000 was approved (UNEP 2001). The *Law on Environmental Protection 1994* was established to raise the ability at national levels to manage environmental issues (UNEP 2001), and updated in 2005 (CBD 2010b). In 2003, the *Management Strategy for a Protected Area System 2003* (Decision 192) was established within the sustainable development framework. More recently, Vietnam has approved the National Action Plan on Biodiversity (CBD 2010b) and National Forest Strategy in 2007 and approved the *Biodiversity Law 2008* (Pescott *et al.* 2010; WWF 2010b). Vietnam ratified the CBD in 1993 (CBD 2010d), the World Heritage Convention in 1987 (UNESCO 2010b), CITES in 1994 (CITES 2010) and Ramsar Convention in 1989 (Ramsar 2010b). The Vietnamese government implemented the Comprehensive Poverty Reduction and Growth Strategy in 2002, which was a strategy that addressed poverty alleviation through improved natural resources management (ADB 2006). This strategy was also included in the Socio-Economic

Development Plan 2006-2010, also aligned with the MDGs, aimed for an increase in forest cover to 43% (ADB 2006).

The Ministry of Agriculture and Rural Development has overall responsibility for managing the Special Use Forest system, which includes a system of national parks, nature reserves, and cultural historic environmental sites (ICEM 2003e). The Ministry also reviews budget allocations for Special Use Forest management boards and oversees implementation of the Five Million Hectare Reforestation Program, which supports Special Use Forest management through protection contracts and reforestation activities. The Ministry also carries out surveys, and plans and develops investment projects for establishing Special Use Forests (ICEM 2003e). In the past, national parks were under the direct management of the Ministry. At present, only eight national parks are under this agency's direct management, with the other parks and national nature reserves managed by local governments (ICEM 2003e). The Forest Protection Department is responsible for forest protection nationwide and the Fisheries Department is in charge of marine protected areas.

The Ministry of Natural Resources and Environment is responsible for implementing the Ramsar Convention and the Convention on Biological Diversity and coordinating the implementation of Vietnam's Biodiversity Action Plan (ICEM 2003e). Apart from its role in designating protected areas, the ministry has no mandate to manage Special Use Forests (T. Sikor pers. comm., 11/2009). Other ministries also involved in conservation include the Ministry of Planning and Investment, Ministry of Culture and Information and the Governmental Office. The Ministry of Planning and Investment, through the annual budgeting process, is responsible for setting funding levels and negotiating budget allocations, including the budget for protected areas, with ministries and the provinces. The Ministry of Culture and Information, together with the Ministry of Agriculture and Rural Development, has the responsibility for managing cultural-historic-environmental sites (ICEM 2003e). The provincial governments also play a large role in protected area management, especially by managing the Nature Reserves and assisting with the management of National Parks.

Vietnam has received considerable support from international organisations and NGOs for natural resource management, particularly in the implementation of the Five Million Hectare Reforestation Program (1998–2010). Over 20 donors committed support for the program with MARD. Loans from the World Bank, the Asian Development Bank and the Japanese Bank for International Development Cooperation are also being assigned to projects under the Five Million Hectares Reforestation Program (Do *et al.* 2005). Also at the national level, conservation organisations such as WWF have supported the strategy and development of the system of parks in Vietnam (Stolton *et al.* 2004). The IUCN is also working to support national environmental strategies and action plans of the government since the early 1980's (IUCN 2007b).

International conservation organisations and development NGOs also play key roles in forest protection. The concept of ICDPs developed during the 1990's, with a dramatic increase in projects from 1997 (Sage & Nguyen 2001). Many organisations are working in partnership with government departments (particularly the Forest Protection Department) to manage national parks and Special Use Forests, such as GTZ in Tam Dao National Park, WWF in Song Thanh Nature Reserve and Cat Tien National Park, and FFI in Van Ban-Hoang Lien Nature Reserve. Other donors and conservation organisations also work in Vietnam, including the IUCN, the Global Environment Facility and the Japanese Bank for International Development Cooperation (Pham *et al.* 2008).

3.4 Economic development influences on biodiversity conservation

Alongside the development of the conservation sectors, from the mid 1980's each of the three countries opened up their economies to international markets and allowed foreign investment with the intent of speeding up economic growth. Prior to the Asian economic crisis of 1998, 'miracle' economic growth (Malhotra 1999) was linked to an explosive increase in pollution, rapid deforestation, loss of habitats and environmental degradation. It has been argued by Malhotra (1999) that the state-dominated economic development model pursued by Cambodia, Laos and Vietnam ignores the environmental costs of industrialisation, instead using natural resources as a comparative advantage over other states in Southeast Asia.

Perhaps one of the greatest challenges facing conservation efforts is the economic development imperatives of the countries. Economic development is a necessary endeavour of each of the governments to improve living standards and reduce poverty. The imperatives are partly represented by the national economic development plans and policies, and are often supported by industries (such as mining and hydropower companies) and are influenced by trends in the consumption of resources (such as timber). Economic development will invariably involve land-use changes that result in a transformation of natural capital (such as stocks of soil, water and air or environmental services) to financial capital (such as cash, credit or savings), through commoditisation of natural resources and increased connection with regional and global markets (Malhotra 1999; Billon 2000; Ingles & Hicks 2004;

Sunderlin & Ba 2005; Stuart-Fox 2006; Sneddon & Fox 2008). The recent wars in each of the Lower Mekong states, however, stalled the transformation of natural to financial capital, impacting on the development pathways of each country. In Cambodia and Laos these past conflicts resulted in up to 90% of the educated classes being lost (Stuart-Fox 2006). In Vietnam, the Second Indochina War also came at a high cost to physical capital (such as roads or buildings), lost economic opportunities and failed development programmes (Stuart-Fox 2006).

Over the past 10 years the national governments in the Lower Mekong have been striving for economic development through large-scale infrastructure investments, such as roads, dozens of hydropower dams and extractive mines, which extend over hundreds of thousands of hectares of land (Sage & Nguyen 2001; Alyward & Tognetti 2003; Carew-Reid 2003; Gillison 2007; Robichaud *et al.* 2009; Singh 2009a, b). Part of the development strategies of the governments is to grant concessions to international investors for mining, agriculture, forestry and hydropower – dozens of which overlap forest conservation areas (Baumuller 2008; WRM 2008; Global Witness 2009), and thus have the potential to increase the destruction of natural habitats. Investments from other countries, particularly China, constitute a part of the support for these developments. The Chinese government and several Chinese companies have invested in multiple large economic projects, especially for mining (particularly bauxite), agribusiness (which includes multiple crops, but especially rubber) and hydropower (Rutherford *et al.* 2008). These large-scale developments have a high potential for environmental damage (Rutherford *et al.* 2008).

In Cambodia, Chanrithy (2010) identified 16 threats, of different severities and impacts, to five protected forests. Among the threats identified, land encroachment was the most severe and other key threats included infrastructure development and land concessions for natural resource-based industries. In Laos, rapid growth and expansion of the economy has led to unforseen environmental costs, including the depletion of species through illegal timber and wildlife trade, pollution and land degradation (Greenwood 2008). In Vietnam, drivers of population growth, migration and poverty lead to threats such as land clearing for agriculture, infrastructure construction, logging, firewood collection, non-timber forest product collection, invasive species, fires and pollution (GEF 2010).

A comparison of threats to conservation areas in the 15 sites in the Lower Mekong is explored further in Chapter 4, but several require special consideration in this chapter, because they are largely driven by national level economic development policies and trends in consumption of resources in the region. Below I discuss five large-scale economic trends in the region that have the greatest effect on conservation of forests in the Lower Mekong, 1) hydropower, 2) mining, 3) timber extraction, 4) plantations, and 5) agriculture.

3.4.1 Hydropower

Hydropower is an important aspect of economic development in each country. Hydropower dams threaten eight of the 15 sites (a score of over 1; Variable 41 in Table 3-1), two of which (in CCPF, Cambodia, and NKD, Laos) are likely to have a severe impact when built. Hydropower dams have a direct impact on the core zones of the conservation areas from flooding, but also have an indirect threat from increased access for logging and hunting. Hydropower dams are not only a problem because they are detrimental to the ecosystems, but they provide limited benefits to the local communities (Alyward & Tognetti 2003) and outcompete conservation as a land use of forestlands because dams are more economically viable in the short-term for economic growth (Vaidyanathan 2011).

Table 3-1 Results of the variables for discussions of the characteristics related to conservation actions. Variable descriptions are in Appendix A1. Abbreviations for sites are presented in Table 2-1. Scoring: 1 = low, 5 = high. [a]While multiple types of production forest might exist in each area, we only record the dominant type.

#	Variable	Vietnam					Cambodia					Laos				
		BMNP	CTNP	STNR	VBNR	TDNP	CCPF	SBCA	PSWS	VNP	MPF	NNT	BCI	NKD	BNR	NEPL
Variables that relate to economic development challenges for biodiversity conservation (Section 3.4)																
18	**Production forest (proportion out of 10)**	2	0	0	0	3	0	0	0	0	0	0	2	0	0	0
19	**Agriculture (proportion out of 10)**	2	2	2	1	3	0	0	1	1	1	1	1	1	1	2
20	**Production forest type[a]**	*Acacia*	none	*Acacia*	pine	*Acacia*	peanut	pine	none	cashew	rubber	none	coffee	eucalypt	rubber	none
28	**Logging threat (score)**	2	2	2	3	3	3	3	4	2	2	4	3	3	4	2
41	**Dam threat (score)**	1	3	3	1	1	4	1	2	2	2	3	1	5	1	1
44	**Mine threat (score)**	1	1	2	2	2	2	3	2	4	2	2	1	1	1	1
Variables that relate to governance challenges (Section 3.5)																
115	**Enforcement capability (score)**	4	4	2	2	3	4	3	3	4	5	3	1	3	2	4
126 by 1	**Budget density ($ per km^2)**	2542	972	85	273	3254	187	322	136	217	142	245	3118	219	267	67
126	**Budget of manager (x$1000)**	560	700	72	70	1200	750	500	400	700	425	1000	330	350	200	200
128	**Source of funding (score)**	4	5	4	2	2	2	2	2	3	1	1	1	2	1	2

A large part of the investments for Cambodia and Laos come from Chinese companies. Only 30% of the population in Cambodia have access to electricity, so the Royal Government of Cambodia is approving the construction of 10 Chinese invested dams (Rutherford *et al.* 2008). Yet in Laos, proposals to dam the Mekong River present serious ecological and economic implications for Cambodia, particularly because of the impact on the flow of the Tonle Sap lake, which affects Cambodian fisheries (Lang 2008). Hundreds of NGOs have requested the Mekong River Commission (which is responsible for the coordination of developments on the Mekong River) to take action against the proposed hydropower dams (Lang 2008). WWF has also called for a 10-year deferral of the construction of 11 Mekong dams in Laos, Thailand and Cambodia until more sustainable techniques can be developed (WWF 2010d).

In Vietnam, hydropower is state-owned, and the government's chief concern is to develop the economy through provision of electricity (Rutherford *et al.* 2008). In 2008, there were 11 large (over 50 MW) operational hydropower dams. By 2025, Vietnam plans to have 48 more dams exceeding 50 MW each. One particularly intense area for hydropower development in Vietnam is Quang Nam Province, where 40 dams have been planned. These will severely impact the areas that overlap with the nation's conservation forests, as they will clear forest areas, destroy aquatic habitats and disturb the biological and ecological systems (Alyward & Tognetti 2003). They will have negative consequences for local people downstream, affecting their agricultural practices through changes in hydrological flows and soil erosion (Goichot 2008).

3.4.2 Mining

While the overall threat from mining to the 15 sites is lower than that of hydropower dams, nine sites are threatened by mining (a score of over 1; Variable 44 in Table 3-1), including every site in Cambodia. Similar to that of hydropower, mining outcompetes conservation as an economic land use in forestlands (Naughton-Treves *et al.* 2005; Sunderlin *et al.* 2005). Vietnam is mineral rich, and more than 50% of the minerals are exported to China; in 2007, this totalled 20% of the exports from Vietnam (Rutherford *et al.* 2008). Mining in Laos is still small-scale, but the national poverty reduction strategy includes mineral exploitation, so it is expected to expand (Rutherford *et al.* 2008).

In Cambodia, several industries have been granted mining concessions and exploration licenses that overlap with six conservation areas (Global Witness 2009). One case is in Virachey National Park, where interviewees reported that the Ministry of Infrastructure, Mines and Energy had granted licenses to Australian and Indochinese companies to explore for minerals, which is against the policies of the Ministry of Environment.[17] In total, the exploration licenses by mining companies cover 180 000 ha (54%) of Virachey National Park (Global Witness 2009).

The investments into mining in Cambodia come from Australia, China and several other countries, and are used for the exploration for a range of minerals, including bauxite, copper and gold (Rutherford *et al.* 2008). Global Witness (2009) suggests that the biggest problem, however, is that the Cambodian government is selling parcels to international companies for private investment, instead of using its mineral resources domestically to rebuild infrastructure and reduce poverty.

[17] Interviews: VNP I4 and I5.

3.4.3 Timber extraction

Timber extraction has been a part of the economic objectives of natural forest areas since the first decades of the 20th century, when Indochina was controlled by the French (Cleary 2005). Now, at the beginning of the 21st century, the trade in timber continues to be an important aspect of economic development in each country. In Cambodia during the 1990's, 33 forest concessions were granted by the government (The Inspection Panel 2006), and between 1991 and 1998, Cambodia exported approximately $2.5 billion worth of timber, equivalent to the annual Gross Domestic Product in that period (Billon 2000). In Laos, during the last decade, National Protected Areas provided a source of timber, as the system covers 75% of productive forests (Singh 2009a). The high intensity of logging of natural forests in Laos contributed to the economic development of the country, but local people did not receive a benefit and it hindered conservation efforts (Morris *et al.* 2004). By 2005, Cambodia and Laos supplied an estimated half a million cubic metres of timber to Vietnam, which was then processed into furniture of which over half was sold to United States and European markets (EIA & Telapak 2008). As the timber industry in Vietnam continues to thrive, there has been a push towards increasing timber plantations in the country to keep up with demand (Phan 2004).

Outside the formal sectors of the economy, however, illegal trade timber is one of the biggest threats to conservation in the region (EIA & Telapak 2008; To & Sikor 2008). This is reflected in the fact that logging continues to be one of the key threats to the 15 forest conservation areas, as identified in this research (Variable 28 in Table 3-1). There is a slow shift, however, to improve legal timber harvesting practices, from the demands of the European and American markets (IUCN 2009).

While much of the timber trade in Cambodia is illegal, opportunities exist for improvements to management practices through legal harvesting. To this end, organisations such as the Wildlife Conservation Society are working to improve the market for legally and sustainably produced timber, through the Sub-Decree on Community Forestry (Blackett 2008). With better control of logging, conservation of natural forests can lead to improvements in ecosystem health and populations of plant and animal species.

3.4.4 Plantations

In the three Lower Mekong countries, in addition to timber extraction from natural forests, a variety of plantations exist for timber and non-timber products. Only three sites of the 15 studied had large areas of production forests (>10% of the area – a score of 1 or more; Variable 18 in Table 3-1). There are, however, diverse types of production forests in 11 of the sites, such as *Acacia* spp., rubber, pine (*Pinus sp.*) and coffee (Variable 20 in Table 3-1). In Cambodia, for example, large-scale plantations also include jatropha (a crop used for biofuels), oil palm, teak (*Tectona grandis*), coconut and *Eucalypt* spp. (Cook 2008; WRM 2008). Local people also plant tree crops for cash income, such as some ethnic minorities in Vietnam, who plant cashew and coffee (Pham 2007).

Foreign investments into plantations in Laos and Cambodia come predominantly from China, Thailand and Vietnam (Cook 2008). Economic land concessions in Cambodia are for up to 99-years (WRM 2008). These are causing pressures on land and environmental damage, through deforestation and encroachment to conservation areas (Cook 2008). Plantations also have a negative effect on local people by displacing communities and preventing their access to the areas (WRM 2008). For example, eucalypt plantations in Laos, funded by the Asian Development Bank through the Industrial Tree Plantations Project, replaced natural forests, some of which were areas important for the livelihoods of local people (WRM 2008). Even the monocultures planted by local people have negative environmental effects, but there is now pressure from environmental organisations to change practices for some crops (such as cocoa) to shade-cropping (Pham 2007).

3.4.5 Agriculture

Agriculture constitutes a large part of land-use in 13 of the 15 sites, with crops covering over 10% of the area (a score of 1 or more; Variable 19 in Table 3-1). The major crop is rice, for subsistence use, but the bigger threat to conservation areas comes from cash crops. Although previously dominated by subsistence farming, Cambodia and Laos are now developing large-scale agriculture crops with investments from Thailand, China and Vietnam (Baumuller 2008). A report by WWF (Baumuller 2008) states that agriculture contributes to 47%, 46% and 21% of the Gross Domestic Product of Laos, Cambodia and Vietnam respectively. Some of the agricultural crops (such as sugar and corn) are expanding, and can lead to clearing of forests (Baumuller 2008; Rutherford *et al.* 2008).

The transformation of shifting cultivation to permanent agriculture has been an important trend over the past two decades. In Southeast Asia, this transformation has been driven by a variety of factors, including the division of land for forestry and permanent agriculture, privatisation of land, and the rise of conservation (Fox *et al.* 2009). Changes in policies for agricultural practices are particularly important in Laos, where the government's policy on forestland allocations is aimed at improving management of resources by reducing shifting cultivation (Morris *et al.* 2004). This is supported by investments from China, which is pushing for modernisation of agriculture by investing over $100 million into cassava, sugar cane and corn (Rutherford *et al.* 2008).

The rationale behind this transformation is that while shifting cultivation can be sustainable and ecosystems can recover in low population-density areas, it is no longer viable with the recent increases in population density and consumption rate, which makes the practice more destructive (Van Gansberghe & Pals 1994). The transformation, however, raises questions for implementing conservation in areas where population densities remain low (Morris *et al.* 2004; Robichaud *et al.* 2009), because the shifting cultivation is not a major threat to conservation areas. Furthermore, internal resettlement of local people is required to reduce shifting cultivation, which has major social impacts (Baird & Shoemaker 2007).

3.5 Governance influences on biodiversity conservation

Improved governance is important for each country, including those in the Lower Mekong region, to more effectively reduce the impacts of economic development to biodiversity conservation, improve management practices in forest areas and improve conservation outcomes (Wells 1998; Swiderska *et al.* 2008; Oldekop *et al.* 2010). There have been several reforms over the past 10 years to improve institutions, the implementation of laws and accountability (Oberndorf 2005; Eng & Craig 2009; Pham *et al.* 2010). Nevertheless, the conservation sectors in Cambodia, Laos and Vietnam continue to be limited by governance constraints. These constraints include a multitude of issues, and in this chapter I discuss how eight different aspects of governance affect conservation interventions in the region, including 1) unresolved land tenure, 2) limited finances for conservation interventions, 3) limited technical capacity and will of government officials to conduct conservation actions, 4) gaps in conservation-related laws, 5) transparency issues in operations of government, 6) weak collaborations within government, and 7) the values for nature held by different actors.

A recent review of the progress of forest law enforcement and governance (FLEG) provides some insight into the progress of governance within each country (Pescott *et al.* 2010). The Cambodian government has had some success with forestry reforms, largely through laws, policies and strategies of the Forestry Administration. Nevertheless, Cambodia still has multiple governance issues, including poor monitoring, suppression of forest crimes and cooperation amongst actors. Laos is in the early stages of its FLEG plan. New laws have been passed and updated and the government has created a Department of Forest Inspection. These actions have improved governance, but there are still substantial challenges, one of which is that the implementation of these actions is only within government. Vietnam is further advanced in its FLEG framework. It has developed and updated a set of conservation laws and implemented a wide range of national strategies and programmes. This has resulted in reduction of forest crimes, reduction in the loss of resources and an increase in the area of natural forest (from 36.7% in 2004 to 38.7% in 2008). Nevertheless, violations of the laws and threats to forest areas are still issues that need to be addressed.

3.5.1 Unresolved land tenure

The civil conflicts in the Lower Mekong during the 1960’s and 1970’s negatively impacted land tenure as local people were moved off their land (Fox *et al.* 2009). Insecure tenure remains an issue for local people in forest areas, and also affects the operation of conservation interventions. One issue in Cambodia is that due to areas of unregistered land title, the majority of Khmer households have little protection against land grabbing from others (Global Witness 2009). In Vietnam, people with insecure tenure have limited control over forest resources and tend to collect more timber from forest areas than those with secure tenure (Nguyen 2008). The insecurity of tenure has, among other things, negative implications for payments for environmental services schemes because local people without recognised tenure arrangements have no official control over the natural resources and so cannot receive funds from PES schemes (Wunder 2005; Pham *et al.* 2008).

From interviews conducted with multiple conservation organisation staff in Cambodia, unrecognised rights and unregistered land title have been a problem, especially with indigenous people, because it limits the establishment of regulations for the control of resources (mentioned in interviews with managers and organisation reports of all five of the conservation areas[18]). Over the past two decades, efforts by government and NGOs have been made to improve local tenure arrangements, including the recent development of communal land tenure for indigenous settlements in Seima Biodiversity Conservation Area (WCS 2010a). The *Land Law 2001* in Cambodia has also improved land classification and ownership (Shields *et al.* 2004). In Laos, the government attempted to control swidden agriculture in the 1990's through the National Land and Forest Allocation Policy, by encouraging minorities to resettle to lowlands and modernise agricultural production (Morris *et al.* 2004; Fox *et al.* 2009; Robichaud *et al.* 2009). This placed emphasis on forest conservation by limiting the forested plots allocated to households for use in swidden agriculture. In Vietnam, all land belongs to the state; so local people only

[18] Interviews: SBCA I2; CCPF I2; VNP I1; PSWS I1; MPF I1, I5

have use rights, which means they do not have the right to make decisions over forest areas (Pham *et al.* 2008). The government is, however, undertaking land-use zoning and is transferring administrative responsibilities to local communities, which increases the influence of local people over management of forest areas (Nguyen 2008; Pham *et al.* 2008).

3.5.2 Limited finances

Limited finance for conservation-related activities hinders the operation of the relevant implementing institutions. For instance, insufficient budget for managing the NPA system in Laos has left several of the protected areas without effective management (ICEM 2003a). Management is ineffective partly because the total domestic budget from the government to manage all the NPAs in Laos was only approximately \$2 000 - two thousand USD - in 2004 (Singh 2009a), increasing to only \$5 000 in 2005 (Poulsen and Luanglath 2005), and to \$15 000 in 2007 (K. Marion Suiseeya pers comm. 11/2009 – interview with the staff at the Division of Forest Resource Conservation in 2007).

Financing data were not readily available for all sites, and due to the nature of projects, funds received by conservation organisations are irregular. Hence the variable used in the results (Variable 126 in Table 3-1) does not have a high accuracy. What the results do show, however, is that there was a wide range of funding levels to the different sites – two sites received very little (less than \$100/km^2/year, which has the likely impact of reducing the capacity to manage areas), whereas three other sites received an order of magnitude more funds (greater than \$1000/km^2/year) from governments and international donors. The reported average management budget per square kilometre within the core areas of Vietnam was around $1425 in 2007, which was higher than those of both Laos ($783) and Cambodia ($201).

The results also show that the funding sources are diverse, with some from NGOs, some from donors and some from the national governments (Variable 128 in Table 3-1). Conservation efforts have been supported mostly by international organisations and local NGOs that concern themselves with biodiversity conservation and local livelihood development (see Chapter 5). The management budgets of the major NGOs exceeded USD $100 000 per year for each of 11 of the 15 conservation areas (Variable 126 in Table 3-1), and the funding source from NGOs was greater than that from government at 11 sites (Variables 128 in Table 3-1).

Since there is a diversity of social, environmental, physical and political factors that influence the costs of protection, it is impossible to provide an accurate estimate for the amount of funds required to implement effective interventions at each conservation area. Nevertheless, conservation financing remains a constraint often reported by protected area managers (mentioned in interviews with managers and project documents from seven areas[19]). Emerton (2004) also states, in relation to Vietnam, "on-the-ground conservation management activities are under-resourced, equipment is scarce, and that low expenditures are made on operations and maintenance" (Emerton *et al.* 2004). To address this issue, conservation organisations are looking towards new sustainable financing methods (particularly through PES) to stabilise and improve funds (Tsechalicha 2008; WWF 2008b).

[19] Interviews: SBCA I2, I3; CCPF I1, I2; VNP I1, I3; STNR I2; VBNR I1; BCI I1; NKD I1

3.5.3 Limited technical capacity

Limited finance also leads to lack of human resources and equipment to operate effectively, reducing rangers' willingness to work and limiting the capacity of staff in the conservation areas. Capacity constraints exist throughout the civil service in Cambodia, with low pay causing low morale, poor work ethics and people holding second jobs, further exacerbated by a low level of education among bureaucrats (Eng & Craig 2009). Although the educational level in Vietnam is slightly higher than in Laos or Cambodia (UNDP 2007), lack of technical expertise remains an obstacle to on-site effectiveness in conservation, making illegal logging and wildlife trade difficult to control (Traffic 2008).

This research found some limits to the effectiveness and capability of law enforcement teams in the conservation areas - only one of the 15 areas scored the highest score of 5, and four sites with a score of 1 and 2 (Variable 10, Table 3-1). The scoring of the variable was a challenge, as there were very few evaluations of enforcement teams and monitoring of violations was irregular. However, discussions with conservation practitioners in the three countries revealed that salaries for government staff were low in some sites (low salaries were mentioned in interviews with managers and project documents from five areas[20]), translating into low capacity, poor motivation and incentives to work effectively, and ultimately a disincentive to work in the conservation sector.

[20] Interviews: SBCA I3; CCPF I2; VNP I1, I3; STNR I2; BCI I1;

3.5.4 Gaps in conservation-related laws

Although environmental laws and regulations have been revised and further developed in the Lower Mekong region (as discussed in Section 3.3), the limited available evidence suggests that the laws and regulations of the national level governments still exhibit some gaps and unclear mandates[21] (R. Oberndorf pers. comm., 9/2009; Oberndorf 2005). This creates confusion over the implementation of laws and delegation of responsibility, with respect to conservation, leading to a lack of synchronized action regarding the protection of national resources. Part of the reason stems from a lack of necessary research before legislation is promulgated; some laws are too general, others too specific, and superior and subordinate regulations are not prepared together, which complicates their implementation (Wescott 2001). For example, in Cambodia while the National Assembly reviews and enacts bills drafted by the Government, it is often done without sufficient consideration or the necessary expertise (Wescott 2001). This leads to short-comings in the legal system, including unclear instructions on how to effectively disseminate and implement the laws. This issue was raised in a group discussion at NEPL, in interviews with management staff of four conservation areas and mentioned by K. Marion Siuseeya, an expert on conservation-area governance in Laos[22], which then leads to weak law enforcement (Sage & Nguyen 2001).

[21] Even the new Protected Areas Law in Cambodia was perceived by one staff member as 'shocking' (MPF I5)

[22] Interviews: NKD I1; NEPL GD1; MPF I5; SBCA I3; CCPF I2; K. Marion Suiseeya pers. comm., 9/2009

3.5.5 Transparency issues

Although corrupt practices were discussed informally by several informants and directly observed on several occasions during field trips, this cannot be elaborated due to a lack of evidence and ethical considerations. Reports on the Lower Mekong, however, suggest that corruption is a critical issue to conservation, because abuses of power lead to direct impacts, such as overcutting of timber and habitat clearance, or indirect impacts, such as poor efficiency of conservation actions and limited control of the wildlife trade (Global Witness 2004, 2007; Stuart-Fox 2008; Traffic 2008; Global Witness 2009; FAO 2010; Pescott *et al.* 2010).

According to the Transparency International Corruption Index, Cambodia, Laos and Vietnam rank low on the global scale (Transparency International 2009). Low transparency of government staff is caused by a multitude of issues, including complicated and long administrative procedures, too many regulations, decision-making that is hidden from public view and limited public information (Wescott 2001). Other contributing factors include low public-sector wages (Eng & Craig 2009), interference from the governments in judicial proceedings and the centralised government systems, which constrains NGOs, media and civil society (Stuart-Fox 2006). Stuart-Fox (2008) suggests that the political culture of Laos and Cambodia partly explains the pervasiveness of corruption, where patronage in the government system perpetuates corrupt practices.

Corruption has a negative effect on conservation. For example, forest guards or even military forces in Laos, Cambodia and Vietnam occasionally accept money to ignore forest violations (EIA & Telapak 2008), negatively affecting conservation enforcement and citizens' confidence in the system. The trade in illegal products, such as logs and wildlife, is often under the control of government officials and lawmakers (Global Witness 2004; To & Sikor 2008). Furthermore, mining exploration licenses that overlap conservation areas have been granted to members of the government or their families (Global Witness 2009). Hence, to improve forest law enforcement and governance in the Lower Mekong, dealing with corruption is a crucial step (Pescott *et al.* 2010).

3.5.6 Weak collaboration within government

Developing collaborations and building consensus among individuals and organisations can be effective when tackling multiple objectives for conservation and development across different jurisdictional areas and resolving conflicts (Pellow 1999; Barrett *et al.* 2001; Leach & Pelkey 2001; Barrett *et al.* 2005; Regan *et al.* 2006; Stacey *et al.* 2006; van den Hove 2006). Collaborations among actors can be vertical, such as government to local, or horizontal, such as organisation to organisation or between government departments.

While vertical relationships among government, non-government organisations and local people appear to be improving through collaborations and participatory processes (see Chapter 5), weaknesses in collaborations are more evident in horizontal relationships among ministries and government departments. In the Lower Mekong countries, several ministries have overall responsibilities for managing conservation areas and responsibility is channelled through relevant departments and provinces to districts (ICEM 2003d) as discussed in Section 3.3. Collaboration within government, however, is weak in the conservation sectors of the Lower Mekong countries (T. Sikor, pers. comm., 11/2009; Miller & Shields 2004; Stuart-Fox 2006; Cao *et al.* 2009; Singh 2009a). Collaboration between ministries was raised in interviews with managers as an issue in management of conserved forests in Cambodia (particularly at the Central Cardamom Protected Forest and Phnom Samkos Wildlife Sanctuary[23]), where the Ministry of Environment and the Forestry Administration (under the Ministry of Agriculture, Forestry and Fisheries) often have conflicts and disagreements over responsibilities in their respective areas and compete with each other for government resources (Miller & Shields 2004). There are several key differences between the two ministries. For instance, differences include different policies, such as either harvesting or protecting of timber resources, or hiring of rangers either locally or from elsewhere. Another difference is the ministerial power and capacity to make decisions over the management of natural resources: for example, the Ministry of Environment has fewer human and financial resources than the Ministry of Agriculture, Forestry and Fisheries. A third difference is the separate geographical jurisdictions: for instance, the Ministry of Environment manages Virachey National Park, but its buffer zone comes under the jurisdiction of the Ministry of Agriculture, Forestry and Fisheries (From an interview with the Director of Virachey National Park[24]).

Governments in Vietnam and Laos also lack coordination among different government ministries and departments. Vietnam has three ministries in charge of natural resource management (for the environment, agriculture and fisheries) and 15 environmental agencies at sub-national levels, but no cooperation, coordination or focal point for planning interventions for resource management (Cao *et al.* 2009). This creates problems in the conservation areas, for instance the Vietnamese national government is proposing a controversial new town on the top of the mountain in

[23] Interviews: CCPF I2; PSWS I2, I5 and I6
[24] Interview: VNP I1

Tam Dao National Park, which will damage approximately 400 hectares of forest, and is opposed by the park management board, a government agency (Interview with the Director of Tourism at Tam Dao National Park[25]). In Laos, communication between ministries is also a problem (Fujita 2004), for example, the national government is proposing a new dam (Nam Theun 1) in the core zone of Nam Kading National Protected Area, which the provincial government opposes (Interview with the coordinator of Nam Kading NPA[26]). The differences and disagreements among the ministries limit the ability of the ministries to collaborate for conservation interventions. Government disagreements also impact local communities in the conservation areas and reduce the ability of decision-makers to resolve local resource-use issues.

3.5.7 The values for nature

The practice of biodiversity conservation is situated within the context of a complexity of held values for nature among actors. The values for nature are part of governance because governance of natural resources includes decision-making that implicitly takes into account the held values for nature among the actors involved. As noted in Section 3.3, interest and investment in conservation from government, international donors and NGOs has increased over the past two decades (Zingerli 2005; Singh 2009a). Although governments in the Lower Mekong have a history of authority over conservation, stemming back to the French colonial period in the first half of the 20th century (Cleary 2005), as conservation has become an increasingly important issue, the implementation of conservation has been affected by the differences in the held values for nature, which differ among actors because of the

[25] Interview: TDNP I2
[26] Interview: NKD I1

different perceptions and worldviews that people hold. These differences have a direct influence on governance and decision-making in biodiversity conservation, especially in the Lower Mekong region where there are multitudes of actors and cultures with interests in conservation areas.

An example is the difference between values held by local people and the national conservation sector. In the Lower Mekong, local people who live near forests rely to a large degree on forest resources as safety nets, including for materials and food for both subsistence and cash incomes (De Koninck 1999; Foppes & Ketphanh 2000; Robichaud *et al.* 2001; Alyward & Tognetti 2003; Carew-Reid 2003; Ingles & Hicks 2004; Bourdier 2008). Local people also hold spiritual values[27] for forest areas. Ethnic minorities in the Cardamom Mountains of Cambodia, for example, believe in and respect forest spirits such as *Yey Mao* (the old black woman) and *Neak Ta Srok* (wise ancestors), which is related to their beliefs in Animism and Buddhism (Milne 2009). Spiritual traditions and related values of the forest, held by local people, were mentioned in interviews and group discussions at all sites in Cambodia and Laos.[28] Conservation organisations and governments, on the other hand, promote values related to sustainable development (such as the sustainable extraction of resources, described in mission statements of organisations and national sustainable development plans), but rarely the non-consumptive use values of nature (Campagna & Fernandez 2007).[29] The difference in values among local and national actors can create friction over whether conservation organisations manage resources

[27] Spiritual values: Indigenous groups within and surrounding protected areas often have long standing traditions that aid in conserving biodiversity (Dudley *et al.* 2005). These values are sometimes attributed to specific 'sacred' areas (such as a hill top, forest patch or water hole).

[28] Interviews: BCI GD2; BNR V1; NEPL GD3; NKD V1; NNT GD1; CCPF O3; MPF I1; SBCA O1, O6, GD3; PSWS O1; VNP I1

[29] Van Dyke (2003) discusses the dichotomy between intrinsic and instrumental values, and further classifies instrumental into non-use values, including option (for expected future use) and quasi-option (yet-to-be-discovered use), and direct and indirect use values.

in conservation areas for the intrinsic value of biodiversity or local material and cultural use (Zingerli 2005).

Actors at different levels also exhibit a pluralism of values, where individuals or coherent groups hold more than one value for nature. Conservation values at the international level, for instance, are diverse. Commitments to the international agreements, such as CBD and CITES, are for environmental services,[30] sustainability of resources and also for the inherent value of biodiversity itself (Higgins *et al.* 2004). The concept of biodiversity itself is, however, problematic because it carries little meaning for people outside the conservation sector, but encompasses several values within it, including intrinsic,[31] aesthetic[32] and economic[33] aspects (Zingerli 2005; Sandbrook *et al.* 2011). Sandbrook *et al*. (2011) analysed the conservation values of a group of 64 conservation students from around the world. Their results showed that, even within this group, the values placed on biodiversity diverged from intrinsic to instrumental. But it is not just conservation students who hold a pluralism of values. Sodhi et al. (2010) found that local people living near protected

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[30] Environmental services: Local people often benefit from other services of natural areas, including water, quality soils and protection from erosion (Blench 1998). Environmental services also benefit populations farther afield, which may also include genetic resources, water and carbon sequestration. Environmental services might not be a value of biodiversity itself, but rather for the natural environment as a whole.

[31] Intrinsic value: Separate from instrumental values, many Western conservation practitioners and donors are driven by an ethical standpoint to protect species and biodiversity for their own benefit – sometimes understood as an 'intrinsic right'. Intrinsic rights of species might be linked to cultural values, such as aesthetic, religious and spiritual values, but intrinsic rights can also be independent of these. Nevertheless, the valuation of intrinsic rights has been heavily debated because it is a difficult concept to define explicitly, local actors often do not share the same viewpoint, and hence it is difficult to use in decision-making processes (Odenbaugh 2003; Justus *et al.* 2009).

[32] Aesthetic values: Often attributed to charismatic megafauna, untouched wilderness areas and recreation, and also used as ethical standpoint to protect forests for future generations to enjoy. It is also a motivation for many conservation practitioners and donors, which has the effect of increasing funding for aesthetically valuable conservation areas or charismatic species. Aesthetic value can also include option, quasi-option and existence values of biodiversity. Operationalisation of this has economic and cultural benefits (Leopold 1949), most obviously recognised by the development of ecotourism.

[33] Economic values of nature can include both use (materials, food, medicine and environmental services) and non-use values (such as tourism, based on an aesthetic value).

forests held a range of values for nature, including environmental and cultural services. Conservation actions, therefore, are not easily portrayed under a single philosophy, but the different values held by a diversity of actors can make way for more pragmatic approaches to conservation practice (Sandbrook *et al.* 2011) - approaches that take into account the needs and interests of multiple different groups.

Values are also 'plastic' and can evolve (Maris & Bechet 2010). For instance, values for nature between international conservation organisations and national governments are merging. Governments in the Lower Mekong have implemented policies and laws related to the environment that are embedded within a sustainable development framework (as described in Section 3.3). Conservation at the national level is influenced by the consideration of global poverty, which is exemplified by the MDGs (especially Goal 7 on environmental sustainability) and National Poverty Reduction Schemes (NPRS; Adams & Hutton 2007). The key idea is that biodiversity conservation should contribute to poverty reduction (Adams & Hutton 2007; Roe 2008; Singh 2009a), because of the assumption that natural resources, including environmental services and collectable products, provide for improved livelihoods (Emerton 2005; Sanderson 2005; Singh 2009a).

Instrumental values of nature relate to socio-economic development, through the extraction of natural resources, which might be in line with the interests of government and conservation organisations. For instance, the interests of International Conservation Organisations (such as WCS and WWF) and the Lao government now coincide through assertions of commitment to sustainable and equitable development, to such an extent that conservation organisations working in Laos are careful to avoid conflicts when discussing conservation with the government (Singh 2009a). In Cambodia, the National Poverty Reduction Scheme explicitly mentions forest management as a key means to improve poverty reduction (GoC 2002). Conservation strategies have become aligned with poverty reduction, the most obvious approaches being the integrated conservation and development projects, which operate in all three of the countries (Chape 2001; Sage & Nguyen 2001; Milne 2009). Campagna and Fernandez (2007), who analyse the vision and mission statements of 24 international environmental organisations (at least 14 of which are present in the Lower Mekong), also suggest that local environmental organisations are aligning with the governments' perspectives of conservation that focus on the instrumental values.

3.6 Discussion and conclusions

This chapter has explored some of the factors influencing the conservation sectors of Cambodia, Laos and Vietnam. I have described the conservation sectors of each country, including the history of protected area establishment, the key organisational actors involved in biodiversity conservation and management, and the national laws, conventions and policies related to conservation in the Lower Mekong. This set the scene for a discussion on the other influences to conservation in conservation areas in the region faced from large-scale economic development and governance of forest areas.

The Lower Mekong countries have been impacted by conflicts over the past 50 years, and their economic recovery has been influenced by the dramatic increase in investment from international NGOs and donors since the early 1990s. Recognising the valuable ecosystems and biodiversity within the Lower Mekong countries, the conservation sector of each country has developed rapidly, particularly over the past two decades. The most important recent developments have been the restructuring of the protection of each country's important biodiversity and natural areas, through the establishment of Protected Area systems, ratification of multiple multilateral environmental agreements and enactment of laws to control forest resources in conservation areas.

Some differences are apparent among the three countries. Cambodia and Laos have a greater proportion of forest protection than Vietnam, but less financing for the protected areas and lower development status than in Vietnam. Cambodia has a greater issues of mineral exploration within conservation areas, more NGOs involved in conservation, but the history of devastating conflict has slowed national economic development and created a high level of corruption. The government of Laos shows some negative sentiments towards international conservation organisations, but Laos has a simpler bureaucratic system and more autonomy in the provinces. The Vietnamese government has strong central control, the country is more developed and the conservation sector is progressing quickly towards new initiatives, but Vietnam has much less forest left to conserve.

Conservation organisations and government, however, have a long way to go to achieve biodiversity and local livelihood development goals, with a particular need to address two key influences. One influence is from the expansion of large-scale economic development initiatives, which are related to the development strategies of each country. Part of the governments' economic development strategies is to grant concessions to international investors, particularly China, Thailand and Australia, for hydropower, mining, plantations and agriculture. Another strategy is through the trade of commodities, both intra-regionally, such as the timber trade from Cambodia and Laos to Vietnam, and externally, such as the trade in agricultural products and minerals to China

These economic development initiatives impact forests, conservation and local people. Though the investments by industry contribute to the national economy, the economic concessions have an impact on conservation areas, which demonstrates the poor management of forest conservation areas by conservation organisations. These economic concessions also outcompete conservation in forestlands, leading to the destruction of habitats. Furthermore, land concessions granted to large companies affect local people's access to forests and resources, displace communities and disrupt land-use practices. The trade in timber from natural forests impacts biodiversity by damaging ecosystem health and threatening plant and animal populations. Shifting agriculture is an issue in some areas of natural forests in the Lower Mekong countries, but in areas where population densities are low, shifting agriculture may be a less environmentally damaging alternative to sedentary agriculture.

A second key influence, weak natural resource governance, limits the effective implementation and control of conservation actions to counter the environmental impacts of economic development. Unresolved land tenure is an issue for local people and conservation interventions, because it limits people's ability to control natural resources and provides little protection from such threats as land-grabbing. Low finances for management of conservation areas lead to under-resourced activities, which then limit the effectiveness of conservation interventions. The limited capacity of the civil service manifests in low morale, poor work ethics and a lack of technical expertise in conservation, which impacts the control of threats to conservation areas, such as hunting and logging. Gaps in legislation and unclear mandates among government departments have repercussions by weakening the effectiveness of law enforcement. Low transparency in government agencies also limits the effectiveness of conservation actions (such as by not prosecuting forest violations), which leads to environmental impacts such as overcutting of timber and clearing of habitat. Weak collaborations within government also affects decision-making for the management of conservation areas, weakens the implementation of policies and laws and negatively impacts local communities.

Conservation is further complicated by differences in values held for nature among the various conservation actors, sometimes resulting in conflicts in interests. Differences in values have the potential to create disputes over the perceived purpose of conservation areas, such as whether to manage nature and natural resources for intrinsic values, cultural values, material uses or all of the above. Incorporating a diversity of values and interests in decision-making, which takes into account social context, can lead to pragmatic conservation approaches. The values of conservation organisations and government are beginning to coincide, such as through the development strategies (for example, the National Poverty Reduction Schemes) that largely focus on the instrumental values of nature to reduce poverty.

The influences on conservation discussed in this chapter are a few of the many social, economic, environmental, political and historical factors that affect conservation practice in the Lower Mekong. Multiple actors are involved in conservation interventions, so resolving the challenges facing conservation organisations requires contextual approaches that understand the social, economic, legal and political settings of the conservation areas. Several of the factors discussed have impacts on both biodiversity and local livelihoods, such as impacts from large-scale infrastructure projects and weak tenure arrangements. Finding strategies that are both broadly accepted by all actors and effective requires building consensus among all actors (including local people and industries) in conservation areas.

Chapter 4 Threats and conservation actions

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4.1 Introduction

One of the greatest challenges to protecting biodiversity in conservation areas is to reduce threats[34]. Typical threats to tropical forest environments include deforestation, unsustainable exploitation of forest resources, pollution and the spread of invasive species (Spangenberg 2007). Conservation action requires clear perceptions of threats and effective ways of responding to them (Pressey & Bottrill 2008). The identification and management of threats in conservation projects, is, however, still weak (Hughes & Flintan 2001; Pressey & Bottrill 2008). There have been calls in the recent conservation literature to systematically compare threats and conservation actions to advance the understanding of the links between the human and natural world, particularly the protection of biodiversity (Salafsky & Margoluis 1999; Margules & Pressey 2000; Pressey & Bottrill 2008; Sunderland *et al.* 2008).

Currently, no standardised method exists for the assessment of threats and actions. Salafsky and Margoluis (1999) suggested a framework to clarify the assessment of threats to biodiversity and projects, which is useful for evaluating individual projects, but falls short of comparing between different projects and areas. Expanding this to compare across sites, Salafsky and Margoluis (1999) called for a standardised catalogue of threats and conservation actions, which is currently being developed by the Conservation Measures Partnership and IUCN Species Survival

[34] Salafsky (2008) distinguishes between the causes of threats and the drivers. The proximate or immediate causes of threats (or the 'direct threat') are the human activities that destroy or degrade biodiversity. The drivers of a threat are the ultimate factors (such as social, economic or political) that contribute to the occurrence of the direct threat. Threats also come from different sources, usually a particular sector of human society (Balmford *et al.* 2009), and can come from local actors (such people living near a protected forest) or external actors (such as a logging company). One example of the causal chain of a threat is that of hunting, perhaps caused by a local person near a protected forest, but driven by the trade in wildlife, which is further influenced by the demand for luxury food.

Commission (Salafsky *et al.* 2008). This system is still under development (Balmford *et al.* 2009) and other research groups are also developing methods (see, for example: Robichaud *et al.* 2001; Ervin 2003; Jarvis *et al.* 2010; Matar & Anthony 2010). There remains a need to advance conservation planning and implementation through clarifying the links between threats and conservation actions and comparing these across multiple sites (Salafsky & Margoluis 1999; Margules & Pressey 2000; Pressey & Bottrill 2008; Sunderland *et al.* 2008).

In this chapter I systematically explore threats and conservation actions amongst 15 sites in three Lower Mekong countries – Cambodia, Laos and Vietnam. While most studies in the Lower Mekong have focused on individual threats or drivers (De Koninck 1999; Alyward & Tognetti 2003; Davis 2005; Kim *et al.* 2005; EIA & Telapak 2008; Greenwood 2008; Meyfroidt & Lambin 2008; To & Sikor 2008; Traffic 2008; Global Witness 2009; Robichaud *et al.* 2009; Nijman 2010), a number of workers have explored multiple threats to protected areas; two of these focused on Cambodia (Lacerda *et al.* 2004; Chanrithy 2010) and one on Laos (Robichaud *et al.* 2001). Lacerda et al. (2004) and Chanrithy (2010) found that the most severe threats to the protected areas in Cambodia were agriculture encroachment and overexploitation (wildlife poaching, logging and fishing). These were countered by a variety of conservation interventions, including community livelihood development, species conservation activities and law enforcement (Chanrithy 2010). Robichaud et al. (2001) reported that the greatest threats in Laos were subsistence agriculture and hunting (for subsistence and trade), which were primarily countered through integrated conservation and development approaches.

In this chapter I broaden the scope of previous explorations of threats and conservation actions. My primary aims are to systematically explore threats to biodiversity in the 15 forest conservation areas and how conservation interventions, operated by government and non-government organisations, are implementing different practices to mitigate the threats. I also compare the threats among the three countries and explore whether threats are mainly from internal (threats from people living in settlements within the conservation areas or adjacent buffer zones) or external sources (such as threats posed by national logging companies or international mining concessions). I first discuss several factors that contribute to the threats to forest areas (Section 4.1.1). Section 4.2 describes the methods used to collect and analyse a set of variables to examine threats and strategies and to compare 15 forest conservation areas of the Lower Mekong. Section 4.3 describes the human and environmental context of the 15 sites and reports the results from the analysis of threats and management. Section 4.4 discusses the implications of the findings, and finally, section 4.5 draws the findings together and concludes.

4.1.1 History and current situation of threats to forests

The Lower Mekong sub-region is one of 34 global biodiversity hotspots, of importance for biodiversity conservation (Mittermeier *et al.* 2004). Protected area coverage has increased over the past two decades in the Lower Mekong, currently with over 100 biodiversity conservation areas greater than 10 000 hectares within these three countries (ICEM 2003d). However, despite this, populations of animal species (such as deer and tigers) have continued to decline as a result of subsistence hunting and wildlife trade (Traffic 2008), and habitats continue to be reduced or degraded (Hirsch 1999; ICEM 2003b; Meyfroidt & Lambin 2008).

The decline in wildlife and habitats are due to several factors stemming from civil conflict, the following periods of reconstruction and development, and an increase in the demand for forest resources. The recent conflicts in the Lower Mekong subregion had a major influence on biodiversity in protected areas. In Vietnam, during the Vietnam-America war from 1955 to 1975, the management of protected areas received little support, the conflicts degraded forests (such as by the use of Agent Orange – a defoliant) and increased the demand for timber (Rambaldi *et al.* 2001). In Cambodia, during the 1970s and 1980s, civil conflict caused forest degradation and animal species population decline (ICEM 2003c; Kim *et al.* 2005). While central Laos was affected by defoliants and bombing in the Vietnam-America war (Robichaud *et al.* 2001), the relative geographic and political isolation of the country has sheltered the country from external biodiversity pressures (Bugna 2002b). This has changed during the past 20 years – environmental costs have increased as Laos has opened up to international markets and expanded its economy (Bugna 2002a; Greenwood 2008).

However destructive wartime was to forests of the Lower Mekong, it was the following periods of reconstruction and development that had more impact on forests (Phat *et al.* 1998; De Koninck 1999). Demand for raw materials, crops and energy have influenced government strategies to expand the economy of the region, through building of roads and hydropower dams, and agriculture and mining developments (Lacerda *et al.* 2004; IUCN 2007a). Large areas in the Lower Mekong countries have been converted from forest to areas for sedentary agriculture during the 1980s and 1990s (Lamb & Gilmour 2003), and agricultural expansion continues to be a factor in deforestation (De Koninck 1999). Energy requirements were traditionally met through gathering of fuel-wood, itself a threat, but hydropower is now the most abundant and increasing energy source in the region, often developed in the vicinity of protected forests (Alyward & Tognetti 2003). The construction of roads associated with major infrastructure developments opens up the forest areas, exposing them to intensified threats of logging, hunting, land-grabbing and further agriculture encroachment (Lacerda *et al.* 2004; IUCN 2007a; Traffic 2008).

Recent research suggests that the current main threats to biodiversity in the Lower Mekong countries are overexploitation of resources, particularly from hunting, logging and collection of NTFPs; deforestation from agriculture and infrastructure development, including the establishment of dams, mines and roads; and degrading processes of fire, over-grazing of livestock and invasive plant and animal species (Robichaud *et al.* 2001; Lamb & Gilmour 2003; Lacerda *et al.* 2004; Polet & Ling 2004; World Bank 2005; IUCN 2007a; Traffic 2008; Robichaud *et al.* 2009; Chanrithy 2010). Over-exploitation of resources is often driven by the high demand for luxury timber and wildlife in the region and globally (Lacerda *et al.* 2004; IUCN 2007a; Nijman 2010). Illegal logging and wildlife trade are highly profitable, largely unsustainable and entwined in an informal and corrupt political economy, allegedly dominated by highly ranked government officials (Global Witness 2004; Ingles & Hicks 2004; Sunderlin 2006; Global Witness 2007; EIA & Telapak 2008; To & Sikor 2008; Traffic 2008). The demand for products is driven partly by increased spending power of Southeast Asian citizens as a result of recent economic development in the region, especially in China (EIA & Telapak 2008; Traffic 2008).

At the local level, the activities of human populations living adjacent to forest areas and local changes in land-use patterns threaten forest areas (De Koninck 1999; Carew-Reid 2003; World Bank 2005). Residents who live within and around forest areas in the three countries, including indigenous minority groups and national majority groups, rely to a large extent on forest resources, including for food, fuel, construction materials, medicines and cash income (Foppes & Ketphanh 2000; Robichaud *et al.* 2001; Alyward & Tognetti 2003; ICEM 2003d; Ingles & Hicks 2004; Sunderlin & Ba 2005; Bourdier 2008). Unfortunately for conservation, several of the local activities, particularly hunting, logging, NTFP collection, livestock grazing and fire, are not only damaging to forests but continue at an unsustainable rate (Lamb & Gilmour 2003; Ingles & Hicks 2004). Nevertheless, traditional agricultural practices and forest product collection activities of minority groups are less damaging than activities carried out by national majority in-migrants to forest areas (De Koninck 1999; Robichaud *et al.* 2001; Robichaud *et al.* 2009).

Threats to forests have been further exacerbated by the weakness of the rules and regulations at local or national levels, corruption of government officials and weak law enforcement at protected areas. These issues arise due to a lack of financial and human resources and technical capacity, often mentioned as issues in the forest sectors of the three countries, and especially in the regulation of wildlife and illegal timber trade (Fujita 2004; Lacerda *et al.* 2004; Sunderlin 2006; EIA & Telapak 2008; To & Sikor 2008; Traffic 2008). Due to the lack of transparent and effective governance and management, the control of forest resources by the managers of conservation areas is a continuing challenge (see Chapter 3). These weaknesses affect both biodiversity conservation and the livelihoods of local residents who depend on forest resources (Davis 2005; Sunderlin 2006).

Threats to biodiversity are managed through different modes, via different organisations and at multiple scales. One mode of management is to target the direct instrumental causes of threats (Hirsch 1999), through enforcement or provision of incentives to those responsible for the environmentally damaging activities. Another mode is to target the less direct structural drivers, such as through improvement of land-tenure and poverty alleviation (Hirsch 1999). Non-government organisations and donors play an important role in pressuring governments to improve their management practices to conserve biodiversity and improve local livelihoods (Global Witness 2004; Davis 2005; To & Sikor 2008).

4.2 Methods

A quantitative analysis of a set of variables was used to compare and explore the relationship between threats, influences and management in 15 forest conservation areas. The method is based on a method developed by Ruiz-Perez and Byron (Ruiz-Pérez & Byron 1999) to compare cases of forest product development using multivariate analytical techniques. Data were collected for five forest conservation areas per country in Laos, Cambodia and Vietnam. The sites were selected using three criteria: a) the forest conservation area was larger than 10 000 hectares; b) there were one or more conservation and development interventions to manage the forest conservation area and associated buffer zone; and c) there had been intervention activities within the past five years (2003-2007). Each site consists of conserved forest and its immediate surrounding area. Sites were also selected based on access and feasibility of doing fieldwork, willingness of the government departments and non-government organisations to collaborate, and availability of data. Key characteristics of the 15 sites are presented in Table 2-1 and the location of each site is presented in Figure 2-1 (see Chapter 2).

Two of the 15 conservation areas were established in 1991 and 1992 in Vietnam. Five forest conservation areas in Laos and Cambodia were established in 1993, coinciding with the establishment of their national protected area systems, and eight more in all three countries have been established since. The size of areas ranges from just over 10 000 ha, such as the Biodiversity Corridor Initiative (BCI) site between Dong Hoa Sao National Protected Area and Xe Pian National Protected Areas in Laos, to over 400 000 ha, such as Nakai Nam Theun National Protected Area in Laos and Central Cardamoms Protected Forest in Cambodia. There is a large variation in population density and demographic patterns among the 15 sites. Five sites do not have inhabitants in the core zone, but six areas have a population density of more than one person per square kilometre. Population densities of the buffer zone are over 100 people per square kilometre in three Vietnam sites, and fewer than 10 people per square kilometre in five sites of Cambodia and Laos. In-migration is occurring in most of the areas, with the exception of Bach Ma National Park in Vietnam, where there is some out-migration to cities.

An initial set of 123 variables was compiled following a review of published and unpublished material (Sanjayan *et al.* 1997; Larson *et al.* 1999; Ruiz-Pérez & Byron 1999; Belcher & Ruiz Perez 2001; Garnett *et al.* 2007; Hill 2007; Malleson *et al.* 2008). These were presented at workshops, attended by staff from the organisations managing conservation areas, in Cambodia and Vietnam. Variables were further revised following workshops and during data collection. Data collection started in September 2007 and continued to June 2008. During this time, the primary researcher (L.P.) visited 12 of the 15 sites, a second researcher (B.H.C.) visited two other sites in Laos, and both researchers visited Nam Et-Phou Louey National Protected Area, Laos. Each site was visited for at least two days to collect data from interviews, documents and organisations' files and web pages (see Section 2.3.3 for more details). Final revisions to the variables occurred during data cleaning and the initial stages of the analysis, which resulted in the final 164 variables (see Appendix 1).

The variables were grouped into groups: 1) environmental characteristics; 2) human characteristics; 3) institutional characteristics; and 4) intervention characteristics. The types of variables used are primarily ordinal, on a scale of 1 to 5, similar to that of the Likert scale (Likert 1932), but also include nominal (qualitative information put into appropriate categories) or continuous variables. Each variable is supported by a qualitative description and references to documents, data and interviews (further described in Chapter 2). A confidence indicator was included as a subjective measure for checking and eliminating variables, on a scale of increasing confidence from 1 (no confidence) to 5 (fully confident).

The analyses were performed on a subset of the variables; only those that are related to threats were included. While several threats have an impact on protected forest areas in the Lower Mekong, workshop participants identified the ten threats as the most important threats to most forest areas. Ten direct threats were selected for analysis: hunting, logging, invasive species, fire, pollution, dams, mining, infrastructure development, agriculture encroachment and land grabbing. The magnitude of their potential to affect species and habitats was measured on a scale of 0 (little, if any, future threat) to 4 (likely to severely damage populations of species and habitats in the near future)[35]. Two classifiers were included to indicate the source of the actors involved in hunting and logging – whether from local people (1), people from outside the conservation area (3) or both (2). Variables covering sites' physical environment, demographics, economy, livelihoods and project activities were used in the analysis to explore the factors related to these threats. Similar to threats, the actions taken by the interventions were identified by the workshop participants as the most common activities that they undertake: research, education and training, local

[35] The score for threats (0-4) is transformed from the original score of 1-5 (as recorded in Appendix 1) by subtracting 1.

economic support, health support and infrastructure development, tourism, land-use planning, institutional development, law enforcement, conservation payments and any other conservation activities (which includes such things as habitat restoration, wildlife rehabilitation, boundary demarcation and monitoring of biodiversity). Analysis of the variables was step-wise, first by analysing individual variables, then bivariate correlations and finally principal components analysis (PCA).

Alongside the quantitative analysis, I illustrate the threats to forest conservation areas by reporting qualitative results from individual sites. Qualitative information, collected for all 15 sites, mainly relied on secondary information from a review of the peer-reviewed literature, 'grey' literature and project documentation, but was supported by over 100 semi-structured interviews and discussions with key informants during visits to the project offices and field sites. Informants included project managers, project staff, forest guards, local people (including village chiefs, farmers and traders), government officials and staff from other NGOs in the area. When possible, direct observations were made of the local land-use, forest quality and obvious threats to the area.

4.3 Results

4.3.1 Human and environment context

In order to understand the similarities and differences in threats in each country and site, which I discuss below, it is important to understand the broad human and environmental context. The major differences between sites in each country are the size of conserved area, forest quality, buffer-to-core ratio and population density (Table 4-1). The Vietnamese sites are characterised by small core zones with comparatively low forest quality, and large buffer zones, with comparatively higher population density. The Cambodian sites have larger core zones, with higher forest quality, and relatively smaller buffers with low population densities. Laos is in-between these two extremes, with medium forest quality (but an outlier, the BCI site, has poor forest quality), large core zones, medium buffer zones and low population density. While these characteristics are not in themselves explanatory, they help contextualise the threats in each area.

4.3.2 Threats to forest conservation areas

The main threats to biodiversity in all 15 sites are hunting and logging (Figure 4-1). During interviews with management staff and forest guards, it was noted that in some sites, such as Mondulkiri Protected Forest and Van Ban Nature Reserve, local residents traditionally hunt for food, but in other sites, such as in Seima Biodiversity Conservation Area and Cat Tien National Park, local residents and outsiders (such as people from other provinces) also hunt for the purposes of wildlife trade[36]. Hunters harvest a variety of animals, including pigs, deer, pangolins and tigers. The source of hunting varies among the sites: hunting is predominantly by local hunters in seven sites, by outsiders in three sites, and by both local people and outsiders in five sites (Variable 26 in Appendix 1).

[36] Interviews: SBCA I1, I2, I4; MPF I1, F1; VBNR F1;

Table 4-1 Site characteristics by country, with standard error. [a] above '1' – larger buffer zone than core zone; below '1' – larger core zone than buffer zone. [b] Created by PCA of variables: forest integrity, forest fragmentation, proportion of high quality forest and buffer-to-core forest transition. [c]The BCI site was removed from this calculation, as it was an outlier with a value of -0.66.

Country	Area of core zone (10^3 ha)	Area of buffer zone (10^3 ha)	Buffer to core ratio[a]	Buffer zone population density (people per km^2)	Forest quality index[b]
Vietnam	48 ± 13	96 ± 43	1.7 ± 0.5	161 ± 46	-0.09 ± 0.10
Cambodia	295 ± 40	152 ± 46	0.5 ± 0.2	18 ± 9	0.20 ± 0.06
Laos	191 ± 73	137 ± 45	1.2 ± 0.4	30 ± 16	-0.02 ± 0.05[c]

Illegal logging is a threat to all sites, but is considered a severe threat (score of 3 or more) in three sites. Results from interviews with forest guards and management staff of six conservation areas in Laos and Cambodia[37] suggest that the reason for logging is the flourishing trade in high quality timber, often by organised groups who selectively cut trees and transport the logs out of the forest via isolated tracks. Similar to hunting, the source of logging also varies among sites: it is predominantly done by local loggers in seven sites, by outsiders in three sites and by both local people and outsiders in five sites (Variable 30 in Appendix 1). For illustration, three management staff and a forest guard interviewed for Phnom Samkos Wildlife Sanctuary (PSWS)[38] in Cambodia suggested that logging is a severe threat (score of 3), done by teams of local people and outsiders. The roots of one species of tree, *mreah prov* (*Cinnamomum parthenoxylon*), are processed in kilns in the forest, to extract oil used to make the psychoactive drug MDMA (3,4-methylenedioxymethamphetamine) – colloquially known as ecstasy). In Nakai Nam Theun in Laos, during interviews with management staff and a forest guard they stated that logging of rosewood (*Dalbergia* sp.), a valuable timber species for making high quality furniture, has increased in recent years[39].

Agriculture encroachment and infrastructure development also threaten most sites (Figure 4-1). In PSWS, the current land use by local people is centred on agriculture. In three interviews with management staff they stated that rapid in-migration has increased the threats to the forest as more land is cleared for settlement

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[37] Interviews: CCPF G5, I2; SBCA I2; PSWS G2, I2; VNP I1; BCI I1, I3; NNT I1, GD1; .

[38] Interviews: PSWS G2, I2, I4 and I6.

[39] Interviews: NNT I1, GD1.

and cultivation[40]. In the BCI site, deforestation in the corridor is caused partly by agriculture encroachment and establishment of rubber plantations (according to interviews with management staff and a focus group discussion[41]). In Van Ban Nature Reserve, the coordinator of the Fauna and Flora International project suggested in an interview that cash incomes are derived mainly from forest resources, particularly the cultivation of cardamom, which requires clearing the undergrowth of the forest for shade[42].

Infrastructure development, including construction of roads and buildings (but not including mines and dams, which are reported separately below), is the greatest threat to some of the conservation areas. For example, in PSWS, the migration of people from other provinces has increased the amount of land cleared for infrastructure development and agriculture[43]. In the BCI site, the results of a focus group discussion on threats suggested that infrastructure development has recently been a key factor changing the land-use patterns of the area[44]. The site is also part of the Greater Mekong Subregion east-west economic corridor, which includes a road that bisects the corridor.

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[40] Interviews: PSWS I1, I4, I5.

[41] Interviews: BCI I1, I3, GD1.

[42] Interviews: VBNR I1.

[43] Interviews: PSWS I1, I4, I5.

[44] Interviews: BCI GD2.

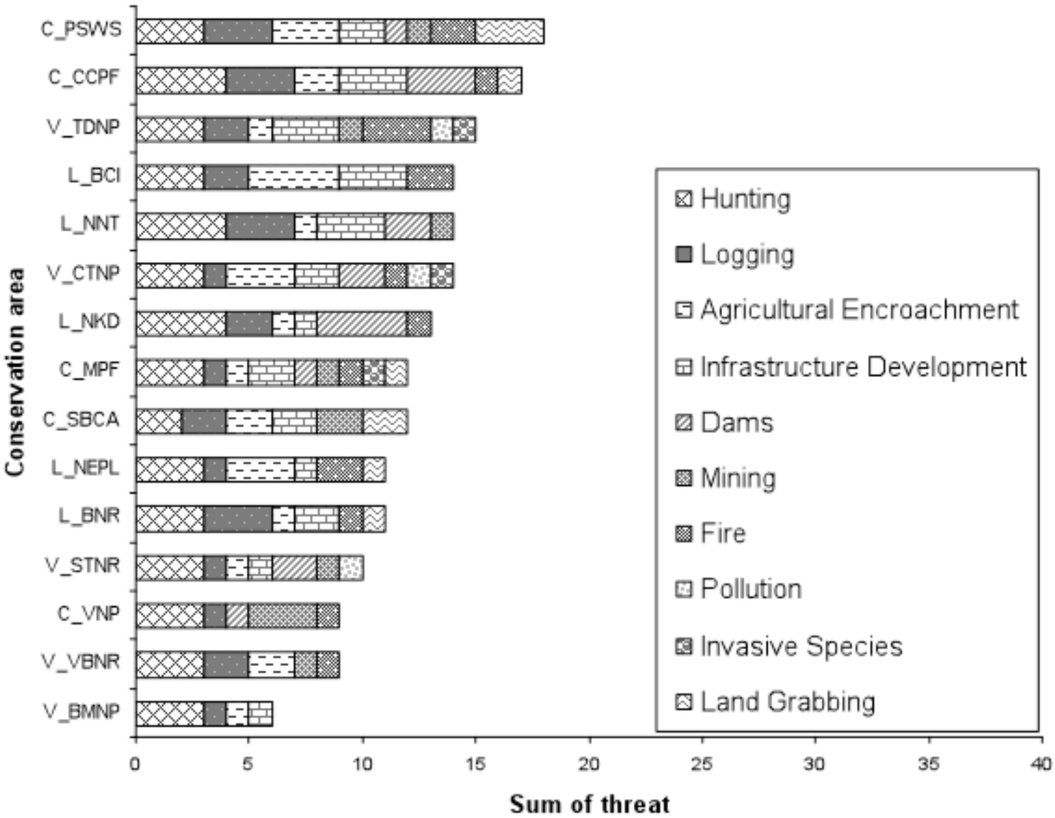

Figure 4-1 Sum of ten threats by site. Each threat is scored on a scale of 0 (no threat) to 4 (likely to be highly damaging to forests and wildlife populations in the near future). Note: infrastructure development in this analysis includes building of roads and buildings, but not mines or dams. Acronyms: BCI – Biodiversity Corridors Initiative (specifically refers to the corridor between Dong Hoa Sao and Xe Pian National Protected Areas); BMNP – Bach Ma National Park; BNR – Bokeo Nature Reserve; C (prefix) – Cambodia; CCPF – Central Cardamom Protected Forest; CTNP – Cat Tien National Park; L (prefix) – Laos; MPF – Mondulkiri Protected Forest; NEPL – Nam Et-Phou Louey National Protected Area; NKD – Nam Kading National Protected Area; NNT – Nakai-Nam Theun National Protected Area; PSWS – Phnom Samkos Wildlife Sanctuary; SBCA – Seima Biodiversity Conservation Area; STNR – Song Thanh Nature Reserve; TDNP – Tam Dao National Park; V (prefix) – Vietnam; VBNR – Van Ban Nature Reserve; VNP – Virachey National Park.

A detailed analysis of three key threats – agriculture encroachment, infrastructure development, and fire (which, if uncontrolled, affects the degradation of forests and potentially changes the assemblage of species) – showed relationships among the socio-economic condition and forest reliance of local people (Figure 4-2). The PC1 axis (representing 47% of the variance) shows a relationship where a greater magnitude of these threats is in areas where the livelihoods of local people are based on non-farm and agricultural activities, rather than forest products. PC1 also represents areas with more infrastructure investment by government and industry. On the lower end of PC1, the relationship shows that fewer threats occur in areas where there is a higher level of poverty, more minority groups, more customary rules and where local people gain much of their incomes from forest resources.

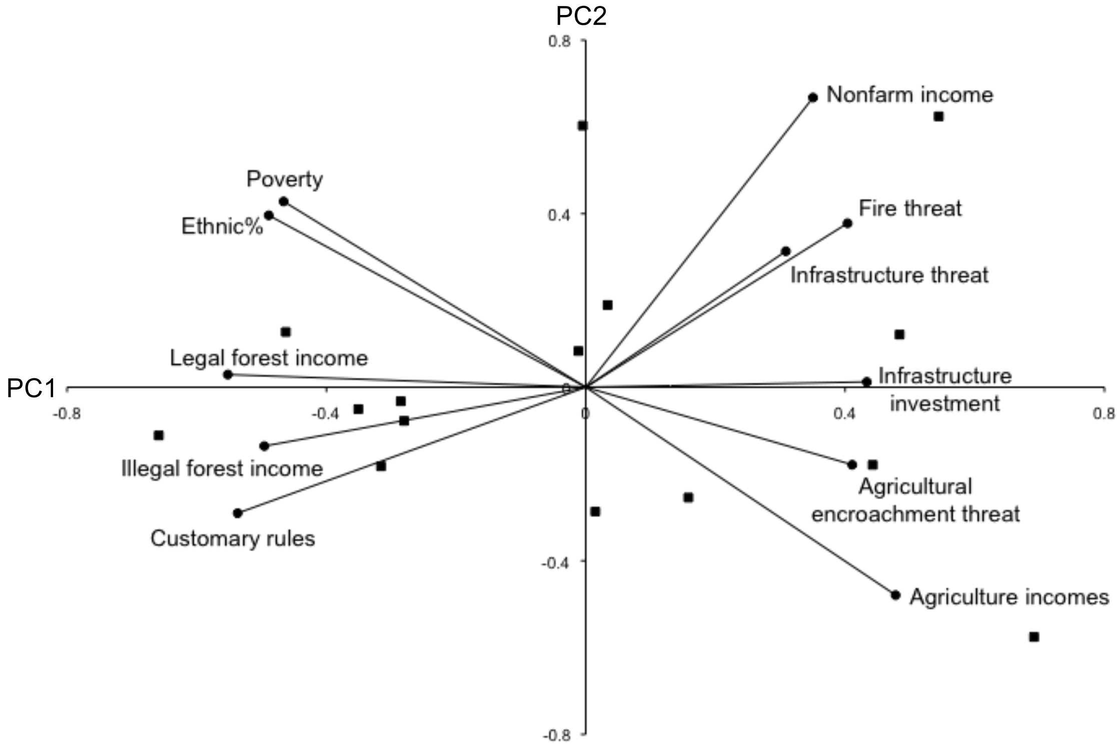

Figure 4-2 Principal components analysis of socio-economic factors and threats of fire, infrastructure and agriculture encroachment. 'Customary rules' indicates the presence of customary rules of local residents; 'Ethnic%' is the percentage of surrounding population consisting of national minorities. Data points represent the sites. Variance explained: x-axis = 47%, y-axis = 17%.

Dams and mining are two other developments that threaten the conservation areas. Dams are currently established in four sites, but future dams were identified as threats in eight of the 15 sites. Development of all of the major hydropower dams is decided by national government and industry. For example, a Chinese investment company is establishing a hydropower dam that borders Phnom Samkos Wildlife Sanctuary and the adjacent Central Cardamoms Protected Forest, which requires connecting roads and transmission lines (noted in three interviews in Phnom Samkos and Central Cardamoms[45]).

Mining is a threat in eight sites and is most obvious in Cambodia (Figure 4-3). While much of the mining activity is by small-scale illegal mining of local people, approval of larger mining activity is influenced by pressure from large companies on governments, with little consultation with local people or between different ministries. In Van Ban Nature Reserve, its coordinator stated a government-approved company established a gold mine on the edge of the nature reserve, damaging the waterways and land near the core zone[46]. Also, a provincial officer in Vang Vieng stated a mine is being established in a section of the core of PSWS, authorized by the Ministry of Industry, Mines and Energy[47]. Areas like Song Thanh Nature Reserve, however, are threatened by mining at a more local level, where local people or outsiders undertake small-scale mining operations, mainly gold panning (Interview with the coordinator of the enforcement team[48]).

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[45] Interviews: PSWS I6; CCPF G3, I2.

[46] Interviews: VBNR I1.

[47] Interviews: PSWS I6.

[48] Interviews: STNR I2.

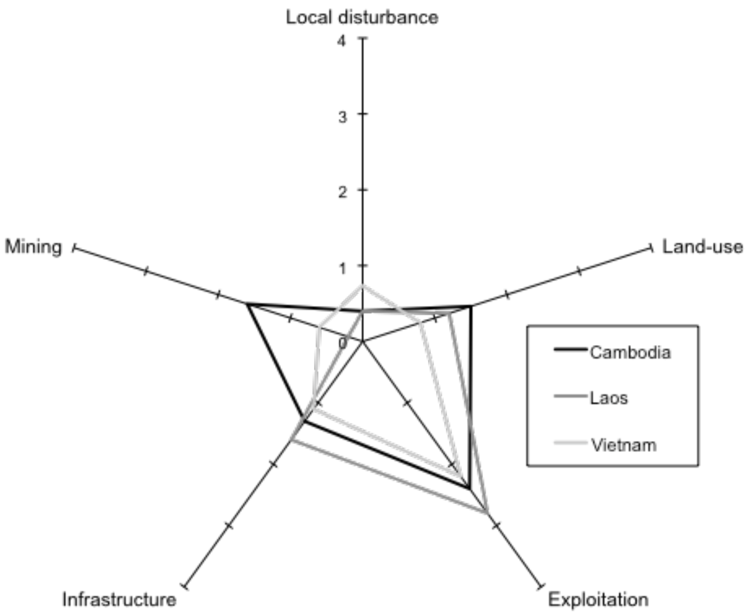

Figure 4-3 Typology of threats by country, based on similar causes. Measurement was scored on a scale of 0 (no threat) to 4 (likely to be highly damaging to forests and wildlife populations in the near future). Categories are an average of the following threats: local disturbance = fire, pollution and invasive species; land-use = agriculture encroachment and land grabbing; exploitation = logging and hunting; infrastructure = dams and infrastructure development; mining.

The magnitude and type of threats are also country-specific. Figure 4-3 represents a typology of all 10 threats based on related causal factors. Cambodia and Laos sites face more threats from infrastructure development than does Vietnam. Nevertheless, Vietnam is threatened more by local disturbance from chemical pollution, fire and invasive species. Land-use threats (agriculture encroachment and land-grabbing - where local people and/or temporary migrants clear forest to sell to wealthier people from other provinces, and this is difficult for local authorities to control) are highest in Cambodia, less in Laos and lowest in Vietnam.

4.3.3 Management of threats

Across all sites, the largest investment by conservation interventions to reduce threats was in law enforcement (30%) followed by education and training and research (Figure 4-4). Other threat reduction activities include local economic support, health support and infrastructure development, land-use planning and institutional development (of regulations, policies and laws). Tourism, while second only to law enforcement, is not a threat reduction activity in itself, but it is a part of the investment of conservation organisations – see Chapter 5.

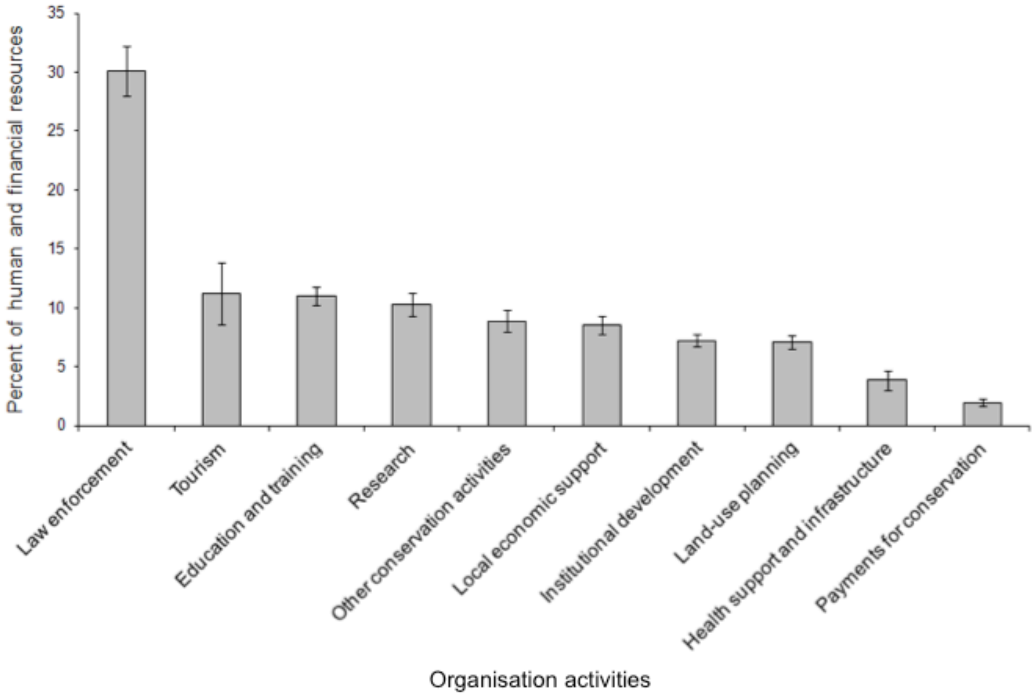

Figure 4-4. Conservation interventions in 2007 across the 15 forest conservation areas, grouped into 10 main categories. Bars represent mean percentage of expenditure of resources across the 15 sites (+/- standard error).

While these 10 categories of management intervention can be delineated, in practice management efforts usually involve working on several activities at once to reduce multiple threats. For example, most law enforcement is implemented by government officials, but in 10 areas local people are also paid to set up village patrol teams and inform the authorities about illegal activities (which is part of the 'conservation payments' strategy). Law enforcement is also supported by the development of institutions at local and national levels. Regulations made at the level of individual villages or entire conservation area are used as tools to reduce overexploitation from hunting, logging and NTFP extraction. In areas such as the BCI site and Van Ban Nature Reserve, the management boards set up the regulations by involving local people in the planning processes and in the management of the forest areas. Conservation area managers also implement land-use planning for villages in or bordering conservation areas, by mapping and zoning forest areas for peoples' use, with the intention of reducing agricultural expansion into forests.

Training of local people and government officials in environmental education is implemented at all 15 sites, often through multiple development projects, and represents a substantial portion of investment in conservation interventions (an average of over 10% - Figure 4-4). Training and awareness activities for national-level actors, such as staff of government departments and industries, are used to build their technical capacity and understanding of conservation. The aims of environmental education at the local level generally are to improve local peoples' awareness and understanding of conservation and the benefits of environmental services, and to improve technical capacity for environmental management. Thus environmental education at the local level is used mainly to reduce the threats from local resource extraction, such as NTFP exploitation, hunting and, to a smaller extent, logging. Furthermore, several conservation organisations use the national media, including newspapers, radio and television, to improve the awareness of conservation in the wider community, as an attempt to reduce the demand for forest resources and hence drivers of some threats.

Local economic support is centred around resource use, by intensifying agriculture, providing training for agricultural techniques and developing the markets for non-timber forest products (such as honey and resin) by setting up community associations. For example, the coordinator of the BCI stated that they spend one third of their time and funds spent in development-related activities, which has a primary focus on natural resource management through training, agriculture and NTFP development, and improvement of infrastructure for schools, clinics and roads[49].

The conservation area managers implement institutional building – which involves the reform of existing regulations, decrees and laws or the development of new ones – at local and national levels. Developing institutions and implementing management plans can help to reduce threats of land-grabbing, invasive species and pollution. Conservation organisations attempt to reduce the impact of large-scale infrastructure, including mines, hydropower dams and roads, by lobbying government and industry. In Phnom Samkos Wildlife Sanctuary, for example, multi-sectoral collaborations, in which the management board collaborates with multiple government authorities and international conservation organisations, have been implemented to develop regulations and enhance the efficiency of the judicial

[49] Interviews: BCI I1.

system to target the most serious threats[50]. In Van Ban Nature Reserve, however, the coordinator reported that a series of locality specific regulations have been set up to control degrading activities and unsustainable exploitation of wildlife and timber[51]. Villagers developed these regulations over several years with the assistance of the nature reserve managers.

Little time and funds are spent on activities to mitigate the threat of fire, primarily because little is known about the causes and impact of the fires to the conservation areas. Research and monitoring is, however, implemented by several conservation organisations.

4.3.4 Linking threats with management

Quantitative analysis using PCA shows that several of the activities are correlated with the magnitude of threats (Figure 4-5), although the total variance explained by this graph is relatively low, at only 35%. One of the clearer patterns is on the x-axis. There is a positive relationship among the activities 'support and infrastructure development' and 'other conservation activities' (which includes practices such as forest rehabilitation and management, support for sustainable resource use, biodiversity monitoring and boundary demarcation) with the threats of pollution, agricultural encroachment, invasive species, fire and infrastructure. Another positive relationship is among the activities of 'conservation payments', 'institutional development', 'research' and 'land-use planning', which appear to be in areas least threatened by infrastructure, agricultural encroachment and degradation

[50] Interviews: PSWS I2, I4.

[51] Interviews: VBNR I1.

from invasive species and pollution. A second clear pattern is on the y-axis, where the activities of ‘education and training’ and ‘local economic activities’ are positively correlated with hunting, but negatively correlated with land-grabbing. Interventions that use law enforcement as a major activity are in sites where land-grabbing is a major threat.

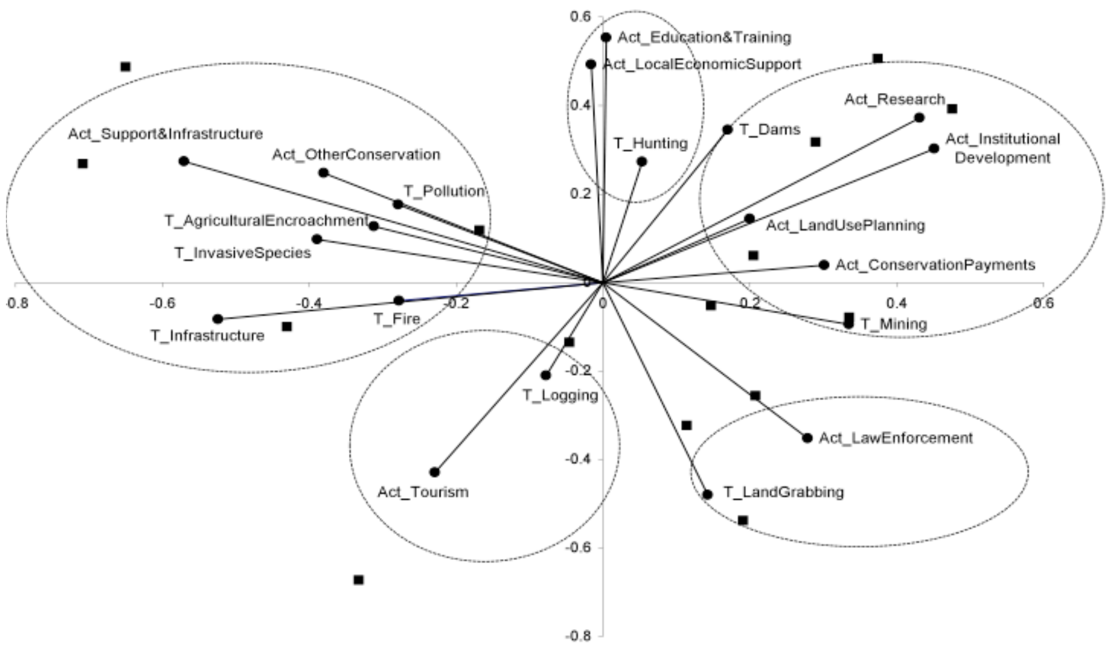

Figure 4-5 Principal components analysis of the relationships between conservation intervention activities ('Act') and threats ('T'). Data points represent the sites; groups of threats and activities are bound by ovals. Variance explained: x-axis = 19%; y-axis = 16%.

4.4 Discussion

Threats to forest areas of the Lower Mekong are complex and inter-linked, and the causes come from both local and external sources. Some specific threats are caused by local-level use of land and forest resources, such as hunting and agricultural encroachment. In several of the conservation areas, local people have a long history of hunting, NTFP collection and swidden agriculture (ICEM 2003d; Robichaud *et al.* 2009). Nevertheless, although wild harvested meat is eaten within the three countries, several of the drivers of hunting come from external international forces, including the demand from China for medicines and wildlife meat (Traffic 2008). The results also show a relationship between agricultural encroachment and agricultural incomes. Agricultural encroachment is a threat driven by local subsistence needs (Robichaud *et al.* 2009) and the national demand for agricultural commodities (De Koninck 1999; Malhotra 1999; ICEM 2003d). Furthermore, new migrants to the forest areas are increasing the pressures of greater agricultural areas in the conservation areas.

External actors (people outside the conservation areas, such as those living in other provinces or working in industries) also influence the threats to forest areas, especially with respect to national socio-economic development interests. Government and industry have an interest in infrastructure development (including hydropower dams and mines) and forest products, especially timber, to support the national economy (IUCN 2007a; EIA & Telapak 2008). Selective logging is often done by local and external actors, but is driven by the international trade in timber (EIA & Telapak 2008). The development of dams and mines in conservation areas perhaps arises from the government's willingness to benefit from mineral exploration and hydropower, which means allowing industries to explore areas away from population centres where forestlands are yet to be exploited. Land-grabbing is also a major threat to some sites, especially in Cambodia, but this is driven by the demand from wealthy individuals from outside the conservation areas, who buy the land for agriculture or housing (Boreak 2000).

The results provide some evidence that organisations are acknowledging whether the threats are caused locally or by outsiders. In several sites, several of the threats come from local land-use. In these situations, the conservation managers are implementing integrated conservation and development approaches, such as involving residents in forest management and planning, rehabilitation of habitats, education and awareness of the environment and conservation, provision of support for agriculture and development of NTFP markets. Outside the conservation areas, organisations are targeting threats from external actors, by building the capacity of governments at the national level to develop and implement regulations and policies, cooperate among authorities and improve the judicial processes. This, then, suggests that expanding the scope of interventions to influence factors at multiple levels, including careful coordination with national government and other national conservation actors (Wells 1998; Barrett *et al.* 2001), is necessary to improve the institutions and reduce the large-scale drivers of forest threats.

The results of the examination of associations between the activities of conservation interventions and the threats to conservation areas provide a picture of the relationships and suggest that specific strategies need to be responsive to specific threats. For instance, 'health support and infrastructure' and 'other conservation' activities are implemented in an attempt to reduce the pressures arising from high populations, such as infrastructure development, agricultural encroachment, pollution and invasive species. Strategies beyond the site (such as institutional development and increasing environmental awareness at the national level) might aid in reducing threats such as dams, through development and implementation of better environmental policies (Sneddon & Fox 2008). Other local activities, including education, training and local economic support, might also be targeted at locally caused threats, such as hunting (although the effectiveness of these types of interventions is yet to be tested). Interventions must be implemented carefully, however, because they may have unintended consequences. For instance, if an organisation attempts to improve infrastructure in an area to reduce some threats related to over-exploitation, it might also cause an increase in threats of pollution and invasive species.

Differences between the social, environmental and institutional contexts of each country also influence, to some degree, the magnitude of threats to biodiversity. In Cambodia and Laos, the weak land tenure system allows for a higher threat of land grabbing than is found in Vietnam, where land tenure and state control are stronger (Pham *et al.* 2008). Also, due to the relatively larger areas and untapped resources within the forest areas of Cambodia and Laos, resource exploitation, agriculture encroachment and infrastructure development are occurring at higher rates. These findings support previous studies of threats in these countries, which suggested agriculture encroachment and resource exploitation were the most severe threats (Lacerda *et al.* 2004; Robichaud *et al.* 2009; Chanrithy 2010). In more developed Vietnam, however, infrastructure development and land grabbing are less threatening, but the population pressures to forest conservation areas are higher, perhaps causing the threats from invasive species and pollution. This suggests that strategies in different countries are required to be pragmatic and adapt to each individual situation, such as recommended by the studies of Cat Tien National Park in Vietnam (Polet & Ling 2004) and Nakai Nam Theun National Protected Area in Laos (Robichaud *et al.* 2009).

4.5 Conclusions

This chapter has explored the threats to forest areas and the actions of conservation interventions at the site level in three Lower Mekong countries, one of the first of its kind at a regional level. The method allowed the threats and conservation actions to be teased apart to identify local to external threats and actions, and how the threats and actions were linked. This was possible only through an assessment of the magnitude of threats and an understanding of the context of the conservation areas. This, then, suggests that further development of the existing frameworks to assessing how conservation actions mitigate threats (Salafsky & Margoluis 1999; Salafsky *et al.* 2008; Balmford *et al.* 2009) should also include a measure of the magnitude of threats and an appraisal of context.

The results of this chapter suggest that threats are country-related and context specific, and that external factors are as important as local factors in causing threats to forest conservation areas. This has implications for the strategies to counter the threats. Integrated conservation and development approaches at the site level might help to reduce local and some external threats, if implemented through appropriate engagement with local resource users (Sayer 2009). A broader suite of strategies by conservation managers, however, such as improving environmental institutions and lobbying industries that are exploiting forest areas, might help to reduce the external drivers and causes of the threats.

The results here lead to three key recommendations. Firstly, reiterating recommendations from other conservation studies (Margules & Pressey 2000; Geist & Lambin 2002; Polet & Ling 2004; Pressey & Bottrill 2008), the different settings and uniqueness of sites suggest that interventions must be made with a good understanding of the local context prior to intervention and be planned systematically for pragmatic conservation actions. Secondly, the results showed some differences in the type and magnitude of threats among the three countries studied, which suggests that targeted and well-implemented policies at the national level could aid conservation interventions to reduce threats. And finally, while no universal approach for reducing all threats exists, due to the pervasiveness of specific threats, including hunting, logging and agricultural encroachment, shared learning across sites could improve the effectiveness of conservation actions and aid in the reduction of threats at a regional level.

Chapter 5 Organisational strategies for reconciling forest conservation and livelihood goals in interventions in forest conservation areas

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Results from this chapter were also presented in a poster at the Society for Conservation Biology Annual Meeting, Beijing, July 2009.

Results from this chapter are also presented in a policy brief: Mai, Y.H.; Sunderland, T.C.H. (eds.)(2009) 'Losing less and winning more: building capacity to go beyond the trade-offs between conservation and development in the Lower Mekong,' CIFOR livelihood brief No. 12, CIFOR, Bogor.

5.1 Introduction

Globally, conservation organizations are under pressure to fulfil multiple objectives in conserving biodiversity. Influencing the choice of implementation strategy is the continuing debate between strict conservation approaches and integrated conservation and development (ICD) approaches, with ICD including poverty alleviation as a primary goal (Wilshusen *et al.* 2002; McShane & Wells 2004; Roe 2008; Sunderland *et al.* 2008). Strict protection is criticised for its failure to achieve conservation (Barrett & Arcese 1995) and its negative impact on livelihoods and development (West & Brockington 2006; Buscher & Whande 2007). The ICD approach is often criticised for failing to sustainably achieve long-term conservation and development (Hughes & Flintan 2001; McShane & Wells 2004; West & Brockington 2006; Buscher & Whande 2007; Hill 2007). The recent discussion of trade-offs between conservation and development suggest an alternative to both, where interventions address issues at the landscape scale (in this chapter, an area greater than 10 000 ha) and negotiate with the multiple interest groups for desired outcomes (Fisher *et al.* 2005; McShane & O'Connor 2007; Haller & Galvin 2008; Sunderland *et al.* 2008).

There remains much uncertainty about what strategies to use to conserve biodiversity in forest conservation areas, which has led to calls for systematic comparisons of conservation interventions (Robinson & Redford 2004; Agrawal & Redford 2006; Ferraro & Pattanayak 2006; Sunderland *et al.* 2008). Systematic comparisons around the world might reveal best practices in promoting conservation and development objectives, however, the context of each intervention site might be so different as to make a universalised approach next to impossible. This chapter addresses the concerns regarding the strategies of biodiversity conservation organisations by focusing on a regional scale. Here, we systematically explore what strategies are employed by a diverse set of interventions to achieve both forest conservation and local livelihood improvement in conservation areas of the Lower Mekong, and how their strategies, including their activities, development of partnerships and site-level negotiations, affect their performance.

Environmental education, local livelihood improvement activities and institutional development ('Institution' is used broadly, to cover rules, regulations and policies, while institutions already exist at local, provincial and national scales, new and reformed institutions continue to be developed) are employed by conservation organizations as tools to conserve forest areas from multiple environmental threats. Activities include implementing conservation awareness programs (Alpert 1996), legal and policy development (Salafsky *et al.* 2002; Koziell & Inoue 2006), providing alternative sources of income to the populations adjacent to protected areas (Fisher *et al.* 2005), such as intensifying agriculture, development of eco-tourism (Brooks *et al.* 2006), and payments for environmental services (Wunder 2007). While diversifying their strategies to include a wide range of stakeholders, most initiatives continue to invest a proportion of funds in traditional wildlife and habitat protection approaches, e.g. establishing and enforcing restrictive regulations, and undertaking land-use planning (Robinson & Redford 2004).

The debates about strategy have also been swayed by political ecology, which emphasizes that conservation is not an isolated field, but is part of a wider context including economic, social and political processes that have direct relevance to the options for action (Adams & Hutton 2007). The processes involve complicated and dynamic interactions between different actors in conservation areas (Berkes

2004), so improving conservation practice requires a better understanding of the multiple interests and politics among stakeholders of conservation areas. The key actors in the national conservation sectors around the world include government and non-government agencies (Wells 1998; Adams 2004), but conservation also involves local agencies and local people who depend on the forest resources within conservation areas (West & Brockington 2006; Springer 2009). However, the political power and interests of government agencies (Chhatre & Saberwal 2005) and international conservation organizations (Adams & Hutton 2007) discount the interests of local level actors who have less power to influence decisions (Swiderska *et al.* 2008).

Extensive negotiations are required to strike a balance among conservation and other stakeholder interests. Implementing organizations often implement techniques to communicate and build consensus among a wide range of stakeholders (including local forest users, government, non-government organizations and industry) through collaboration (such as partnerships; Barrett *et al.* 2001), participatory planning methods (Hannah *et al.* 1998; Polet & Ling 2004), and consultation (Herrold-Menzies 2006). Conservation initiatives increasingly adopt co-management approaches, develop partnerships and solicit the active involvement of local communities in developing and framing management plans in an attempt to strengthen local organizations and improve buy-in (Hughes & Flintan 2001; Leach & Pelkey 2001; Polet & Ling 2004; Robinson & Redford 2004; Parr 2008). Recent studies have suggested, however, that several implementation problems continue to be caused by minimal or poor negotiation; local people are not participating in the design or implementation of conservation initiatives, there is little consultation, and non-governmental organizations (NGOs) are not partnering enough with government and other organizations for mutual benefits (Berkes 2004; Schmidt-Soltau 2004; Hill 2007; Bourdier 2008; Swiderska *et al.* 2008).

The Lower Mekong countries (Laos, Cambodia and Vietnam) are situated within a ‘biodiversity hotspot’ (Myers *et al.* 2000) and thus important for biodiversity conservation. Thirty-five percent of the forests are conserved in the three countries (ICEM 2003d). Nevertheless, faunal populations have continued to decrease, driven by a prolific trade in wildlife and animal products (Traffic 2008; Nijman 2010), extensive areas of natural habitat have been lost (Global Witness 2007; Meyfroidt & Lambin 2008), institutions and organizational capacity are weak and thus statutory regulations are not well enforced (ICEM 2003d; Pescott & Durst 2010).

Interest and investment in conservation from government, international donors and NGOs has increased over the past two decades (Zingerli 2005; Singh 2009a). Given that poverty rates are high in each country (Carew-Reid 2003) and local people in the vicinity of protected areas of the Lower Mekong countries often rely on forest products (ICEM 2003d), local, national and international organizations have implemented conservation interventions with the dual aim of local livelihood improvement (Robichaud *et al.* 2001; Sage & Nguyen 2001; ICEM 2003d; Roe 2008). These interventions are supported by the governments in the Lower Mekong, which have a history of authority over conservation stemming back to the French colonial period in the first half of the 20th century (Cleary 2005). The priorities of government are, however, more for economic development than conservation (Malhotra 1999; Billon 2000), making it a challenge for conservation interventions to balance the two. National socio-economic development plans are taking a step forward by including sustainable natural resource management as goals for poverty alleviation (ADB 2006; GoC 2006; GoL 2006; Pescott & Durst 2010).

Recent studies of integrating conservation and development in the Lower Mekong provide recommendations and lessons learnt for intervention implementation (Sage & Nguyen 2001; ICEM 2003d; Lacerda *et al.* 2004; Hill 2007), but there is no systematic comparison across the three countries. There is also little understanding of how organizations choose between strategies of conservation, development and institutional support and how organizations relate to each other. This project was undertaken in order to fill this gap by systematically analysing the strategies and relationships between conservation and development interventions. We look beyond donor-funded projects to the perspective of the multiple organizations that implement interventions at different levels within conservation areas. As interventions are influenced by multiple stakeholders, including local people, private sector, non-government organizations (NGOs) and governments (Buscher & Whande 2007), we hypothesise that relationships between organizations are an important factor in deciding strategies.

This chapter also goes one step further and explores the factors influencing the success of these interventions. A challenge with this is that there is much debate over what constitutes 'success' of interventions – the definitions and perceptions of success are diverse (Axford *et al.* 2008), measuring success is challenging (Agrawal & Redford 2006) and the effectiveness of outcomes are rarely measured (Brooks *et al.* 2006; Ferraro & Pattanayak 2006). We intend to contribute to this debate through the analysis of achievement towards the stated objectives of conservation organizations and discussing the issues in measuring performance. Through the use of a 'progress' measure, we explore whether the development of partnerships, site-level negotiations and implementing multiple different activities has an effect on achieving their desired outcomes. While there are different cultural understandings of conservation that might determine the success of interventions, we concentrate on a region, albeit with different cultural and historical differences within it, which helps to mitigate the potential variation factor. We focus on stakeholder involvement because of the widespread belief that approaches that include local people through participatory approaches, consult with all relevant stakeholders and form collaborations among multiple organisations are important to progress and success (Stoll-Kleemann & O'Riordan 2002; Berkes 2004; Robinson & Redford 2004; Sayer & Wells 2004; Haller & Galvin 2008).

5.1.1 Case selection

This study is based on 15 sites – five forest conservation landscapes in Laos, Cambodia and Vietnam (Figure 2-1). The criteria for site selection were: a) The forest conservation area was larger than 10 000 hectares; b) There was one or more conservation and development interventions to manage the forest conservation area and associated buffer zone; and c) There had been intervention activities within the past five years (2003-2007). The cases were selected based on access and feasibility of doing fieldwork, willingness of the implementing organizations to collaborate in the data collection process and availability of data. Note that the focus of this chapter is on 'conservation areas', which are predominantly protected areas and other officially designated areas, not community forests, community protected areas or other community-based initiatives.

In this study we analyse the interventions of three types of implementing organization, which we refer to as 'management bodies', 'non-partner organizations' and ‘partner organizations’. Management bodies are the conservation management authorities at each of the 15 sites, and all have the dual aim of achieving biodiversity conservation as well as local livelihood improvement. These often take the form of a direct partnership between national government and an international conservation NGO (see Table 2-1). ‘Other organizations’ (often NGOs) manage conservation and/or development interventions that are focused on at least part of the buffer or core zone. Some of these organizations operate at a greater scale outside the conservation areas; five of the interventions operate across more than one of the selected sites. We classified the other organizations as ‘partner’ or ‘non-partner’, based on whether they did or did not have an arrangement with the management body to implement specific activities at the same site. The primary focus of the data collection was on the interventions of the 15 management bodies, with a further 28 interventions of partner and non-partner organizations being included into the analysis. The sites and associated management bodies are presented in Table 2-1.

5.2 Methods

A list of variables was developed through expert consultation and a review of literature. The variables were separated into four categories, the environmental setting, socio-economic conditions, institutional framework and management body characteristics. The initial list of 123 variables was presented and revised at two workshops in Cambodia and Vietnam. The variables were applied to all 15 sites and were further revised, and additional variables were included during data collection to ensure relevance to the study focus and ease of measurement. Subsequent revisions occurred during data cleaning and the initial stages of the analysis to produce a final matrix of 164 variables (Tables A1-1 to A1-4). A shortened version of 20 variables

Table 5-1 Variables used in the analysis to describe intervention activities, strategies and progress[52]. [a]The scale here does not include values of '2' and '4', but only the extreme and median values are described.

Variable name	Measurement (2003 to 2007)
Research	% effort: combination of financial and human resource cost Could include: - socio-economic studies - biological studies - research activities
Environmental education & conservation awareness	% effort: combination of financial and human resource cost Could include: - activities to improve education and awareness of local people; - training courses to improve understanding of the environment by staff members or government officials.
Training and non-environmental education	% effort: combination of financial and human resource cost Could include: - training to improve agriculture techniques or management of community associations - education to improve literacy or health
Local economic initiatives	% effort: combination of financial and human resource cost Could include: - activities to improve the incomes of local people; - implementation of local associations
Support & infrastructure development	% effort: combination of financial and human resource cost Could include: - activities to improve sanitation, health care and services; - building of roads, bridges and water facilities
Tourism	% effort: combination of financial and human resource cost Could include: - tourism operation - interpretation centres - tourism development - improvements to infrastructure for tourism
Land-use planning	% effort: combination of financial and human resource cost Could include: - Participatory Land Use Planning (PLUP) - Planning of and delineation of community protected areas, forestries or fisheries
Institutional development	% effort: combination of financial and human resource cost Could include: - efforts to change the market system - efforts to change the legal system

[52] The two education-related activities 'Environmental education and conservation awareness raising' and 'Training and non-environmental education' have been re-scored, based on Variable 139 (Education and training) and Variable 148 (Environmental education) in Appendix 1, and crosschecked with the collected descriptive information for each intervention.

Table 5-1 Cont.

Variable name	Measurement (2003 to 2007)
Law enforcement	% effort: combination of financial and human resource cost Could include: - operation of a law enforcement team - implementation of community patrols
Conservation payments	% effort: combination of financial and human resource cost Could include: - payments for information provided by local people - payments for community monitoring teams
Other conservation activities	% effort: combination of financial and human resource cost Could include: - activities to aid populations of wildlife (for example, captive breeding) - activities to improve forest quality - monitoring of wildlife and forest - boundary demarcation
Diversity of activities	Calculated using the Shannon-Wiener index of diversity for the 11 activities.
Stakeholder involvement[a]	Degree to which stakeholders have been consulted or participate in the intervention: 1=Very few of the potential stakeholder groups have been consulted with and/or participate 3=Several stakeholder groups have been consulted, currently collaborate and/or participate 5=All stakeholder groups have been consulted, organisations are collaborating and/or local people are involved in the organisations activities
Progress towards conservation/livelihood improvement/institutional development	1 = objective not a part of the intervention 2 = objective a part of the intervention, but intervention not on target to meet objectives 3 = intervention on target to meet objectives

from the management body characteristics section was developed to collect information from the partner and non-partner interventions (Table A1-5).

All cases were defined by the list of variables characterising the ICD strategies (Table 5-1). The types of variables used were primarily ordinal, on a scale of 1-5. By using ordinal scales, the data's accuracy is prioritised over the precision of the data. Other variables were nominal (qualitative information put into appropriate categories) or continuous variables such population and area.

For each data point, a qualitative description was used to explain the value given, supported by references to documents, databases, interviews and/or direct observations. A confidence indicator was included as a control measure for checking and eliminating variables, based on the consistency and reliability of values scored through the multiple available sources. To ensure temporal consistency, we collected information for the variables corresponding to the period from 2003 to 2007.

Data collection started in September 2007 and continued through June 2008, by two researchers (L.P. and B.H.C.) with the aid of local partners and research assistants, including translators. Although time was a major constraint, the use of fewer data collectors enabled the consistent interpretation and input of data to allow comparability and consistency among different sites. Data were collected from available information through documented sources, interviews with intervention staff, forest guards and local residents, and where possible, crosschecked by direct field observations of the researchers.

We analysed a subset of the variables for management bodies, partner and non-partner organizations (see Table 5-1). These variables described intervention activities, stakeholder consultation and progress. The intervention activities were split into eleven categories and were scored based on estimated resources of staff time and budget allocated to the different activities. A measure of the diversity of activities (as measured by the Shannon-Wiener diversity index) was also included because it is hypothesised that organisations spreading themselves over a wide range of activities will have lower progress. Furthermore, management is more complex as organisations deal with multiple types of interventions.

Although measures of 'success' are often challenging and unreliable, we attempted to explore whether progress towards the objectives of the intervention (e.g. as reflected in project log frames) were related to certain intervention strategies and activities. For the measure of progress we collected information from interviews with intervention staff and available documents. We separated progress variables into three categories: progress towards conservation objectives, progress towards local livelihood improvement objectives and progress towards institutional reform objectives (such as improving regulations and building technical capacity of government officers and organizations), and scored progress on an ordinal scale of 1 (objective not a part of the intervention's focus), 2 (objectives are a part of intervention's focus, but intervention is not on target to meet objectives) and 3 (interventions on target to meet their objectives).

We found some challenges in acquiring reliable and precise data for progress at the landscape scale, for three reasons. Firstly, the study is based on interventions of numerous institutions and interventions that differ in the period they have been active. Secondly, during the course of field visits, organizations rarely undertook or provided evaluations over the past 5 years (of the 43 interventions in this study, 15 provided documented sources that discussed their performance), so it was impossible to collect strong success or failure factors through objective and independent documented sources. Thirdly, each organisation has its own indicators of project development and progress, thus making it impossible to use universal indicators across all interventions. The only option for our purposes was to interview management staff, which we conducted with every organization. Some of the information received for measuring progress variables could be potentially biased towards over-reporting successes and underreporting challenges in achieving targets. The progress variables are therefore scored by three categories to increase the accuracy and confidence of the data at the expense of precision, and the analysis still provides several results.

Likewise, while organisations employ techniques such as local participation, consultation with multiple stakeholders and forming collaborations among organisations, the effectiveness of these tools is difficult to gauge. The challenge lies in the paucity of data available from documents and the interviews conducted with the 43 organisations. There was some data that relate to the strength of participation, consultation or collaboration used by the organisations, but in most instances the information did was not available for all three techniques. Due to this lack of data, the variables of participation, collaboration and consultation (see Appendix 1) were amalgamated to form the variable 'stakeholder involvement'. The stakeholder involvement variable was thus an indicator of the frequency of consultations, local participation and/or collaborations among organisations, rather than an indicator of the strength of these techniques.

The analysis methods used were similar to those developed by Ruiz-Perez and Byron (1999), to compare cases of forest product development around the world using multivariate analytical techniques. We used three steps to analyse the data: 1)

Box-plots and descriptive statistics were used to examine each variable 2) Bivariate analysis of specific variables was done using correlations and regressions (using SPSS; Statistical Package for the Social Sciences 2007, SPSS Inc., v.16.0); 3) Multiple variable analyses of related variables were done to identify the patterns and trends of factors influencing project intervention activities and progress. These results are crosschecked with qualitative responses from interviews, documents and observations at each of the sites. We maintained confidentiality of the interventions in this analysis by not identifying specific points on the graphs.

One multiple variable analysis technique used was principal component analysis (PCA) in Excel, which is used to identify inter-group relations of variables (e.g. intervention activities) and cases (i.e. sites). The first axis of PCA plot (the x-axis) represents the main axis of variation in the data, with the second axis (the y-axis) then representing the next axis of variation. The strength of the PCA is indicated by the cumulative 'percentage of variation explained' by the first and second axis.

For the second multiple variable analysis, we hypothesise that the 11 activities and diversity index will influence the achievement of intervention objectives. To test this, we used ordinal regression because progress is recorded in an ordinal scale. Ordinal regression is used to find a relationship between progress and activities undertaken. We only use non-zero variables, hence for the analysis of partner and non-partner organization interventions we excluded activities of tourism, law enforcement and conservation payments. The ordinal regression was done iteratively (using n-1 activity variables) to produce the best model, hence in the results we removed the 'local economic activities' variable for the analysis of progress towards biodiversity conservation, and removed 'other conservation activities' from the analysis of progress towards livelihood and institutional development.

There were some comparability issues among the interventions due to the diverse types of interventions operating at the 15 conservation areas. While each of the interventions is unique, they can be compared in an analysis. The reason for this is that each of the organizations is operating interventions with the goal of improving local livelihoods and/or conservation of biodiversity. Nevertheless, we separate organizations into the aforementioned groups – management bodies, partner and non-partner organizations. While there may be contextual factors that underlie the strategies that organisations employ in the conservation areas, by analysing the organisations separately from context, we can see the generality of strategies that are employed across the region.

5.3 Results

5.3.1 Description of contexts and interventions

Environmental conditions at the 15 sites are diverse, with a wide variety of forest types, ranging from dry dipterocarp forest to semi-evergreen and evergreen forest; some centred on mountains (such as Tam Dao National Park, Van Ban Nature Reserve and Nam Et Phou Louey National Protected Area) and others on flat terrain (such as Mondulkiri Protected Forest and the corridor between Dong Hoa Sao and Xe Pian National Protected Areas). Exploration of 49 variables related to socio-economic conditions showed that local conditions are complex and diverse at the 15 sites. For illustration, high population densities are around some conservation areas (such as Tam Dao and Cat Tien National Parks), and other areas have low population densities (such as Virachey National Park, Nakai Nam Theun National Protected Area and Van Ban Nature Reserve). In some sites, there is a high diversity of ethnic groups (such as in Nakai Nam Theun National Protected Area) and others are more ethnically homogenous. The dependence of local people on forest resources also varies from relatively low (categorised as less than 40% of subsistence and cash income from forests) in five sites to very high (over 90% of income from forests) in two sites. The threats to the forest areas are site-specific, driven by a variety of processes that is perhaps due to the diversity of contexts. Illegal hunting and logging, however, are universal threats. Other major threats include agricultural encroachment, dam building, other infrastructure development and mining.

Organization strategies are as varied as are the contexts in which they function. Several of the organizations operate on large budgets (greater than US $100 000 per year) in large areas (such as the Watershed Management and Protection Authority in the 430 000 hectare Nakai Nam Theun National Protected Area), and these tend to implement a variety of different activities for multiple projects. Some organizations, however, are implementing very small interventions (such as projects with budgets of $10 000 per year) that focus only on specific activities in small areas or single villages. The intervention length also varies from less than one year (such as Free the Bears in Bokeo Nature Reserve) to 17 years (such as Youth with a Mission in Cambodia and Cat Tien National Park Management Board). Although the organizations are varied, they all have primary goals to implement conservation and/or development interventions within the conservation areas and in the surrounding landscape.

We focus here on the activities and relationships of organizations operating in the 15 sites. The fifteen management bodies are all under the jurisdiction of a government unit, such as a management board, forestry administration, department of forestry or other. There are, however, differences between them because three are directly government-run and the remainder are partnerships between the government institutions and other organizations (see Table 2-1). Fourteen of the fifteen management bodies collaborate with other NGOs, the exception being Van Ban Nature Reserve where there are no other non-government organizations in the area. Seima Biodiversity Conservation Area, Cambodia, illustrates an example where multiple organizations are operating in a single conservation area. The Forestry Administration of the Ministry of Agriculture, Forestry and Fisheries is responsible for forest conservation, but is supported by the Wildlife Conservation Society, an international NGO, for technical advice and financial support. Livelihood improvement activities in key villages are mainly implemented by a partner organization, the Cambodian Rural Development Team (CRDT). Non-partner organizations are also active in Seima, such as the Red Cross, which implements health-related support to several villages in two communes, including water, sanitation and nutrition.

5.3.2 Analysis of activities

The activities of the 43 interventions of the 15 sites are diverse. Law enforcement is implemented for the control of forest resource exploitation (such as hunting, logging, agriculture encroachment and non-timber forest product collection). Tourism development is often employed as a mechanism to achieve sustainable financing, with the added benefit of contributing to the improvement of the livelihoods of a handful of residents in the vicinity of the conservation areas. Livelihood improvement activities are often targeted to those that reduce pressures on forests; such as fodder production to remove cattle from forests, non-timber forest product development for ensuring sustainable use, agriculture extension to reduce people's reliance on forest products, and family planning to reduce population pressure on already scarce land resources. Institutional reform, represented in the variables 'land-use planning' and 'institutional development' (Table 5-1), is to develop national and local regulations for controlling trade of wildlife and wood, acquiring tenure rights for local people and building government officials' technical capacity. Environmental education and conservation awareness-raising are implemented to improve understanding and knowledge of conservation and the environment by local people, protected area management staff and government officials. Training and non-environmental education aims to improve agriculture techniques, health care and literacy of villagers. Wildlife research, social research and other conservation activities (including boundary demarcation and wildlife monitoring) are also a part of several interventions.

The management bodies implement all eleven primary activities, but the focus is mainly on law enforcement (Figure 5-1). Tourism is implemented by only eight of the management bodies, and their effort is highly varied, with one intervention, the Gibbon Experience in Bokeo Nature Reserve, spending the majority of its resources on the development of eco-tourism. All management bodies implement livelihood improvement activities with the intent of reducing the pressure on wild resources by encouraging alternative livelihoods. Institutional development and land-use planning are also a component of the management bodies' portfolio.

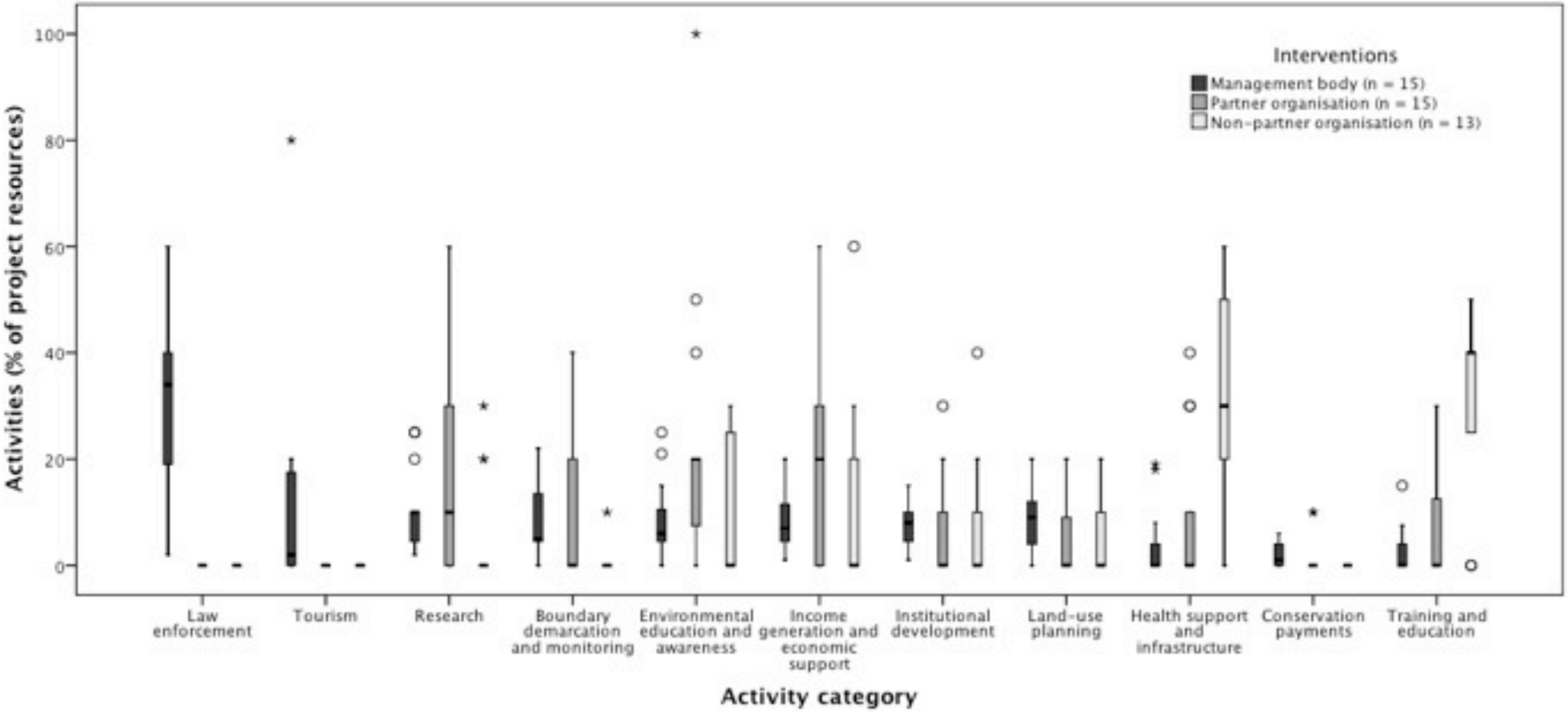

Figure 5-1 Box plots of the resource allocation to 11 activities by three categories of interventions: those of management bodies, non-partner and partner organisations. The outliers (circles and stars) represent individual interventions. The total of all activities adds to 100%.

Other organizations work in the sites to implement conservation, livelihood improvement or integrated activities, which often consist of single interventions or multiple donor-funded projects. Some of the organizations are solely conservation focused, implementing activities such as law enforcement training (such as the Wildlife Conservation Society in Nakai Nam Theun National Protected Area), environmental education (Save Cambodia's Wildlife and Association of Buddhists for the Environment in the Central Cardamoms Protected Forest) and species-focused conservation and monitoring (Fauna and Flora International's crocodile conservation project in the Central Cardamoms Protected Forest, and Free the Bears in Bokeo Nature Reserve). Others work specifically on livelihood improvement, such as the Red Cross in Seima Biodiversity Conservation Area. Yet others are combining conservation and development goals, such as Deutscher Entwicklungsdienst (DED) and WWF in Bach Ma National Park, Vietnam.

There is a clear difference among the activities of management bodies, partner organizations and non-partner organizations (Figure 5-1). The partner and non-partner organizations rarely implement law enforcement or tourism, and are primarily development oriented, with the majority of resources spent on local livelihood and community development. Interventions implemented by partner organizations do more research, environmental education and income generation activities than those of non-partner organizations. Environmental education is particularly specific to some of the partner organizations, such as the Association of Buddhists for the Environment in Central Cardamoms Protected Forest. Species monitoring is also a large part of some partner organizations, such as crocodile monitoring by Fauna and Flora International in Central Cardamoms Protected Forest and elephant surveys by the Wildlife Conservation Society in Nakai Nam Theun

National Protected Area. Non-partner organizations are focused more often on support for local livelihood development, including public health support (such as Healthnet in Cambodia), infrastructure development, non-environmental education and training (such as Helvetas in Vietnam, which provides training to improve agricultural productivity and sustainable use of natural resources), and some implement environmental education and provide economic support (for example microcredit, market development and development of non-farm incomes) to local people. All types of organizations, however, implement institutional development and land-use planning activities but primarily, management bodies dominate these activities.

Direct or indirect conservation payments seem to be a rarely employed conservation tool. For management bodies, partner and non-partner organizations, payments made to local people for conservation average less than 2% of the total resources for the interventions. These payments are primarily for assistance with law enforcement and for information about illegal activities, where informants are directly rewarded for reporting evidence of non-compliance with local regulations. One example of a reward mechanism system is that of the Nam Theun 2 hydropower plant on the edge of the Nakai Nam Theun National Protected Area, which is providing $1 million per year to the Watershed Management and Protection Authority to conserve the watershed (Robichaud *et al.* 2009).

We present a PCA plot of the activities of the three groups of interventions to show the diversity of strategies employed (Figure 5-2). The x-axis of the PCA plot is explained largely by the variables of 'health support and infrastructure development' and 'training and education' at one end, opposed to 'law enforcement' and 'conservation payments'. This suggests a polarisation from development-related activities (training, public health provision, and to a lesser extent local livelihood activities) to conservation-related activities (notably law enforcement, conservation payments, research and other conservation activities). Interventions of management bodies tend to focus more towards conservation activities, and the interventions are relatively homogenous by comparison to those of partner and non-partner organizations. Non-partner organizations are much more focused towards livelihood improvement, namely health support, infrastructure development, training, education and income generation; and are largely absent from the right side (conservation activities) of the graph. Partner organizations are more specialised to certain activities, and so are scattered on the PCA plot, though tend to be absent from the extreme left of the graph (i.e. pure development activities such as health, infrastructure and training support).

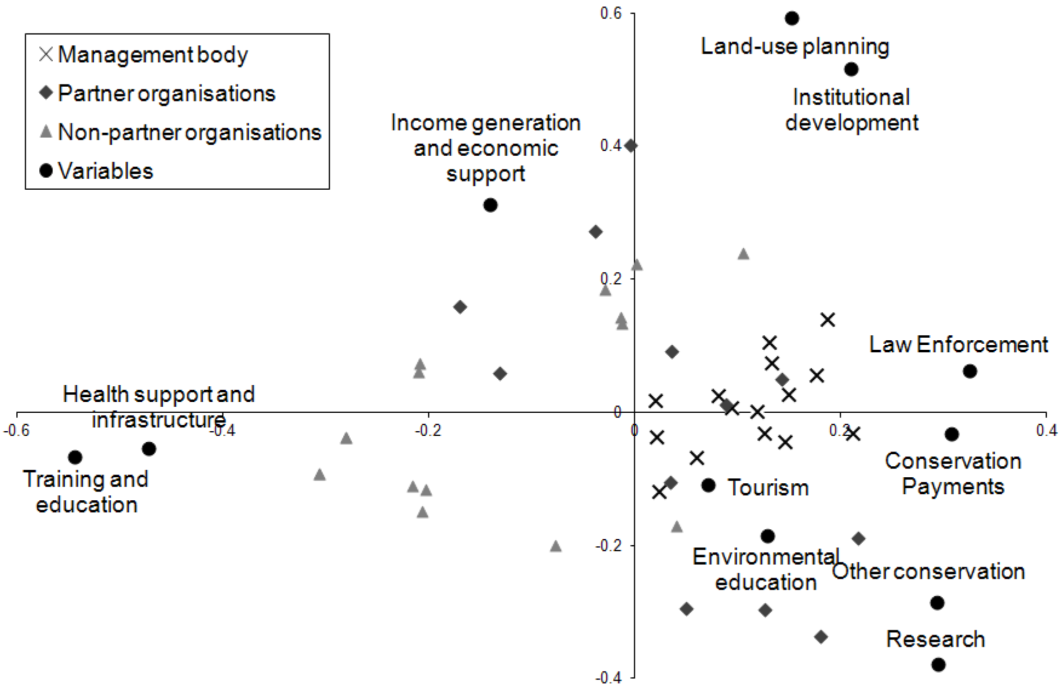

Figure 5-2 Principal component analysis of 11 implementation activities of all 43 interventions. Variance explained: x-axis = 24%; y-axis = 14%. 'Other conservation' includes rehabilitation, boundary demarcation and monitoring.

5.3.3 Analysis of progress

There is a clear distinction between management bodies, partner and non-partner organizations, hence they were split and analysed independently. Management bodies have objectives for biodiversity conservation (four of which are on target), livelihood improvement (four are on target) and institutional development (two are on target), but this is not the same for the 28 partner and non-partner organizations. Using crosstab analysis, 13 of 15 partner organizations have targets for biodiversity conservation and five of these are on target to meet objectives, while the non-partner organizations do not often include biodiversity conservation objectives (Crosstab analysis: Chi-square = 14.763; d.f. = 2; p-value = 0.001). Twenty-four non-partner and partner organization have targets for livelihood improvement, and eight of these are on target to achieving their objectives, but there is little difference between the groups (Crosstab analysis: Chi-square = 4.379; d.f. = 2; p-value = 0.112). Twelve partner and non-partner organizations have objectives for institutional development, but only four of these are on target to achieve objectives, and there is little difference between the two groups (Crosstab analysis: Chi-square = 3.877; d.f. = 2; p-value = 0.114).

The activities implemented by partner and non-partner organizations influence the progress towards biodiversity conservation and livelihood improvement objectives, but do not appear to influence progress towards institutional development (Table 5-2). Biodiversity conservation achievement is improved by the implementation of research and 'other conservation activities', such as monitoring of wildlife and rehabilitation of forest. Achieving improvements to livelihoods is supported by the implementation of health support, infrastructure development and local economic activities to improve income generation (such as agricultural extension). The diversity of activities did not have an effect on progress. Furthermore, the choice of activities did not influence any progress indicators of the site management bodies.

Tests on correlations between stakeholder involvement and progress of partner and non-partner organizations did not show any strong results, but this is possibly because 23 of the 28 organizations had a stakeholder involvement score of '5' (high degree of involvement). Tests on correlations between stakeholder involvement and progress of management bodies shows that to achieve targets of livelihoods, a high degree of involvement of various stakeholders is required (Spearman's Rho = 0.554; p-value = 0.032), and this may also be the case for biodiversity conservation targets (Spearman's Rho = 0.464; p-value = 0.082). Nevertheless, stakeholder involvement does not seem to be a factor in deciding progress for institutional development objectives (Spearman's Rho = 0.169; p-value = 0.547).

Table 5-2. Ordinal regression of activities against perceived progress towards biodiversity conservation, livelihood improvement and institutional development for 'other organisations'. Analysis was done by an iterative process (n-1 variables) to produce the best model, so the variable of 'local economic initiatives' was removed from analysis of biodiversity progress, and the variable of 'other conservation activities' was removed from analysis of livelihood and institutional development progress. The variables of tourism, enforcement and conservation payments were not part of the interventions of other organisations, and so were removed. [a]Goodness of fit: Chi-square = 22.095, P-value = 0.995; Cox and Snell $R^2 = 0.693$. [b]Goodness of fit: Chi-square = 103.537, P-value = 0.000; Cox and Snell $R^2 = 0.366$. [c]Goodness of fit: Chi-square = 51.990, P-value = 0.139; Cox and Snell $R^2 = 0.453$.

Variable	Biodiversity objectives on target[a]			Livelihood objectives on target[b]			Institutional objectives on target[c]		
	Estimate	df	Sig.	Estimate	df	Sig.	Estimate	df	Sig.
Progress = 1	3.96	1	0.271	4.689	1	0.275	0.193	1	0.965
Progress = 2	9.183	1	0.035	8.869	1	0.061	2.487	1	0.572
Diversity of activities	3.112	1	0.201	0.152	1	0.929	0.529	1	0.772
Research	0.079	1	0.091	0.078	1	0.211	-0.01	1	0.865
Support & infrastructure development	-0.026	1	0.561	0.102	1	0.038	-0.006	1	0.899
Land-use planning	0.075	1	0.409	0.106	1	0.19	0.068	1	0.396
Institutional development	-0.055	1	0.374	0.061	1	0.315	0.036	1	0.538
Other conservation activities	0.175	1	0.024	-	-	-	-	-	-
Training and non-environmental education	-0.053	1	0.322	0.068	1	0.156	-0.078	1	0.131
Environmental education & conservation awareness	0.032	1	0.333	0.031	1	0.445	-0.003	1	0.938
Local economic initiatives	-	-	-	0.107	1	0.04	-0.007	1	0.891

5.4 Discussion

Neither classic approaches of protectionist conservation nor integrated conservation and development are dominant at the sites we studied in the Lower Mekong. Rather, it appears that there is a mosaic of approaches and activities in and around forest conservation areas. The high level of law enforcement activities of the management bodies suggests that protection of valuable biodiversity is a priority at the forest conservation areas. Livelihood improvement is, however, undertaken as an indirect measure to reduce threats to conservation areas by providing alternative livelihood strategies. Several of the management bodies in the Mekong sites administer activities that link forests with local livelihoods, such as NTFP development, ecotourism and involving local people in conservation activities. Institutional development for regulations, laws and tenure rights is implemented by organisations at both the local and national scales, because improving governance is a benefit to biodiversity conservation (Wells 1998; Barrett *et al.* 2005; Swiderska *et al.* 2008; Oldekop *et al.* 2010). While payments for environmental services are not a commonly implemented strategy to support conservation and development, PES is an emerging mechanism for conservation in the three countries (Pham *et al.* 2008; Tallis *et al.* 2009).

5.4.1 Partnerships for conservation, less for development

Why are certain activities done through partnerships and others not? There may be multiple reasons for this. International conservation organizations working in these countries have a mandate to support the governments' efforts in protecting forest resources, as indicated by the structure of the management bodies of the conservation areas. The other organizations working in these protected forest areas have different attributes in their management, particularly in their mandate, motivation, capacity and power (Castillo *et al.* 2006). Partnerships may be formed with organizations with different management attributes, yet have similar agendas towards conservation. For example, while the management bodies implemented local livelihood improvement activities that were focused on forest resources, partner and non-partner organizations more frequently implement activities that shift local people's focus away from forests through other livelihood improvement activities, such as agricultural intensification, health-related interventions to reduce population pressures on already scarce land resources, non-farm income generation and infrastructure support. Partner organizations, generally non-government organizations, mostly target their activities towards achieving biodiversity conservation, and hence appear as supporting the efforts of the management bodies. This may suggest that non-government organizations are providing a service that the government institutions responsible for forest management are unable to provide because of limited capacity. On the other hand, organizations not partnering in a particular site are focused less on conservation and more on livelihood improvement, including health support, training and sustainable use of natural resources. This suggests that non-partner organizations have agendas that are different from the management bodies, and hence it would be inefficient to form partnerships.

The progress of interventions is determined by the scope of the interventions. When focusing on conservation and development at the site-level, such as that of the management bodies, the intervention is required to diversify its strategy by focusing on all three objectives of conservation, livelihood improvement and institutional development. This makes sense because conservation agencies are dealing with complex issues over large landscapes, and recommendations suggest they need to expand their focus in order to deal with trade-offs and they need to diversify activities in order to achieve and balance multiple objectives (Hughes & Flintan 2001; Sunderland *et al.* 2008). Nevertheless, when we look at the other organizations, several of the organizations are focused on livelihood improvement or conservation, not both. Perceived progress towards these objectives appears to be better achieved when organizations focus on fewer activities that strictly target conservation or development.

5.4.2 Pragmatic solutions to conservation problems

Organizations in Cambodia, Laos and Vietnam are attempting to seek pragmatic solutions by adapting to the local context. There are multiple stakeholders in each of the areas, with a specific set of social, environmental and political factors characterising each site. Pragmatic strategies are then an option for dealing with issues on a day-to-day basis, depending on the problem at hand. A strategy might be to increase law enforcement to a remote area because of frequent reports of illegal logging, or in another area, a development strategy is implemented to assist communities to improve rice production to reduce encroachment to the forest areas.

Part of this pragmatic approach is to improve understanding of the local context and to work with multiple stakeholders through participatory and collaborative approaches. Although previous studies have noted the lack of appropriate stakeholder involvement (Hill 2007; Bourdier 2008), we found that the majority of organizations were employing practices of local participation and collaboration with other stakeholders. Furthermore, for the management bodies of the 15 sites, perceptions of progress is better when the organizations are employing practices of improving negotiations with other stakeholders, through participation, collaboration and consultation. An improvement in perceived progress might be because participation by local interest groups helps to improve understanding of their different perspectives, thus improving effectiveness of conservation interventions (Stoll-Kleemann & O'Riordan 2002). While there are institutional, political, financial and social challenges to be able to collaborate with organizations and local interest groups, they are important elements in improving interventions (Barrett *et al.* 2001; Leach & Pelkey 2001; Stoll-Kleemann & O'Riordan 2002; Schmidt-Soltau 2004; Tongson & Cola 2007).

Pretty and Smith (2004) recommend that the kind of participation necessary to improve outcomes for conservation should be at least functional (where participation is seen as a means to meet predetermined objectives) or interactive (where participation is for joint analysis, action planning or strengthening of local groups and institutions). Where participatory practices are not satisfactory at the local level, organizations need to seek a more functional kind of participation that can more effectively achieve set goals. An approach might be to employ consensus-based decision-making to create a common understanding of a problem and the required actions among a diversity of stakeholders, which can reduce conflicts (Pellow 1999). This also means accepting the differences in interests, power and agendas of different stakeholders, by implementing practices of negotiation that are in consonance with the political and cultural contexts of each country.

5.4.3 Monitoring and evaluation required for better indicators of success

Success of these interventions is difficult to measure and compare, as the definitions and perceptions of success are diverse (Axford *et al.* 2008), especially when comparing interventions of different scopes. This issue is reiterated because, as Ferraro and Pattanayak (2006) discuss, evaluations are rarely done for a wide variety of reasons (they list 8), and so it is not unusual that we found few evaluations of interventions. Our measure of perceived progress is a useful indicator to explore some assumptions and discuss the strategy of organizations. Nevertheless, the progress variable was, in most situations, therefore weak due to the lack of available information. Through the course of this research, we gained only a surface understanding of the interventions. More detailed knowledge of the history of the sites and interventions would improve this measure of performance, and might reveal that conservation challenges are even larger than described by the current data. While there are likely to be biases from the response of the interviewees, and despite the paucity of the data, the results provide some important findings related to progress, negotiations and conservation-development focus.

A key problem remains: that the effectiveness of outcomes in conservation and development interventions are rarely measured (Brooks *et al.* 2006). This may be due to multiple logistical issues, such as staff being overworked, insufficient funding and a lack of a strategic vision of the conservation areas, but we have not typified these reasons in the analysis. Nevertheless, we reiterate others' recommendations and suggest that one needs to set and measure tangible outcome targets and measure progress towards them (Sayer & Campbell 2004; Sayer *et al.*

2007; Kapos *et al.* 2009). The key reason for implementing monitoring and evaluation procedures is because a focus on outcomes by setting a counterfactual (that is, asking 'what if the intervention did not happen?') can demonstrate impact towards protecting biodiversity (Ferraro & Pattanayak 2006). In the current climate of thinly stretched budgets, monitoring and evaluation is a part of good management, by providing early warning signs of slow progress, improving accountability and ensuring the funds are well spent (Stem *et al.* 2005; Ferraro & Pattanayak 2006).

There is a wide diversity of strategies employed by conservation and development interventions at the 15 sites. Each site has its own unique combination of characteristics and interest groups, which influences the choice of the activities employed by the interventions. The results, however, provide an illustration of the types of strategies employed, regardless of context. While we found some important results for the management of interventions, we recommend that if doing research based on case comparisons, extended periods of field research are necessary to understand better each site and context. We found issues in comparing the cases of interventions and sites, because each is distinct and their scope is greatly varied. Recent papers have suggested that detailed case studies remain an important method for understanding complicated issues (Gerring 2004; Flyvbjerg 2006). While comparisons across cases can provide useful patterns, case studies are critical to gain a clear understanding of the different contexts and actors in each situation so as to be useful for other conservation practitioners and researchers of conservation and development issues. By combining both qualitative and quantitative analysis, mixed methods are easily applicable to this type of research, and have been used in international development for decades (Tashakkori & Creswell 2008). Mixed methods have the advantage of flexibility and are well suited for understanding both culture and context, which allows for implementing culturally sensitive interventions and evidence-based practices (Nastasi *et al.* 2007).

5.5 Conclusions

Similar to the findings of Polet and Ling's (2004) study of Cat Tien National Park, rather than following the classical approaches of strict protection or integrated conservation and development, what we have seen is that interventions employ a mosaic of pragmatic approaches to address issues in forest conservation areas. The managers of conservation areas are operating in complex environmental and social contexts, and so are tasked with improving conservation, livelihoods and institutions, often with the assistance of multiple other organizations. These partner organizations are focused on specific conservation and livelihood objectives, implementing activities such as species monitoring, education and income generation, but there are also non-partner organizations operating at the same sites that often aim to improve the livelihoods of local residents, largely through health work and infrastructure development.

As the results suggest, employing practices of stakeholder involvement, including local participation and collaboration with multiple stakeholders, might help improve biodiversity conservation and livelihood development by assisting with the management of conservation areas. Due to the complexity of contexts and limited available data, however, the results did not provide detailed insights into the successes and challenges of stakeholder involvement techniques. Thus, further mixed methods approaches (such as through a statistical comparison of multiple in-depth case-studies of collaborations and participatory approaches) could help to provide a much-needed understanding of the mechanics of collaborations and participation in complex circumstances such as the Lower Mekong conservation areas.

Chapter 6 An assessment of future scenarios for conservation and livelihoods in Cat Tien National Park, Vietnam

6.1 Introduction

Multiple options are available to managers of forest conservation areas and choosing the best possible option can be assisted through analysis of the associated costs and benefits. An option of protecting forests to conserving biodiversity, where local resource use is restricted, can improve conservation of an area but may impose negative social and economic effects on local resource users (West & Brockington 2006). Integrating conservation and development might aid in improving local livelihoods, but might not be the best option in areas where threats to biodiversity are caused by extra-local actors, or where there are limited opportunities for local people to derive alternative income sources (Sanjayan *et al.* 1997). Payments for environmental services, whereby an environmental service (such as water or carbon) is voluntarily traded between two parties (Wunder 2006), is also an option for improving local incomes and financing conservation. PES, however, may not be successful if the payment levels are low or contracting mechanisms are not well developed (Tallis *et al.* 2008). This chapter explores the options of forest protection, integrated conservation and development and PES through an analysis of scenarios at one site, Cat Tien National Park (CTNP) and the associated buffer zone in southern Vietnam.

One of the largest international concerns in the last few years is over climate change and its mitigation. The forestry sector accounts for approximately 20% of greenhouse gas emissions each year (Houghton 2003; Baumert *et al.* 2005). By way of carbon trading, the forestry sector can potentially contribute to mitigating climate change while concurrently improving the conservation of biodiversity (Strassburg *et al.* 2010). Conservation agencies are hence looking towards the emerging mechanism for reducing emissions from deforestation and degradation in developing countries (REDD+; Angelsen *et al.* 2009). REDD+ includes both forest conservation as well as afforestation and reforestation (Angelsen *et al.* 2009). In REDD+, the amount of carbon gained or lost in a specific area of forest is calculated by measuring the difference between a baselines (derived from an analysis the recent historical trends in forest cover) and the actual carbon in the area, with countries being rewarded for the carbon they save through policies and practices to reduce carbon loss or sequester carbon (Angelsen 2008b). The mechanisms for implementing REDD+ are still being discussed in global negotiations.

Influencing the options for conservation and development are the interests of multiple stakeholder groups in and around conservation areas (Wells 1998). There is uncertainty over the strategies that enable wins for both livelihoods and biodiversity. National governments have some power to determine the management of conservation areas, including the policies related to the control of resources and payment schemes for environmental services. Large-scale developments, including the construction of roads and plantation concessions, are in the interest of government and industry but often impinge negatively on forest conservation areas. Local livelihoods are at stake when management influences the use of resources in or surrounding the forest areas. However, use by local people can put pressure on forests and biodiversity – this includes exploitation of timber and wildlife, and encroachment of agriculture (De Koninck 1999; EIA & Telapak 2008; Traffic 2008).

This chapter explores the processes involved in environment and development decision making in forest areas, particularly the trade-offs between biodiversity and livelihoods goals. Our aim is to explore the effects of environment and development scenarios on biodiversity and local livelihoods of CTNP. We do this through participatory modelling with stakeholders at CTNP, using the simulation model STELLA (Isee-systems 2006). Participatory modelling allows a group of users to create models of a system, which enables participants to explore options in the system, therefore enriching debate and revealing important insights to real problems (Sandker *et al.* 2010a). In this case, four scenarios were selected through a participatory approach with various stakeholders: 1) business as usual ("BAU"), 2) more emphasis on developmental goals ("Dev"), 3) trying to balance environmental and developmental goals ("E&D"), and 4) more emphasis on environmental goals ("Env").

Vietnam has been pioneering in establishing a legal framework for payments for environmental services (PES) and is now piloting PES in two watersheds in Vietnam (Pham *et al.* 2008). Since PES might be a future option for CTNP, we explore PES using the four scenarios, including for carbon and water, and analysis their potential contribution to the budgets of government and incomes of local resource users. We also discuss the feasibility of each scenario and how each might be implemented, by interviews with staff at Cat Tien National park and local people. We hypothesise that the benefits to biodiversity and livelihoods are greater overall for an environment and development scenario, but implementing actions for this scenario are the most challenging. Through the model results, this study clarifies the trade-offs between conservation and development and explores whether PES and REDD+ schemes are a viable option for conservation efforts.

Section 6.2 describes the management and biophysical and social context of Cat Tien National Park. In Section 6.3, we present the methods for STELLA modelling, including details on each scenario, data collection and the model structure. We then present the results from the modelling procedure in Section 6.4.1 and present the interview results that explore the feasibility of implementing each scenario in Section 6.4.2. In Section 6.5 we discuss the implications of the results on biodiversity conservation and livelihood development Cat Tien National Park and Vietnam, and Section 6.6 concludes.

6.2 Cat Tien National Park

With our focus on PES, Vietnam is appropriate given Vietnam's advanced policy framework (Pham *et al.* 2008; Petheram & Campbell 2010; Pham *et al.* 2010). We selected Cat Tien National Park because of its importance as an internationally recognised area for wetlands (Ramsar 2010a), endemic birds and biodiversity (BirdLife 2004), and is tentatively listed as a World Heritage site (UNESCO 2010a). We also wanted to examine a landscape where population pressure is high and threats come from local people rather than major external threats.

Cat Tien National Park, officially declared a National Park in 1998, lies within the provinces of Dong Nai, Binh Phuoc and Lam Dong in the south of Vietnam (see Figures 6-1 and 2-1) and is managed by the Cat Tien National Park Management Board. Zoning of the area consists of a core area of 71 790 ha (split into two sections) and an official buffer zone of 251 445 ha (Petheram & Campbell 2010). Cat Tien was sprayed with herbicides during the America-Vietnam War (1965-1973), and subsequently selectively logged for valuable timber species (Polet & Ling 2004). The CTNP Management Board is financed by the Ministry of Agriculture and Rural Development but also receives funds and collaborates with other government departments and international conservation organisations, particularly WWF. The objectives of the National Park are: (i) To conserve the local ecosystems, (ii) to preserve the watershed of Tri An Reservoir, (iii) to provide research opportunities for national and international scientists, and (iv) to act as a destination for sustainable tourism (Morris & Polet 2004).

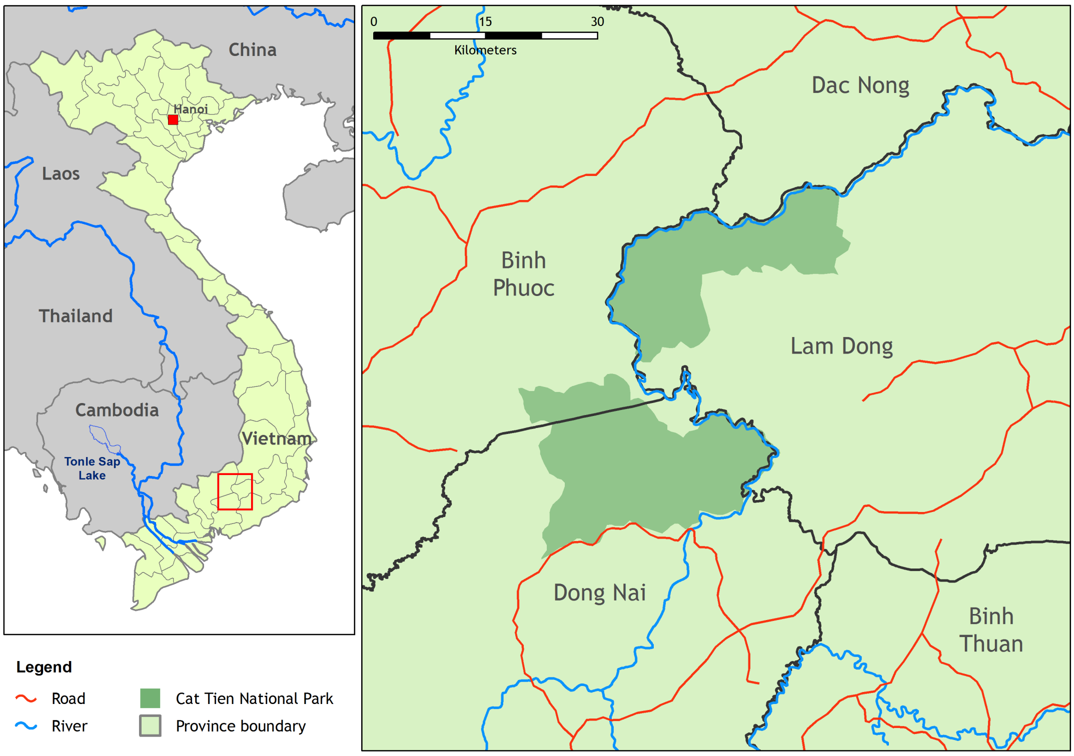

Figure 6-1 Map and location of Cat Tien National Park.

The main types of vegetation are classed as mixed forest, bamboo forest, semi-evergreen forest, evergreen forest, bush/scrub forest and plantation (Polet & Ling 2004). The management board has confirmed the presence of 40 threatened fauna species listed on the IUCN Red List, including the Rhino, *Rhinoceros sondaicus annamiticus*, and several herds of Gaur, *Bos gaurus* (Polet & Ling 2004), a large ungulate with a distribution across south and southeast Asia (Pasha *et al.* 2004). Nevertheless, numerous threats exist to the habitats and species of Cat Tien National Park, mainly arising from the population in and surrounding the core zone, including agricultural encroachment, hunting of wildlife and selective harvesting of timber and bamboo. As of 2010, there are approximately 600 people in the core zone and approximately 200 000 people in the buffer zone (Nguyen Van Thanh, pers. comm., 3/2010). The growing population has increased the demand for agricultural land. Hunting is also an issue because of the high demand for bush meat. Invasive species of plants and animals have also contributed to habitat degradation and decreases in species populations (Morris & Polet 2004).

The buffer zone consists of human settlements and state forest enterprises. There are eleven ethnic groups living in and around the Park, but 74% of the buffer zone population is the national majority group, Kinh (Morris & Polet 2004). Two indigenous minority groups, Chau Ma and Stieng, inhabit the area, but there are also eight other minority groups that have recently migrated from Northern Vietnam. Indigenous people have a long tradition of shifting cultivation and livestock rearing. The new immigrants to CTNP buffer zone, who have settled since 1990 (Morris & Polet 2004), mainly implement agriculture activities (Nguyen 2007), particularly involving annual crops (such as rice, maize and cassava), perennial crops (such as cashew and coffee) and plantations (such as rubber and *Acacia mangium*). There are five forest areas surrounding the National Park that are managed by the Vietnamese government. Four of these are State Forest Enterprises (SFEs), managed for the production of timber from plantations and selective logging of natural forests. Selective logging has reduced in recent years and the enterprises in Dong Nai province have restrictions on the use of natural forest areas (Tran Van Thanh pers. obs.). A fifth area, Vinh Cuu, has recently been established as a Nature Reserve from a previous state forest enterprise.

6.3 Methods

6.3.1 Creation of the model

One approach to exploring options for implementing conservation and development initiatives is through analysing scenarios via systems dynamic modelling. A systems dynamic approach is useful because it allows for the analysis of complex temporal dynamics, such as interlinked changes in forest cover and local incomes, and hence can demonstrate the outcomes under different scenarios. In this chapter we have used the software package STELLA v9.0.3 (Isee-systems 2006), which allows for easy communication with stakeholders, even those not familiar with modelling, and is thus suitable for participatory modelling.

Creation of the models commenced at a workshop in Cat Tien National Park, where 31 participants compiled a model over five days in 2007. We subsequently revised and updated the Cat Tien model in a four-day workshop in April 2009, involving two representatives from Cat Tien National Park, a researcher familiar with Cat Tien based at the University of Agriculture in Ho Chi Minh, and five researchers from the Centre for International Forestry Research, some of whom were at the initial workshop. Participants discussed the main trends and events in Vietnam that have an effect on conservation and development at Cat Tien and four scenarios were developed. Each scenario influences the multiple components in the model, as shown in Table 6-1. The assumptions under each scenario were discussed and agreed to by the workshop participants.

6.3.2 The scenarios

6.3.2.1 Scenario 1: Business as usual (BAU)

This scenario is a continuation of what has recently happened at CTNP, which shows the current strategy (as of 2009) of implementing conservation and local livelihood development. The scenario highlights three main conservation strategies: forest resource protection by CTNP management board, ecotourism and watershed protection by local people (as specified in Table 6-1). In the core zone, CTNP management board are attempting to reduce negative impacts from local people on the forest, which involves enforcement of laws stopping agricultural encroachment and resource extraction. Some encroachment (900 ha per year) and hunting (5% of Gaur population per year) are, however, still occurring in the core and buffer zone forests. Tourist numbers are steadily increasing and will be expected to be about 30 000 visitors per year in 20 years.

Table 6-1 Changes in the system for each scenario. CTNP = Cat Tien National Park; VND = Vietnamese Dong[53]; NTFPs = non-timber forest products; SFE = state-forest enterprises; PES = payments for environmental services; VND = Vietnamese Dong. More details are described in the electronic version of the model (Appendix 1). [a]Rates are per year. [b]Rotations for harvesting are every seven years, so only 1/7 of the area (is harvested per year; assuming also that revenues increase by 50% for a development scenario. [c]Assuming double the harvest rate for development and less for E&D and Env scenarios (but including reduced impact logging for these scenarios).

Process	Scenario 1 Business as Usual (BAU)	Scenario 2 Development (Dev)	Scenario 3 Environment & Development (E&D)	Scenario 4 Environment (Env)
Forest conversion to local land uses[a]	900 ha	1500 ha	600 ha	150 ha
Forest conversion to infrastructure[a]	3%	10%	3%	3%
Agriculture cropland conversion to agroforest[a]	2%	4%	3%	1%
Agroforest conversion to local plantation[a]	1.5%	3%	2%	1%
Total conversion to SFE plantations over 20 years	20 000 ha	50 000 ha	0	0
Income non-farm and off-farm work[a]	2 000 000 VND/household/year	4 000 000 VND/household/year	1 000 000 VND/household/year	200 000 VND/household/year
Income NTFP and illegal activities[a]	5 600 000 VND/household/year	8 400 000 VND/household/year	6 200 000 VND/household/year	4 500 000 VND/household/year
Hunting of Gaur[a]	5% population	8% population	3% population	None
CO_2 payments	None	None	Yes	Yes
Costs from loss of CO2	-	Included	-	-
Payment distribution for core zone carbon[a]	-	-	15% to CTNP management board 5% to government 80% to households	15% to CTNP management board 5% to government 80% to households
Payment distribution for SFE carbon[a]	-	-	70% to government 30% to households	70% to government 30% to households
Water payments	300 000 VND/ha	None	600 000 VND/ha	400 000 VND/ha
Total area under PES water	20 000 ha	None	40 000 ha	30 000 ha

[53] Vietnamese Dong exchange rate in March 2010 was approximately 19000 = $1 US

Table 6-1 (continued) Changes in the system for each scenario.

Process	Scenario 1 Business as Usual (BAU)	Scenario 2 Development (Dev)	Scenario 3 Environment & Development (E&D)	Scenario 4 Environment (Env)
Area under protection by contracts to local residents (Programme 661)	8 800 ha	8 800 ha	None	None
Government revenue from plantations[a,b]	2.86 million VND	150% BAU	Same as BAU	Same as BAU
Government revenue from selective logging[a,c]	1500 ha @ 7.3 million VND/ha	200% BAU	70% BAU	30% BAU
Park protection	Normal	Less	Enhanced	Greatly enhanced
SFE protection and PES effect	Normal	Less	Enhanced	Greatly enhanced
Agriculture encroachment from buffer zone[a]	30 ha	60 ha	15 ha	5 ha
Donor funds to National Park[a]	3.6 billion VND	2.5 billion VND	4 billion VND	4.5 billion VND
Core zone relocation	-	-	-	Yes
Improvements to agricultural productivity[a]	0.4%	0.6%	0.4%	0.25%
Tourism - increase in visitors and price over 20 years	30 000 @ 125 000 VND/person	30 000 @ 125 000 VND/person	100 000 @ 320 000 VND/person	50 000 @ 380 000 VND/person
Revenue from tourism to indigenous people[a]	5% tourism revenue to park	5% tourism revenue to park	20% tourism revenue to park	15% tourism revenue to park

Over half of the buffer zone is currently forested, managed by State Forest Enterprises, and their revenue comes from plantations and selective logging. We assume, through expert opinion from the manager of Cat Tien National Park of the trends seen in the local area, roughly 15% of the forest areas in the buffer zone will be converted to rubber, cashew and coffee over the next 20 years. People living in the buffer zone are also allocated 8800 ha of natural forest land for protection through the Five Million Hectare Reforestation Program (also known as Program 661 - Prime Minister's Decision No. 661 in 1998; Do *et al.* 2005), where households receive an income for this of 100 000 VND/ha/y. Furthermore, a scheme has been set up to pay local people for environmental services by the water utility companies in Ho Chi Minh City, where a total of 20 000 ha is under PES contracts for water at 300 000 VND/ha. The payment distribution for this scheme is 80% to local people, 10% to CTNP management board and 10% to the government. The baseline for the carbon stock in the forests is calculated from the BAU scenario.

6.3.2.2 Scenario 2: Development (Dev)

This scenario shows a future where infrastructure and livelihood development occurs more rapidly, but at a cost to the environment. To further improve the livelihoods of local people in the buffer zone and to achieve poverty alleviation, 50% of buffer zone forestland is converted for households to invest in cash crops such as rubber, cashew and coffee (Table 6-1). The agricultural productivity of local farms is also assumed to improve substantially (0.6% per year). A trade-off assumed in this scenario is that conservation will be less of a priority and so biodiversity will be affected. Budgets allocated to the park will decrease and PES for water will cease, resulting in less forest protection and more illegal activities.

Nevertheless, payments for forest protection and tourist numbers will remain the same as the BAU scenario.

6.3.2.3 Scenario 3: Environment and development (E&D)

This scenario is targeted to improve forest protection but also enhance livelihoods, with the added benefits from an expansion of payments for environmental services. Local people benefit from improved agricultural productivity (0.4% per year) and more land for agroforests. The natural forests in the buffer zone do not change dramatically, although there is still some encroachment from infrastructure and agriculture (600 ha per year). The largest benefit to local people is the implementation of payments for environmental services for water and carbon. In this scenario, payments for water will increase to 600 000 VND/ha/y and more land (approximately 40 000 ha) will be allocated for this mechanism. The REDD+ mechanism for paying local people for reduced deforestation and degradation of the forest areas is taken into account through performance payments. Carbon payments will be calculated each year from the BAU carbon baseline for all forestlands (agroforests, plantations and core and buffer natural forests). Payments will be distributed over time according to the contractual arrangements; here the payment scheme is assumed to follow a curve of higher payments for the first 5-10 years and then slowly decreasing to the 20th year. The reason for this assumption is that higher up-front payments will be needed to motivate changes, but then payment levels over time can be reduced because other development options deliver income after some time (such as improved agricultural productivity). The revenue from REDD+ will go to three beneficiaries – local people, CTNP management board and the district government. In this scenario, there is a reduced rate of conversion of natural forests to plantations and agroforests, so the amount of carbon on local people's land is less than the BAU baseline. Instead, the government and national park will pay local people for the reduced rate of deforestation in the core zones and buffer zone. Part of the revenue from REDD+ will also go to district government and the national park. Further benefits to the National Park will include increased budgets, enhanced forest protection and more tourists (up to 100 000 per year in 20 years). Management of timber harvesting from SFEs will also improve through a Reduced Impact Logging scheme.

6.3.2.4 Scenario 4: Environmental (Env)

This is a scenario where most of the benefits accrue from conservation initiatives, with limited benefits for local people. One of the key differences in this scenario is the core zone re-settlement program, where the 600 local people who live in the core area will be moved to the buffer zone (Table 6-1). Tourism will increase to 50 000 visitors per year in 20 years, each paying a premium of 500 000 Dong to the National Park. Lower numbers are assumed compared to Scenario 3 because strict environmental policies will limit environmental damage from tourists by limiting tourist numbers. Conservation is also improved under this scenario, including improved forest protection and halting of forest conversion in the buffer zone. State management of forests also incorporates Reduced Impact Logging, local land use is dominated by agroforestry and local people continue to be paid for environmental services for water (30 000 ha at 400 000 VND/ha) and carbon (the same as in Scenario 3). Nevertheless, local people do not improve their agricultural productivity as much as other scenarios.

6.3.3 Data collection

During the workshops, sectors were allocated to groups of participants to create and define the model equations. Information was based on the expert knowledge from the Cat Tien representatives and supported by available data from documented sources (internet references, reports and other publications).

Following the workshops, I revised the model and ran a field trip to Cat Tien National Park in March 2010. The purpose of the field trip was to crosscheck and validate the information in the model and test the results of the model by exploring conservation and livelihood development processes. An assistant translator (H.T. Bach) and myself visited four villages in the buffer zone to conduct interviews with farmers, commune leaders and police. Eighteen interviews were conducted, including four at La Nga, seven at Ta Lai, three at Dac Lua and four at Da Tek. One group discussion was held with three villagers and two police at Da Tek. Interviews were also held with six National Park staff and two interviews with staff of two state forest enterprises (La Nga and Vinh Cuu). Interviews are coded with a letter and number. The letters are as follows: F = interviews with farmers or commune leaders; GD = group discussion; NP = interviews with national park staff; SFE = interviews with staff of State Forest Enterprises.

Interviews with villagers included questions about the village statistics, livelihoods at different times of the year, land use, forest use, challenges they face in gaining incomes and their plans and aspirations. Interviews with National Park staff were about checking the model, references to data and the strategies for different actions, including payments for environmental services, patrolling and livelihood development activities. Interviews with SFEs included questions about the forest type, production, methods and future plans.

Secondary information was collected from maps, data on operations at the National Park and state forest enterprises, research reports and publications.

6.3.4 The model

The scope of the model is limited by the availability of the information and the system's complexity. The model was limited to key components of processes that have an effect on livelihoods and the environment at the scale of the entire area of CTNP – not specifically detailed for any village or district. Twelve 'sectors' were created in the model (see Appendix 2, which details the model and the source of information. The STELLA model also contains details of the source of the data.):

1. Policy scenario: This sector includes the component that sets up the four scenarios for the model. This component is connected to 29 components in other sectors of the model.
2. Land cover in the buffer zone: This is the key sector for land-use change. Plantations are a major component of this sector, but all major land-uses are captured including natural forest, agroforests, annual cropland and infrastructure land. We make the assumption is that rice land and local forest areas (those owned by local communities) in the buffer zone will not change over 20 years.
3. Buffer zone population: This sector includes population of indigenous and migrant (Kinh) groups. There are approximately 200 000 people in the buffer zone, and this population has an effect on land-use in the buffer and

threats to the National Park. The population of indigenous people will change under Scenario 4, if they are relocated from the core to the buffer zone.

4. Core zone population: This sector includes the population who live in the four core zone villages. The core zone has approximately 600 individuals, 85% of whom are indigenous minorities. The CTNP Management Board has plans to relocate them from the core and this is modelled under Scenario 4.
5. Livelihoods of farmers: This sector includes all aspects of the cash and subsistence incomes gained from livelihoods of the people in the buffer zone, the majority of whom are farmers. The livelihoods of all people are assumed to be the same, as the difference between indigenous and non-indigenous people does not noticeably affect the key indicators. The components of livelihoods include incomes from agriculture (including plantations and forest products), non-farm work and payments for conservation (under the Program 661) and environmental services (water and carbon).
6. Land cover of the core zone: This sector includes natural forest, agriculture and wetlands. The forest of the National Park is threatened by encroachment from the buffer and core zone villages, both captured in this sector. The areas of agriculture that are left to regenerate to natural forest are also captured.
7. Gaur: We selected population changes in Gaur (*Bos gaurus*) as an indicator of the change in conservation value of the area. The components include natural birth and death rates of the Gaur as well as the impact of hunting.
8. Tourism: This sector was included because the CTNP management board currently gains over USD $200 000 from tourism. The national park receives both national and foreign visitors. Each of the scenarios has a different number of tourists and incomes (see Table 6-1).

9. Government Budgets: Budgets available to the CTNP and the district government will influence the ability of each to implement certain activities. In this sector, budgets come from funding through payments for water and carbon, and yearly funding from the national government. The National Park also receives funding from donors. The district governments also receive funding from the State Forest Enterprises, which include natural forests (selective logging) and plantations (timber harvests).
10. PES carbon: This sector calculates the changes in carbon for land-uses in the core and buffer and then calculates the potential carbon payments to district government, local resource users and CTNP. Carbon is calculated for the following land uses: include natural forest (buffer and core zones), agroforests and plantations. Degradation of natural forest is calculated by estimating the removal of carbon from activities such as non-timber forest products (NTFP; such as bamboo), introduced weeds (such as *Mimosa pigra*, which inhibit the growth of natural forest), illegal and selective logging, poor fire management and tourism.
11. PES water: This sector calculates the payments to local people for protecting the area under PES contracts for water. Each scenario will assume a different per-hectare payment and different percentage of the natural forests and agroforests under contract in the buffer zone (see Table 6-1 for the exact values).
12. Total net economic benefits: This sector adds all of the economic values together to indicate the benefits of each scenario, represented by a single variable – the 'total net benefit'. The components used to calculate this variable include economic benefits accrued to local livelihoods, the budgets

of the government, an estimate of the economic value of biodiversity and the cost associated with carbon loss from the system in Scenario 2.

Most of the calculations generated within the sectors are simple algebraic equations. Two equations developed in the model, which are important to the outcomes of the model, are presented here for illustrative purposes. All other equations are in the Appendix 2. The first is the equation for calculating the payments from carbon to beneficiaries in scenario 3 (E&D) and 4 (Env):

$$P_b = tC_l \times A_l \times \$t \times c$$

Where P_b = carbon payments to the beneficiaries (local people, government and CTNP management board), based on yearly performance; n = year; tC_l = Average tonnes of carbon gained per hectare of land-use as compared to the BAU scenario; A_l = area of land-use; \$t = price in US dollars per tonne of CO^2; c = conversion of Carbon to CO_2 equivalent (3.67). The amount of money per year is then disbursed Payments to local people include payments from local land uses and payments from the National Park and government for reductions in degradation of the natural forest. Payments for carbon are also calculated for the government (primarily state forest enterprise lands) and National Park.

The second example is the equation to calculate the population dynamics of Gaur (*Bos gaurus*) using a standard differential equation for population growth and the rate of hunting:

$$G_t = r_i \times (1 - \frac{G_{t-1}}{c_G}) - r_h \times G_{t-1}$$

Where G_t = current population of gaur; r_i = rate of increase in population of gaur (including natural births and deaths); G_{t-1} = previous year's population of gaur; c_G =

carrying capacity of gaur; r_h = rate of hunting of gaur under different scenarios. The parameters in this population model were estimated from a survey of the published literature (Chaudhury 2002; Pasha *et al.* 2004), data from surveys at the CTNP and discussions with the National Park staff.

Eight indicators of the changes in conservation and development status were used in the model. These include gaur population, park funding, total carbon in the buffer zone, total carbon in the core zone, incomes from tourists to park, income from tourists to indigenous people, total household income and total net economic benefits. These indicators were used as part of a sensitivity analysis, which was done to 1) check the internal consistency of components; 2) ensure the components are represented correctly and in the correct order of magnitude; and 3) see the effect of different input components on the indicators. As recommended by Borner *et al.* (2010), sensitivity analysis was done by increasing and decreasing the value of the input components by 30% and observing the effect on the indicators. Following sensitivity analysis, those components that had a large effect on the indicators were further reviewed and crosschecked with other sources of information to improve accuracy. Further details of the model components and sectors are described in Appendix 2.

6.3.5 Alternative assumptions

Once complete, the model was run for each of the different scenarios. Nevertheless, some factors in the model are uncertain. To explore these uncertainties model runs were made under varying assumptions, using sliders and switches in the interface. Sliders and switches allow the user to vary specific variables. Sliders can be set at multiple values within the variable extremes, whereas switches only have two alternate values for particular variables (either on/off or high/low). The model was re-run for different combinations of each of the following:

1. A slider to account for the uncertain economic value of biodiversity in forests. This value is complicated because any value must take into account future discount rates (which may even be negative - European Communities 2008) of multiple environmental services (Costanza *et al.* 1997), which are themselves difficult to calculate (European Communities 2008). Hence the model included two estimates of the added value of keeping forests rather than converting to other land uses. One estimate of the added value of biodiversity is at \$700 $ha^{-1}y^{-1}$ USD, which is calculated from the value of forests as ecosystem services mentioned by Costanza et al. (1997), but excluding the carbon value and the ecosystem value of agroforests that they calculated because we sectors accounting for these. A second estimate used in the model is \$100 $ha^{-1}y^{-1}$ USD as a comparison, which assumes a much lower added value of natural forest ecosystems as compared to agroforests, plantations and annual crops.
2. A slider to account for the price per tonne of carbon. For forest-related trading in 2008, this was approximately \$7 USD (Hamilton *et al.* 2009), but because of the expected growth in the carbon market, this might increase substantially over the next 20 years, so an average value of \$20 USD was also used.
3. The carbon payment mechanisms are one of the greatest uncertainties in this model. While carbon content of forests have recently been measured, monitoring degradation of forest areas has not yet been implemented in Cat Tien National Park, hence the number of tonnes of carbon lost each year from

human use is currently unknown. Two levels were tested: high degradation at 6 tC/y for the buffer zone and 4tC/y for the core zone; low degradation is 2tC/y for the buffer zone and 1tC/y for the core zone.

4. The development scenario (Scenario 2) comes at some cost to the environment. A switch is therefore used to calculate the carbon loss under the development scenario (as compared to the business-as-usual scenario) and included in the analysis of total net economic benefits.

The first run of the model assumed the values of $700 USD per hectare for added biodiversity value, $7 USD per tonne of Carbon dioxide, low degradation and no costs for carbon loss.

Section 6.4 shows the results of the scenarios and changes in assumptions through a set of graphs and tables from the STELLA program. The scenario outputs for three indicators (the Gaur populations, funding to CTNP and total household income) are almost linear, so the results have been presented in Table 6-2 showing the values at 5-year intervals. The results for incomes and net economic benefits are presented in three tables (Tables 6-3, 6-4 and 6-5), using 'net present value' (NPV, which calculates the total current and future worth of an economic commodity over the 20 years of the model by using a 10% discount rate per year). The changes of carbon in the entire landscape and net economic benefits are presented in Graphs 6-2 and 6-3 showing the four scenarios.

6.4 Results

6.4.1 Results from the model

The effects on biodiversity and conservation are represented by Gaur populations (Table 6-2), carbon stored in the landscape (Figure 6-2) and park funding (Table 6-2). The result of the model for populations of Gaur showed a decrease in the BAU scenario and Dev scenario, an increase in the E&D scenario, and the highest increase in the Env scenario. Carbon storage in the landscape increases under the BAU, E&D and Env scenarios, but carbon is lost from the system in the Dev scenario. The Env scenario also has the highest storage of carbon in the landscape. The E&D scenario shows the best outcome for national park funding, but even under the BAU and Dev scenarios, National Park funds increase slightly.

Table 6-2 Changes in Gaur populations, funding to Cat Tien National Park and total household incomes under four scenarios. Model assumptions: \$7 USD (133 000 VND) per tonne of CO_2-e, low-forest degradation.

Indicator		Scenario			
	Year	BAU	Dev	E&D	Env
Gaur population (individuals)	0	95	95	95	95
	5	91	79	101	116
	10	88	65	107	141
	15	85	55	113	170
	20	82	46	119	201
Park Funding (billion VND/y)	0	20.5	18.5	23.6	22.5
	5	21.3	19.3	29.3	26.7
	10	22.0	20.0	33.9	29.6
	15	22.7	20.8	38.5	32.2
	20	23.4	21.5	42.6	34.7
Household Incomes (million VND/y)	0	28.9	28.7	29.4	29.0
	5	28.4	29.8	29.3	28.2
	10	28.3	31.9	29.3	26.9
	15	28.2	34.1	28.9	25.1
	20	28.0	36.0	28.0	22.8

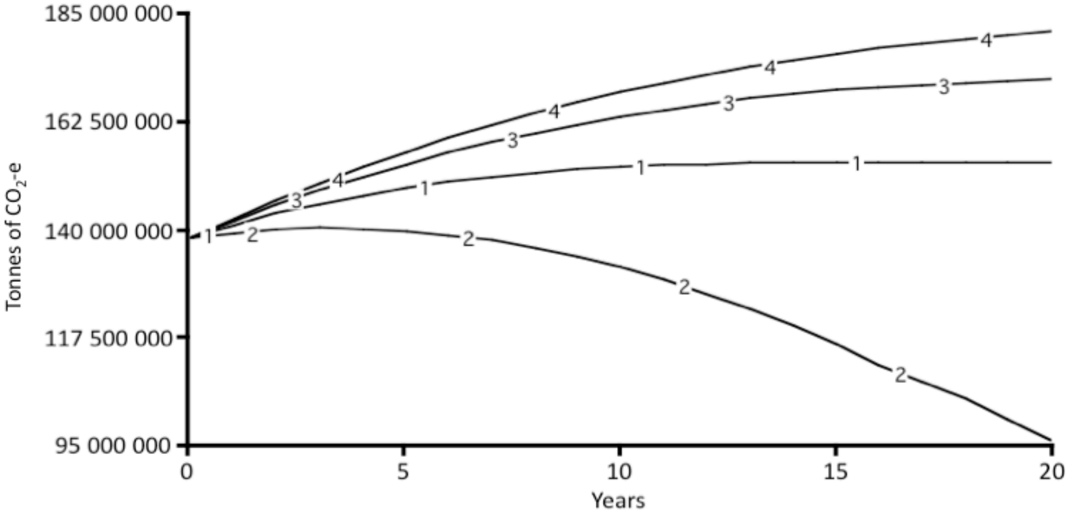

Figure 6-2 Changes to the storage of carbon (tonnes of CO_2-e) in the entire landscape under each scenario (1-4). Scenario 1 = Business as Usual; Scenario 2 = Development; Scenario 3 = Environment and Development; Scenario 4 = Environmental. Model assumption: low forest degradation.

Total household incomes decrease under all but the development scenario (Table 6-2), which generates the highest net present value for local incomes (Table 6-3). This is mainly due to the increases in conversion to plantations from other land-uses, the increase in non-farm income (from wage-paying activities and non-agricultural sources, such as manufacturing), off-farm incomes (from labour on other farms) and NTFP collection. Under the Env scenario, local people gain slightly more than the BAU scenario, from the income sources of non-farm and off-farm work and payments for environmental services. Local people, however, receive the least under the Env scenario, because the payments from carbon are not enough to substitute the losses from all other income sources.

Payments for environmental services play only small role to the incomes of local people, totalling less than 5% of net present value of incomes (Table 6-3). Protection payments from Program 661 contribute less than 0.1% of the net present value of incomes of the BAU and Dev scenarios. Payments for water contribute far more (over 800%) than protection payments under the BAU scenario, but still only about 2% of the total NPV of incomes under an E&D scenario. Carbon payments of the E&D and Env scenarios are similar to that of water payments, at 1.2% and 2.9% of NPV of incomes respectively.

Table 6-3 Net present value of the different income sources for local farmers. Net present value (million Vietnamese Dong per household) is based on a 10% discount rate. [a]Other includes income from non-farm work, off farm work, NTFP collection and livestock. Assumptions: values of $700 USD (13.3 million VND) per hectare for biodiversity value, $7 USD (133 000 VND) per tonne of CO_2-e, low forest degradation.

Source	BAU	Dev	E&D	Env
Plantations	28.99	33.53	29.28	26.19
Agroforests	76.83	78.97	75.43	71.76
Annual crops	55.01	54.24	52.77	53.95
Non-farm and off farm work	54.72	64.98	58.46	50.47
Protection payments	0.18	0.18	-	-
Water payments	1.51	-	6.06	3.27
CO2 payments	-	-	5.15	8.04
Other[a]	53.74	61.22	50.39	47.28
Total	270.98	293.12	277.54	260.96

A comparison of the total net economic benefits of each scenario indicates that the Env and E&D scenarios win over the Dev and BAU scenarios (Figure 6-3, Table 6-4). This result stems from the increase in budgets of the government and National Park and the added value of biodiversity in the forest areas under the Env and E&D scenarios. The difference is even greater if the model includes costs for carbon lost under the development scenario (run 2 in Table 6-4), with the NPV of the Dev scenario dropping by 2.7 trillion VND. Even in Run 3 of Table 6-4, where the value of biodiversity in forests is at $100 USD per ha (1.9 million VND) more valuable than other land uses and no costs of carbon are calculated, the value for total net benefits of the E&D scenario is within 1% of the Dev scenario, and the Env scenario is only 3% less than the Dev scenario. If, alternatively, the price of carbon is at $20 USD (380 000 VND) per tonne (run 4 in Table 6-4), then the economic value of the Env scenario is 16% greater than that of the Dev scenario.

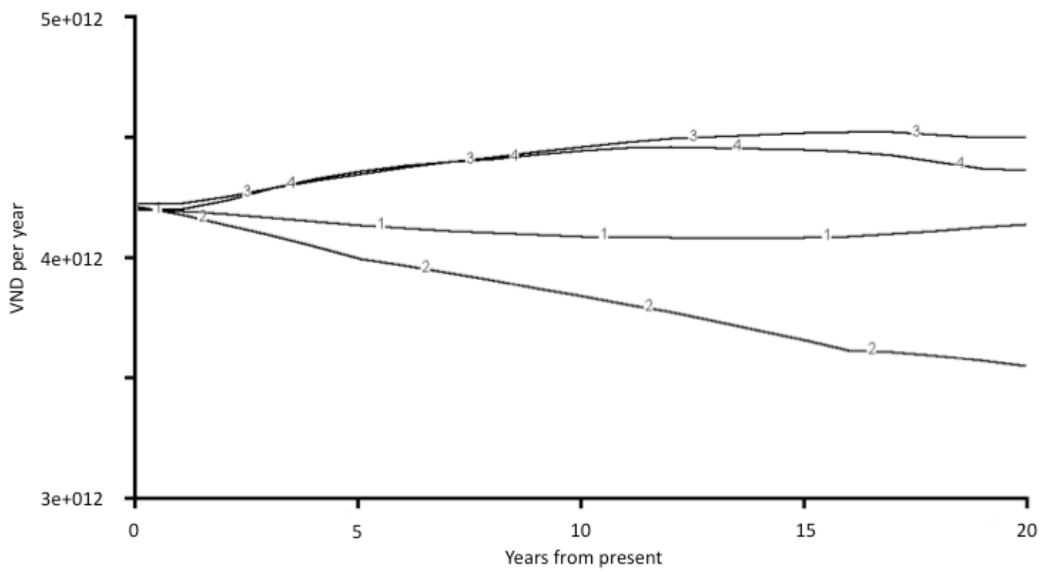

Figure 6-3 Changes to total net economic benefits under each scenario (1-4). Scenario 1 = Business as Usual; Scenario 2 = Development; Scenario 3 = Environment and Development; Scenario 4 = Environmental. Assumptions: \$7 USD (133 000 VND) per tonne of CO_2-e, low forest degradation, costs for loss of carbon in the Dev scenario not included, value of biodiversity at \$700 USD (13.3 million VND) per hectare per year.

Table 6-4 Net present value for total net economic benefits under the four scenarios, with varying assumptions for carbon costs, biodiversity value and carbon payments. Net present value (trillion Vietnamese Dong) is based on a 10% discount rate. The scenarios were run from initial conditions, then each of the factors were changed as shown. Initial assumptions are: carbon payment is $7 USD (133 000 VND) per tonne of CO_2-e, forest biodiversity added value is $700 (13.3 million VND) per hectare per year. BD = biodiversity.

Run	Change	BAU	Dev	E&D	Env
1	-	39.3	37.6	41.5	41.3
2	Costs for carbon lost in Dev scenario	39.3	34.9	41.5	41.3
3	BD value at $100 USD	17.9	19.0	18.9	18.4
4	CO_2 payment at $20 USD	39.3	37.6	43.0	43.5

There remains an issue, however, that livelihood incomes are lower in the Env scenario than all other scenarios (Table 6-5). Different rates of degradation and prices of carbon can influence the NPV of local peoples' incomes. If we assume a higher rate of degradation of forests under the BAU scenario, then this lowers the baseline for carbon stored in forests. A lower baseline has an effect on the net present value of total household incomes (Table 6-5), because it increases the amount of money that local people receive from carbon payments. If the rate of degradation is high (run 2 in Table 6-5), the net present value for total incomes increases by 3.5 million VND (1.3% NPV) for the E&D scenario and 7.7 million VND (2.9% NPV) for the Env scenario. If, alternatively, the carbon payments are increased (run 3 in Table 6-5) from $7 USD per tonne CO_2-e to $20 USD per tonne CO_2-e, then the added payment (5.9 million VND net present value) under the Env scenario outweighs the NPV for incomes from the BAU scenario. Only when both the value of carbon is at $20 USD per tonne CO_2-e and the rate of degradation of forests is high (run 4 in Table 6-5), the E&D and Env scenarios are better for local incomes than a Dev scenario. While the carbon payments are still small for local people, the local governments receive 70% of the revenue from carbon in the large state forest enterprises (Table 6-1), thus increasing the budget of local government under the E&D and Env scenarios.

Table 6-5 Net present value for household incomes under the four scenarios, with varying assumptions for the price of carbon and level of forest degradation. Net present value (million Vietnamese Dong per household) is based on a 10% discount rate. The scenarios were run from the initial assumptions, then each following run tested different values for the price of carbon and level of degradation. \$/tC = US dollars per tonne of CO_2-e.

Run	\$/tC	Degradation rate	BAU	Dev	E&D	Env
1	7	Low	271.0	293.1	277.5	270.0
2	7	High	271.0	293.1	281.0	267.7
3	20	Low	271.0	293.1	287.1	275.9
4	20	High	271.0	293.1	296.9	295.2

6.4.2 Reality check: implementing the scenarios

While the model highlights the potential for an improved environment, more money to local people, greater funds to government and a bright future for carbon markets, there are constraints to actually implementing activities to achieve these benefits. An analysis of interviews with local people from four villages and staff of the National Parks and state forest enterprises indicate that there must be improvements to implemented actions and governance before the benefits are realised.

The Development scenario entails a high rate of increase in incomes to local people, and as long as this scenario gives more income to local people than the environment and development scenario, then the development scenario will likely be favoured. For this to occur, some of the government revenues must go to local people for training in agriculture practices. Interviews with 10 local people from all 4 villages suggest that they wish to improve the productivity of crops through better quality plants, more irrigation and fertilizers, improvement in skills (such as planting techniques) and an increase in the number of harvests per year[54]. Six interviews with local people from all four villages also suggest that they would like to improve the roads, gain more land and improve animal husbandry[55]. If agriculture is not the best option, eight local people across the four villages expressed their wish to move elsewhere and work in service jobs, such as factories or other wage-paying labour during interviews[56].

Local people have little control over forests, yet an environmental scenario (such as in Env and E&D scenarios), especially with carbon payments, has an effect on their

[54] Interviews: F1, F3, F6, F8, F9, F10, F11, F15, F16, F18
[55] Interviews: F4, F10, F11, F12, F14, F16
[56] Interviews: F9, F12, F13, F14, F15, F16, F18, GD1

livelihoods. The Vietnamese government controls almost all natural forest areas, except local sacred forests, so any forest use is illegal. Nevertheless, interviews with seven different local people who live near forests in Ta Lai, Dac Lua and Da Tek villages stated that they sometimes resort to collecting non-timber forest products to either supplement their livelihoods or as a main activity when they have no land[57]. The majority of products collected are bamboo and rattan for construction and trade, but people also fish and collect leaves, seeds and fruits for consumption. Local people are penalised for collecting NTFPs; the main penalty is a fine or, if their income is so low that they could not pay the fine, then they receive education about the value of the forest and instruction on the rules of the national park by the village leaders and forest guards[58]. If the government was to increase the protection of the forests, five local people from Dac Lua and Da Tek villages claimed that they would respond by changing to non-farm trades[59]. Four respondents also claimed that collecting products from the forest is hard work, but those who are landless need assistance from other villagers to move away from forest-use[60].

The effectiveness of implementing carbon payments to local people depends on the actions of CTNP and the state forest enterprises. In four interviews with staff of Cat Tien and the state forest enterprises[61] report that they lack the methods, skills and funds to improve the management of forests, especially in the methods to measure carbon stocks of the forest and enforcement. So to improve forest management, each organisation requires training, especially in monitoring forests and biomass, and funds to enhance the regeneration of forests through planting trees. Government and

[57] Interviews: F8, F9, F10, F13, F15, F16, F19
[58] GD1; Interview NP3
[59] Interviews: F8, F9, F10, F16, F19
[60] Interviews: F6, F7, F8, F19
[61] Interviews: SFE1, SFE2, NP1, NP3

non-government organisations play a role in implementing payments to local people, including training of local people and developing contracts to receive the funds. Funds to park management might also be increased through tourism enterprise development, such as that of a recent WWF project in Cat Tien National Park, which is developing ecotourism in the indigenous villages in the buffer zone of the national park (WWF 2009).

How do the organisations managing the forests improve protection to reduce threats? The leader of the enforcement unit claims that pressures coming from people living in the buffer zone, especially cutting of timber and clearing for agriculture, threaten forests[62]. Violations recorded by the National Park have increased from 239 violations in 2005 to 574 violations in 2009[63]. While some poor people in villages collect products from the forest, staff are doubtful that reducing poverty can reduce threats because the World Bank implemented a 10 year project to protect and manage the forest area of Cat Tien while developing livelihoods of rural residents (World Bank 2007), but the threats continue. Besides, violators are often not poor. Interviews with the Director and staff at Cat Tien National Park suggest that an increase in staff might not help to curb these threats, but perhaps education and training of existing staff will[64]. Education of local people includes teaching about the damage to forests from local peoples' activities, teaching about forest protection and advocating the benefits of conserving the forest. Several staff suggested that training and financial support to local people might help them to move their activities away from forests[65].

[62] Interview NP3
[63] Interview NP3 and presented recent data
[64] Interviews: NP1, NP2, NP3
[65] GD1; Interviews: NP1, NP3

6.5 Discussion

The analysis of costs and benefits of different future scenarios of Cat Tien National Park highlights some trade-offs between biodiversity conservation and the livelihoods of local people. The trade-offs are noticeably distinct between carbon sequestration and total household incomes, but trade-offs also occur among household income sources, park funding and Gaur populations. If the current situation continues as usual, the forest quality of the core zone might remain relatively unchanged and populations of Gaur might decrease. Nevertheless, past experience of re-demarcation of the core zone because of encroachment (Morris & Polet 2004) and the current trend of illegal activities suggest that these threats remain central issues to the conservation of Cat Tien. The BAU scenario also suggests that local incomes and government revenues will remain relatively unchanged. The results from the model, however, reveal an impetus by the government to shift from the BAU scenario, as the benefits from improving the environment or development outweigh the benefits of continuing as usual.

Harvey *et al.* (2010) argue that REDD has the potential to benefit biodiversity conservation, and, given an appropriate policy framework, our results support Harvey *et al*.'s argument. Two biodiversity indicators, Gaur populations and carbon, could improve under environmental scenarios (Env and E&D) with the introduction of PES, if properly implemented under a correct set of institutional and contractual arrangements. Incomes to local people, on the other hand, tend to be worse under environmental scenarios and better under a development scenario. But, if the forests are highly degraded and the future price of carbon is at $20 USD, incomes are better under a strict environmental scenario. Furthermore, when the environmental scenarios include a high value for biodiversity, they provide the best net economic benefit. The results, then, suggests that local people and local governments could gain revenue from carbon. If the price for carbon is high enough and distributed fairly, the benefits might then be enough of an incentive to reduce land clearing and improve conservation through appropriate policies.

One of the major issues in implementing a PES approach for CTNP is the equity of benefit sharing. The current situation of forest control, where the National Park and state forest enterprises near Cat Tien manage and control most of the forests, provides only limited benefits to local people living in the area (see Chapter 3). While there are schemes to allocate forestland to local people in some areas of Cat Tien and to pay for water as a forest environmental service, these schemes remain relatively small (Pham *et al.* 2008). As interview results suggest, any further restriction on the local use of forest resources will have greater negative consequences to those local people who have no land and who rely on forest resources for their livelihood.

Petheram and Campbell (2010) discuss the issues of local people's interest in participating in a PES scheme in Cat Tien, and suggest that a number of conditions must be adhered to for local people to participate and benefit from a scheme to effectively reduce degradation and deforestation. Safeguards of PES could require that an equitable transfer of positive incentives be used to encourage local people to reduce their use of forest resources (Sommerville *et al.* 2009). Under such a scheme, carbon payments could go through government with the condition of channelling to local people, who then receive both monetary and in-kind support (such as agricultural intensification, training in non-agricultural activities and forest protection). If, by setting up contracts, the payments for carbon come at the right stages throughout the period of a REDD+ scheme, this might have the potential to contribute a substantial income to people and might provide an incentive to not convert (perhaps at least in the early stages - Sandker *et al.* 2010b). Nevertheless, protecting forests may not out-compete other land-uses and unless incomes and support from PES are higher than the current level, local people are possibly less likely to be involved in a PES scheme (Petheram & Campbell 2010).

The recent international interest in REDD+ has the potential to provide an avenue for investment in the conservation of Cat Tien. There are several considerations that must be taken into account if REDD+ is to provide positive benefits to all stakeholders, and these continue to be discussed in the REDD literature (such as Angelsen 2008b, a; Angelsen *et al.* 2009; Harvey *et al.* 2010), so are not elaborated here. Vietnam, however, presents an important case because both PES and REDD+ schemes have been discussed recently at the national level, and PES is well advanced in the policy processes (Pham *et al.* 2008; IIED 2010). The strengths and weaknesses of setting up REDD+ schemes at Cat Tien National Park, when they have an element of financial benefits flowing to local people and organisations, are similar to those of setting up PES schemes. On the positive side, one of the strengths of Vietnam is its strong centralised control and policy development (Pham *et al.* 2008; Pham *et al.* 2010), which results in widespread action when the state commits to specific policy options (e.g. the 5-Million Hectare Reforestation Project; see also Chapter 3). PES is likely to be mainstreamed throughout Vietnam after the current period of piloting (Vu 2010). This should result in economies of scale (and thus reduce transaction costs) and coordination in relation to issues such as carbon accounting (Phelps *et al.* 2010).

Pham *et al.* (2008) and Petheram and Campbell (2010), contend that there are obstacles to implementing effective, efficient and equitable payments for environmental services in Vietnam. Wunder (2008) also suggests that there are four conditions for poor people to participate as sellers in a PES scheme, including eligibility, desire, ability and competitiveness, which are hindered by two key conditions that tend to be anti-poor: 1) insecure land tenure and 2) high buyer-transaction costs when working with numerous smallholders. In Vietnam, land ownership rests with the state, and while households have rights to use the land, there is yet to be clear legal recognition for local people to make decisions about participating in PES, which especially impacts the less well-off households. Another challenge is to improve institutional arrangements, especially by clarifying responsibilities of each ministry involved (for further discussions on governance issues, see also Chapter 3) and developing a well-designed program that includes conditional cash transfers to achieve welfare gains and environmental benefits (Wunder 2008). Furthermore, the model in this chapter shows that a large proportion of the total NPV comes from biodiversity, which is, perhaps, of limited use to Vietnam. Development of global payments for biodiversity would enable a greater realisation of the benefits to conservation at places such as Cat Tien National Park.

Neither biomass nor carbon has been measured or monitored at Cat Tien National Park, making the assessment of the role of carbon in future scenarios challenging. Monitoring of forest resources is critically important, particularly for REDD+ schemes (Angelsen *et al.* 2009), and should be part of a condition of payment. Indicators of forest degradation and deforestation from field-collected data and remote sensing need to be monitored systematically and on a regular basis.

Further challenges of implementing the E&D scenario include improving the understanding, awareness and technical capacity of government staff, foresters and local people. Not only is this important for implementing PES and REDD+ schemes, but also to improve conservation of forest areas. Similar to other areas in Vietnam (Sage & Nguyen 2001), Cat Tien National Park is facing issues of a lack of skills and investment. Improvements to the protection of the National Park require an improvement in the clarity, implementation and enforcement of the laws, and better cooperation between local authorities, provincial authorities and other actors in the landscape. Economic considerations are also important, such as the markets for tourism, carbon and water (as an environmental service), in order to secure funds for the National Park, state forest enterprises and local communities that have management responsibilities over the forest areas.

6.6 Conclusions

The results from modelling environment and development scenarios of Cat Tien show some key trade-offs between biodiversity conservation and local livelihoods, particularly between household incomes and carbon sequestration. Furthermore, while an environmental scenario (Env and E&D) has the potential to produce the best outcomes, it also challenged by a variety of obstacles including development of institutions, setting appropriate contracts to pay local people, and improvements to technical capacity and conservation strategies.

Similar to the conclusions of Sandker *et al.* (2010b), who studied REDD payments in Central Africa, carbon payments do not necessarily out-compete other land-use options at the local level. But in areas like Cat Tien, due to the lower value of cash crops than in Central Africa and the high degradation of the secondary forests, implementing REDD+ might be a lucrative option if the price of carbon is higher than $20 USD per tonne. The benefits are especially good for State Forest Enterprises and the National Park management board.

Recommendations from this study suggest improving institutions (monitoring, compliance, laws, implementing well-designed programs and implementation of policies of government), capacity building (of National Park and government staff, foresters and local people for forest protection, monitoring and sustainable use of forest resources and improved agricultural practices) and monitoring for adaptive management. Safeguards for implementing PES for carbon and water should be included in contracts to increase benefit sharing to local people. Conditionality must also include monitoring of forest resources.

Chapter 7 Conclusions

7.1 Introduction

The primary aim of this thesis was to explore the nature of conservation and development interventions and the factors influencing these interventions in forest conservation areas of Cambodia, Laos and Vietnam. One method used was an analysis of 164 variables capturing the context and management of 43 conservation or development organisations and 15 conservation areas to explore the factors influencing conservation at the landscape and national scales, the threats to forest biodiversity and implementation strategies of conservation organisations. A second method used a systems dynamic model (STELLA) to explore the effect of different environmental and development scenarios on biodiversity and livelihoods at one site, Cat Tien National Park in Vietnam. The results provide some clear patterns that lead to conclusions about the strategies of conservation and development interventions, but also highlight some issues with the approach used in this type of research.

This chapter elaborates on the findings from the exploration of conservation and development interventions in the Lower Mekong. First, I reiterate the findings from each of the questions posed in Chapter 1. I then draw conclusions from these findings, discuss the implications for conservation practice in the Lower Mekong and the research's contribution to the literature. I provide recommendations for improving conservation practice and research in conservation. Finally, I discuss the limitations and recommend future directions for research.

7.2 Main findings from the four research questions

This research set out to explore the nature of conservation and development interventions and the factors influencing these interventions in 15 forest conservation areas in Laos, Cambodia and Vietnam. The exploration of four key research questions has revealed important findings about the nature of conservation and development in the Lower Mekong.

Q1 What are the key economic and governance factors that influence conservation actions in the Lower Mekong countries?

The conservation sectors of Cambodia, Laos and Vietnam have developed over the past 30 years to form a powerful body of actors and actions. The conservation sectors are supported by multilateral international agreements, particularly the Convention on Biological Diversity and the Convention on International Trade in Endangered Species of Wild Flora and Fauna, international investments from organisations such as the International Monetary Fund, the World Bank and GTZ, and in the last few decades, national biodiversity, forestry and environmental laws and policies. Despite some progress in governance and financial investments, implementing conservation in forest areas has been constrained by economic development imperatives of governments in the three countries. The economic imperatives arise from governments' priorities in economic growth, partly through granting land concessions to international investors for plantations, hydropower, agriculture and mineral exploration. Granting land concessions on conservation lands demonstrate poor management of forest conservation areas by letting land concessions outcompete conservation and threatening forest areas. Governments also have an interest in the international trade in timber, which impacts conservation areas by degrading ecosystems and threatens plant and animal species. Several governance issues also limit biodiversity conservation actions in the Lower Mekong countries, particularly unresolved and unregistered land tenure, low finances available for managing conservation areas, limited technical capacity of government officials, gaps within the conservation-related national laws, transparency issues in government and weak coordination among NGOs and government departments. The practice of biodiversity conservation is also situated within the context of a diversity of different values held for nature among different actors. These differences influence the priorities set by governments and organisations for conservation, such as whether conservation is either for protection or use of forest resources. Incorporating a diversity of values can lead to pragmatic strategies that are appropriate for the context of individual conservation areas.

Q2 What are the causes and drivers of the threats to biodiversity in the Lower Mekong countries and how do conservation interventions attempt to mitigate these threats?

Conservation actions require a clear understanding of threats and their drivers, but standardised methods for assessing threats and actions are still under development (Salafsky & Margoluis 1999; Salafsky *et al.* 2008). Chapter 4 systematically explored a set of threats and linked them with actions undertaken by conservation organisations. The key threats to forest conservation areas are extraction of resources, such as hunting, logging and mining, and clearing of habitat, such as agricultural encroachment, infrastructure development and dams. Although threats to forest conservation areas are country-related and specific to the local context, the causes of the threats are generally conducted by both outside actors and local people. Essentially, national and regional development interests drive some of the major threats to biodiversity, to the extent that external factors are as important as local factors when analysing the impacts on forest areas. This has led to a diverse strategy of conservation and development interventions to address threats by actors, which involves law enforcement of locally-caused threats, education of local communities about the benefits of biodiversity conservation, developing alternative local livelihoods to reduce overexploitation of forest resources and reforming institutions at the local and national scales to control externally-caused threats. The results suggests that to effectively reduce threats to the forest conservation areas in which conservation interventions operate, organisations must understand the context of threats, should share experiences with organisations at other conservation areas in the Lower Mekong and further develop environmental policies at the national level.

Q3 What strategies are employed by interventions to achieve both forest conservation and local livelihood development and how do strategies affect intervention performance?

A systematic analysis of the interventions conducted by 43 conservation and development organisations in forest conservation areas revealed some clear patterns in the strategies used to protect biodiversity and improve livelihoods. Intervention strategies are diverse, spreading themselves among a broad set of activities to achieve conservation and development goals. The strategies are pragmatic, adapting to the local context, but there is a trade-off between conservation and development approaches. Partnerships are formed with other conservation and development organisations to assist the management bodies of conservation areas to achieve conservation outcomes, often through environmental education, rehabilitation of habitats, monitoring of species and local livelihood improvement activities. Organisations that are not partnering, on the other hand, are focused more towards livelihood improvement, such as through health support, infrastructure development and agricultural training. The results also suggest that employing practices of stakeholder involvement and developing partnerships between organisations with different agendas could contribute better to improved outcomes for biodiversity and local livelihoods.

Q4 How do alternate environment and development scenarios affect biodiversity, livelihoods and the future conservation strategies?

Analysis of different conservation and development scenarios at one conservation area, Cat Tien National Park, shows some clear trade-offs between local livelihoods and biodiversity. Trade-offs are distinct between carbon sequestration and household incomes, but are also present between household incomes and other conservation factors, such as park funding and Gaur (*Bos gaurus*) populations. Accounting for the economic benefits from biodiversity and livelihoods suggests, however, that combining environmental and development goals could produce the best overall outcomes. Opportunities have presented themselves in the form of payments for environmental services and reduced emissions from deforestation and degradation, which, under the right policy framework and carbon price, could benefit both local people and the government. Nonetheless, there are challenges to implement these mechanisms, especially to improve distribution of benefits to local people and Cat Tien National Park. These results indicate that PES and REDD+ are possible options for biodiversity conservation in the Lower Mekong, if the necessary safeguards for monitoring of forest resources and benefit sharing to local people are met.

7.3 Main conclusions

This research illustrates a diversity of pragmatic strategies used by organisations to conserve biodiversity. No particular strategy is dominant, but organisations choose a set of activities that resembles each of the four main approaches to conservation of biodiversity: 1) protectionist, 2) integrated conservation and development, 3) market-based, and 4) institutional reform. As Chapter 4 and 5 suggest, protectionist strategies are used to mitigate the high level and diverse threats to biodiversity, particularly hunting, logging and agricultural encroachment, hence interventions necessarily require a large investment in law enforcement. But, since local resource users live in or near the forest areas, integrated conservation and development approaches are also implementing livelihood development activities (such as improved agricultural techniques and sustainable harvesting), environmental education and infrastructure development.

The results in Chapter 5 also suggest that institutional reform approaches, such as developing local resource-use agreements, developing regulations on hunting and revising national environmental laws (several of which are presented in Chapter 3), are implemented to improve the efficiency and operational capacity of national and local actors to improve conservation outcomes. Nevertheless, the challenges in governance, as discussed in Chapter 3, suggests that further institutional reform is necessary to continue to improve the development and implementation of environmental laws and regulations.

Market-based approaches, such as PES and REDD+, are not a commonly implemented strategy to support conservation and development (as discussed in Chapter 5 and Chapter 6). Nevertheless, market-based approaches are an emerging mechanism for conservation, and the results of Chapter 6 indicate that improvements to the mechanisms, such as improved benefit-sharing to local communities, better monitoring of forest resources and a high price for carbon sequestration (over \$20 per tonne of CO2) when REDD+ is implemented, could provide better strategies for supporting conservation and more finances for conservation managers and local people.

Conservation interventions are influenced by a wide range of actors, including government, NGOs, industry and local communities, some of which are far outside designated boundaries of the forest conservation areas. Donors, international agreements, environmental ministries and international conservation organisations collectively determine the choice of strategy for implementing conservation interventions. But the international demand for forest products, particularly timber and wildlife (explored in Chapter 4), and the economic development imperatives of national governments and industry, such as through hydropower, plantations, timber extraction, agricultural development and mining concessions (explored in Chapter 3), increase the threats to biodiversity in forest conservation areas. To overcome the factors that impact biodiversity, Chapter 5 showed that conservation organisations are working collaboratively with government, other organisations and local resource users to improve participatory approaches and build consensus and implement the most effective strategy to conservation and development interventions.

Conservation is faced with several challenges partly arising from factors related to the social and environmental context of the sites, for example, threats from local resource use and insecure land-tenure. Protecting biodiversity requires an in-depth understanding of the type and magnitude of threats to biodiversity in conservation areas (as discussed in Chapter 4). Choosing the appropriate strategy to mitigate threats requires an understanding of the livelihoods of local resource-users and the influence of actors from farther afield, such as residents from villages outside the conservation areas, international mining and hydropower companies. Chapter 5 shows, for example, a range of local dependence on forest products, but at the same time, several areas are planned for hydropower and mining developments by government and industry. Decisions also need to take into account wider governance issues, such as corruption and gaps in conservation-related laws, and the relationships among actors, including culture and values of local residents, at multiple levels. The use of partnerships among different groups of local people and organisations can help to acknowledge these factors, thus improving conservation outcomes.

The results and conclusions from this research in the Lower Mekong region have made several contributions to the global literature on biodiversity conservation. As Adams and Hutton (2007) suggest, conservation actors are protecting biological resources by establishing multilateral environmental agreements, policies and laws about who can use resources, where, when and how. This current research expands the understanding of conservation actions by discussing recent advances in policies and laws in the Lower Mekong countries, which have developed rapidly over the past few decades, and has explored the diverse activities undertaken by governments and non-government organisations to protect biodiversity in forest areas.

The global rate of biodiversity loss is driven by actions such as unsustainable extraction and development in natural areas (Naughton-Treves *et al.* 2005; Agrawal & Redford 2006; Pressey & Bottrill 2008; Nijman 2010). This thesis provides case examples of several specific threats to forest areas in the Lower Mekong, which supports the work of Salafsky *et al.* (2008) on the classification of threats, and further expands the understanding of the main threats and how organisations attempt to mitigate them. The results support the findings from Hughes and Flintan (2001), Kiss (2004) and Wunder (2006) that the illegal trade of timber and wildlife are still major challenges to biodiversity conservation. To curb the trade in wildlife and timber, governments and non-government organisations need to strategically target the drivers outside the conservation areas, particularly to change the consumption patterns of these resources across the region and internationally. Protectionist approaches are an important part of the strategy used by conservation organisations, but, supporting the suggestions of Adams and Hutton (2007) and Bruner *et al.* (2001), protectionist interventions need to be well-resourced and well-managed to effectively protect biodiversity.

This research has contributed to the discussions about how to implement ICDP approaches (Sanjayan *et al.* 1997; Wilshusen *et al.* 2002; McShane & Wells 2004; Robinson & Redford 2004; Sayer *et al.* 2007; Sayer 2009). Even though the effectiveness of ICDPs have been questioned by many researchers and practitioners in the last couple of decades (for example Barrett & Arcese 1995; Hughes & Flintan 2001; Wilshusen *et al.* 2002; Adams *et al.* 2004; Kiss 2004; Naughton-Treves *et al.* 2005; Agrawal & Redford 2006), ICDP approaches are widely implemented by government and non-government organisations across the Lower Mekong. Previous recommendations by conservation scholars have argued for conservation organisations to expand the spatial scale of biodiversity conservation interventions, to effectively engage with stakeholders and to respect the socio-political context (Robinson & Redford 2004; Sunderland *et al.* 2008; Grantham *et al.* 2009; Sayer 2009). The results in this thesis show that conservation and development interventions in the Lower Mekong have implemented activities that attempt to address these concerns to some extent, by implementing conservation interventions at a landscape scale with a diversity of strategies and engaging with multiple stakeholders through functional participation (Pretty & Smith 2004) with local people and collaborations among organisations.

Finally, the thesis has contributed to the literature on PES and REDD+ (Angelsen 2008a; Tallis *et al.* 2008; Angelsen *et al.* 2009; Sommerville *et al.* 2009; Tallis *et al.* 2009; Harvey *et al.* 2010), by exploring how PES and REDD+ might contribute to future conservation interventions in the Lower Mekong and highlighting some issues to be considered in implementation. While PES and REDD+ could provide improved strategies and more finances for conservation efforts, the approaches are limited by poor benefit sharing mechanisms to local people and poor monitoring of forest resources. Nevertheless, the results support the notion that REDD+ can positively contribute to biodiversity conservation (Harvey *et al.* 2010). The conclusions also support the recommendation of Sommerville *et al.* (2009) that safeguards should be implemented in REDD+ and PES schemes to include fair benefit-sharing to local people.

7.3.1 Differences among countries

This thesis has also highlighted some key differences of conservation practices among the countries. Cambodia is still feeling the effects of the past civil conflicts. The loss of technical capacity from these conflicts has reduced the effectiveness of governance of conservation areas, for instance, weak land tenure has given rise to threats of land-grabbing from outside individuals, and the high level of corruption in government has led to widespread illegal logging, often by government officials. Threats to forest areas, such as from the granting of land concessions and development of new infrastructure (including mines, hydropower dams and roads), are driven by the national government’s imperative for economic development.

Cambodia currently receives large amounts of support from donors, multilateral organisations and NGOs to improve conservation efforts. On the positive side, this means that conservation organisations implement strategies that attempt to work with locals and multiple organisations to overcome impediments imposed by large-scale threats. The powerful presence of multiple NGOs, however, means that there is a risk that competition among NGOs can lead to the reduced efficiency of conservation interventions.

While Vietnam has a history of conflict, the state has the strongest policy framework and state governing structures of the three countries. Large-scale infrastructure (such as roads and hydropower dams) has developed quickly, but the effects of these developments in conservation areas are starting to show, for example through the presence of invasive species and pollution, which are particularly damaging to forests and rivers, respectively. Nevertheless, at the same time, Vietnam is taking opportunities to develop new forest management processes and mechanisms, such as the 5-Million Hectare Reforestation Project and a REDD+ framework. Vietnam's conservation areas are smaller than those in Laos and Cambodia, with high human populations in the buffer zones, but the general approach to conservation in Vietnam is yet to shift from the general protectionist strategy to an approach that addresses the livelihood concerns of local people (Galvin & Haller 2008). The strong top-down management of these areas constrains local involvement and economic benefit sharing, and relocation of people from the core areas remains a contentious issue.

Laos is a land-locked country with the Mekong River supporting the livelihoods of a large proportion of the rural residents. While Laos has hundreds of sub-national conservation and protection forests covering areas larger than in

Vietnam, government funding to its conservation areas is much less than in Vietnam and, unlike Cambodia, international funding is restricted to a select few of its protected areas. Forests are also an important aspect of rural livelihoods; hence the government requires conservation interventions to have socio-economic development outcomes. Conservation organisations aim to improve the capacity of the provincial and district governments, which have some autonomy over conservation areas. Also, unlike Cambodia and Vietnam, one of the issues in Laos is that logging by the government (largely for the timber trade to Vietnam) is poorly managed, which is having a negative impact on sustainability of forest resources.

7.3.2 Implications and recommendations

The findings of this research have some implications for the practice of conservation in the Lower Mekong and more broadly. These implications lead to some general recommendations for conservation interventions.

<u>Focus on developing improved conservation institutions</u>: Chapter 3 discusses several natural resource governance issues affecting the implementation of conservation, particularly transparency issues in government, gaps in national conservation laws and limited technical capacity of government officials. Conservation interventions, operated by partnerships of government and international conservation organisations, can implement institutional reform activities that help to resolve several of the governance issues that inhibit the practice of conservation. Institutional reform can include, for instance, developing regulations for resource extraction at the local level, improving financial accountability and transparency of government departments, reforming environmental legislation at the national level and by developing formal agreements

between local and national conservation actors to jointly manage conservation areas (Wells 1998; Swiderska *et al.* 2008; Pescott *et al.* 2010).

Shared learning across sites: Chapter 4 showed that there are some common key threats to biodiversity in forest areas, including hunting, logging, agriculture encroachment and infrastructure development. While there are differences among sites and countries, shared learning among managers of conservation areas in the region could help to improve conservation actions that mitigate threats. One such approach could be to enable coordinated approaches to reduce threats, for example, by combining skills and resources of different government departments and non-government organisations to target illegal hunting and the wildlife trade. Another approach could be to lobby together for changes in national development policies to reduce the impact of infrastructure development (Salafsky & Margoluis 1999; Sayer & Campbell 2004; Salafsky *et al.* 2008).

Partner with relevant organisations for better conservation outcomes: As the results of Chapter 5 indicate, partnerships between conservation and development organisations at the sites can help to improve the outcomes of the forest conservation areas. Caution is warranted, however, because partnerships can involve high transaction costs and there might be limited benefits to organisations by forming partnerships. Nevertheless, effective communication and consultation among multiple stakeholders is important to supporting relationships between partners (Leach & Pelkey 2001; Fisher *et al.* 2005).

Implement regular monitoring and evaluations of interventions: Brooks (2006) points out that the effectiveness of the outcomes in conservation and development interventions are rarely measured. The lack of monitoring and evaluations of conservation and development interventions was also a constraint to this research, which limited the ability to test factors influencing progress in Chapter 5, and was possibly a constraint to the effectiveness of interventions at the 15 sites. Furthermore, there was a general lack of understanding by organisations of intervention performance and the factors that lead to positive outcomes, which limits the effectiveness and efficiency of interventions. Implementing adaptive management can improve performance through setting clear goals in management plans and implementing regular evaluations of intervention progress (Lee 1999; Sayer & Campbell 2004; Stem *et al.* 2005; Axford *et al.* 2008; Maris & Bechet 2010).

Continue to develop PES and REDD+ mechanisms: The market-based approaches of PES and REDD+ are relatively new in the Lower Mekong but they have the potential to provide large economic and institutional benefits. Chapter 6 showed that an environment and development scenario that incorporates PES and REDD+ could provide more benefits than a solely development-related scenario. This suggests that interventions should consider PES and REDD+ in their options for future biodiversity conservation interventions (Angelsen *et al.* 2009; Sommerville *et al.* 2009; Harvey *et al.* 2010), in the event that the carbon price is at least $20 a tonne.

7.4 Limitations and future directions for research

A cross-country comparison with multiple sites per country is a challenging task, and this research was very ambitious in its goals. Unfortunately, the lack of available data with which to measure performance and the influences on the success of interventions limited the results of this research (as discussed in Chapter 2 and 5).

Furthermore, due to the resource and time limitations, the research project was not able to conduct a more in-depth local-level analysis of the conservation and development interventions. These constraints limited the ability to provide more detailed insights into the intricacies of conservation and development interventions and success factors of those interventions.

In hindsight, the research design could have been improved by strategically selecting variables to address key issues. For instance, a set of variables could be developed to focus on the factors that influence the success of partnerships or the capability of law enforcement teams to mitigate local threats to biodiversity. The set of variables should be small enough so the researchers can effectively spend the available resources to collect reliable data.

Despite good planning, time was a constraint to this research. Research of this type takes a long time, both logistically to carry out the field trips and intellectually to understand the intricacies of social and political settings of the conservation areas. To ensure the reliability of the information entered for the variables, researchers should ensure that there is adequate time prior to field trips to obtain the relevant government permissions to access information and enter conservation areas, and ensure that there is sufficient time in the field to gain an in-depth understanding of the context and triangulate the collected information.

The strategies of conservation interventions are related to the environmental, social and political contexts of each site. Future research could use a network of independent case studies under a common framework (similar to that of CIFOR's Poverty and Environment Network - CIFOR 2008), each the depth of a Masters or PhD study, with the synthesis done by a network of researchers. Each in-depth case study of individual interventions in conservation areas could focus on topics such as an exploration of local-level conservation strategies, factors influencing the performance of interventions and the details of trade-offs between conservation and development.

7.5 Summary

While this research focuses on one region, the experiences from the analysis conservation interventions in this thesis provide an important snapshot of biodiversity conservation globally. Conservation in the Lower Mekong has changed dramatically over the past 20 years, conservation policy has expanded and government and international investment has grown. Conservation strategies are now complex and operating beyond the boundaries of conservation areas. Organisations implementing conservation and development interventions in Cambodia, Laos and Vietnam use a diversity of pragmatic strategies that resemble each of the four main approaches to conservation of biodiversity: 1) protectionist strategies are used to mitigate the high level and diverse threats to biodiversity (Hughes & Flintan 2001; Kiss 2004; Wunder 2006); 2) integrated conservation and development strategies are implemented to assist local resource users who live in or near the forest areas (Hughes & Flintan 2001; Wunder 2006; Sayer & Campbell 2004; Frost *et al.* 2006; Garnett *et al.* 2007; Springer 2007); 3) institutional reform approaches are implemented to improve the efficiency and operational capacity of national and local actors to improve conservation outcomes (Wells 1998; Barrett *et al.* 2001); and 4) market-based approaches, which are an emerging mechanism for conservation, are implemented to provide extra funds for conservation managers and local people (Brown 2002; Buscher & Whande 2007; Igoe & Brockington 2007).

Conservation interventions are influenced by a wide range of actors, including government, NGOs, industry and local communities, some of which are far outside designated boundaries of the forest conservation areas. Biodiversity conservation is also influenced by wider societal factors, including governance and economic development, which can limit the effectiveness of interventions to conserve biodiversity. These issues need to continue to be addressed by taking into account social, economic and governance factors in the implementation of conservation interventions, particularly through building consensus and collaborating with a wide diversity of actors in and outside conservation areas.

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Appendix 1 – Variables for the 15 conservation areas

This appendix is a list of the variables for the data collected for the context (environmental, social and institutional factors) and interventions (managing interventions and other interventions) at the 15 sites. Variables that are described here are explained in Chapter 2 and used in Chapters 3, 4 and 5. Some of the results use a transformation of the variables described here (such as from hectares to square kilometres, or a combination of multiple variables). Several of the scales here do not include values of '2' and '4', but only the extreme and median values are described .

Table A1-1 Variables for environmental characteristics of the 15 conservation areas.

Group	Var	Measured variable	Measurement (2007 current estimate)
Geographical features	1	Area in core zone	Current number of hectares in the conserved area
	2	Area in buffer zone	Current number of hectares in the area adjacent to the conserved area - formal buffer if one exists; - or area within a five kilometre radius of conserved area
	3	Perimeter	Number of kilometres of the perimeter of the conserved area
	4	Perimeter: jurisdictional boundary	Number of kilometres of the perimeter defined by a country or provincial jurisdiction
	5	Perimeter: adjacent conservation area	Number of kilometres of the perimeter bordering another conserved area
	6	Precipitation	Average rainfall per year (mm)
	7	Climate zone	Category (humid tropical, humid, subtropical, temperate, montane, submontane)
	8	Average Altitude	Average across area (m)
	9	General landform	Type of landform that describes most of the conservation area: 1= flat, 2= low or rolling hills, 3= hills and plateaus, 4= steep hills with only a few flat areas, 5= mountainous
	10	Soil quality	Quality of soils for agricultural potential and biodiversity: 1=poor soils, 3= scattered patches of medium soils, 5=a lot of good quality soils covering the entire area

Group	Var	Measured variable	Measurement (2007 current estimate)
	11	Buffer to core topography transition	1=buffer zone has more mountains than core zone 2=buffer zone has more hills than core zone 3=no change between buffer and core zone 4=core zone has more hills than buffer zone 5=core zone has more mountains than buffer zone
Biological features	12	Important species	Number of known species listed on national or international threatened species lists, such as Vietnam's Red Data Book, including endangered, vulnerable and near threatened species.
	13	Habitat diversity	Shannon Diversity Index Derived from the percent of each type of habitat in core zone: negative sum of (the percent habitat multiplied by its natural log) Note: natural habitats included here are those with an area of more than 10%. These are measured as a proportion out of 10.
	14	Fragmentation of habitats	1=Cut by several roads, multiple small patches of forest intruded by agricultural lands; 3=Cut by some roads, few large patches of forest with little agricultural intrusions; 5=Few roads, one large patch with few agricultural intrusions
	15	Integrity of habitats	1=low integrity; 3=medium integrity; 5=high integrity
Land cover and use of the entire landscape	16	Primary forest	Estimate, from documents or from gis database (ha). Measured as a proportion, out of 10, of the total land cover
	17	Secondary forest	Estimate, from documents or from gis database (ha). Measured as a proportion, out of 10, of the total land cover
	18	Production forest	Estimate, from documents or from gis database (ha). Measured as a proportion, out of 10, of the total land cover
	19	Agriculture	Estimate, from documents or from gis database (ha). Measured as a proportion, out of 10, of the total land cover
	20	Production forest type	Dominant type of production forest
	21	Crop type	Dominant type of agriculture
	22	Buffer to core land use transition	1=no change; 3=even gradient of change; 5=sharp change
Pressures on the conservation area	23	Hunting intensity	1=Infrequent 3=Regular 5=Excessive
	24	Hunting threat	1=Is not likely to threaten populations 3=May damage some populations in the medium term 5=Likely to irreversibly damage populations in the near future
	25	Hunting: rank	Rank compared to other threats

Group	Var	Measured variable	Measurement (2007 current estimate)
	26	Hunting: actor	Where are the hunting actors from? 1 = predominantly local 2 = local and outside people hunt in the area 3 = mostly outsiders come to the area to hunt NB: if a trader comes to buy from a local, the local is the one hunting - not an outsider.
	27	Logging intensity	1=Infrequent 3=Regular 5=Excessive
	28	Logging threat	1=Is not likely to threaten populations and habitats 3=May damage some populations and habitats in the medium term 5=Likely to irreversibly damage populations and habitats in the near future
	29	Logging: rank	Rank compared to other threats
	30	Logging: actor	Where are the direct logging actors from? 1 = predominantly local people 2 = local and outside people log in the area 3 = mostly outsiders come to the area to log NB: if a trader comes to buy from a local, the local is the one logging - not an outsider.
	31	Invasive species intensity	1=few invasive species 3=invasive species taking over some small patches of habitats 5=invasive species covering large areas of habitats, causing damage
	32	Invasive species threat	1=Is not likely to threaten populations and habitats 3=May damage some populations and habitats in the medium term 5=Likely to irreversibly damage populations and habitats in the near future
	33	Invasive species: rank	Rank compared to other threats
	34	Fire intensity	1=no fire 3=some fires with little effect on the forest or its species 5=fire is frequent and damaging to habitats and species
	35	Fire threat	1=Is not likely to threaten populations and habitats 3=May damage some populations and habitats in the medium term 5=Likely to irreversibly damage populations and habitats in the near future
	36	Fire: rank	Rank compared to other threats
	37	Pollution intensity	1=very little pollution 3=some industrial pollutants and agricultural chemicals affect some patches of habitats 5=many industrial pollutants and agricultural chemicals damage many habitats and species
	38	Pollution threat	1=Is not likely to threaten populations and habitats 3=May damage some populations and habitats in the medium term 5=Likely to irreversibly damage populations and habitats in the near future
	39	Pollution: rank	Rank compared to other threats

Group	Var	Measured variable	Measurement (2007 current estimate)
	40	Dam intensity	1=no hydropower or irrigation dams 3=some dams in the area, affecting small patches of habitat 5=dams are common and impact large patches of habitat
	41	Dam threat	1=Is not likely to threaten habitats 3=May damage some habitats in the medium term 5=Likely to irreversibly damage habitats in the near future
	42	Dam: rank	Rank compared to other threats
	43	Mine intensity	1=no mining 3=some mining in the area, affecting small patches of habitat 5=mines are common and impact large patches of habitat
	44	Mine threat	1=Is not likely to threaten habitats 3=May damage some habitats in the medium term 5=Likely to irreversibly damage habitats in the near future
	45	Mine: rank	Rank compared to other threats
	46	Infrastructure intensity	1=little infrastructure in the area 3=some roads and other infrastructure occupy small patches of land 5=roads and other infrastructure occupy large areas of land
	47	Infrastructure threat	1=Is not likely to threaten habitats 3=May damage some habitats in the medium term 5=Likely to irreversibly damage habitats in the near future
	48	Infrastructure: rank	Rank compared to other threats
	49	Agriculture encroachment intensity	1=agriculture does not encroach on the conserved forest 3=some small areas of forest are encroached by agriculture every year 5=many large patches of forest are encroached by agriculture every year
	50	Agriculture encroachment threat	1=Is not likely to threaten habitats 3=May damage some habitats in the medium term 5=Likely to irreversibly damage habitats in the near future
	51	Agriculture encroachment: rank	Rank compared to other threats
	52	Land grabbing intensity	1=Infrequent 3=Regular 5=Excessive
	53	Land grabbing threat	1=Is not likely to threaten habitats 3=May damage some habitats in the medium term 5=Likely to irreversibly damage habitats in the near future
	54	Land grabbing: rank	Rank compared to other threats

Table A1-2 Variables for human characteristics in the 15 conservation areas.

Group	Var	Measured variable	Measurement (2007 current estimate)
Demographic Conditions	55	Population in core	# people
	56	Population in buffer	# people
	57	Number of settlements	number of settlements (communes, villages, groups or the most accurate delineation)
	58	Major ethnic group	is the dominant group in the landscape the national majority (0) or a minority group (1)?
	59	Ethnic minority groups	number of ethnic minority groups comprising over 5% of the population
	60	Ethnic minority population	# individuals of ethnic minority groups in the core and buffer.
	61	Life Expectancy	Number of years
	62	Mortality Rate	Infant mortality rate per 1000 live births
	63	Language	People thatspeak the national language 1= few speak the national language (roughly: less than 20%) 2= about half speak the national language 3= almost all speak the national language
	64	Literacy	Literacy rates in adults
	65	Education	Attendance rates at primary school level
	66	Migration	in- and out- migration of individuals to the area between 2003 and 2007. 1 = more out-migration 2 = low rate of in-migration (less than 2%/year) 3 = high rate of in-migration (greater than 2%/year)
	67	Temporary employed migrants	Effect of employed people who work in the area for a short period of time (ie. Miners, construction workers, military etc. who are present in the area for a short time but live elsewhere) 0 = There are a number of people in the area (for construction work, trade etc.) but they have little effect on the forest 1 = Employed migrants in the area are more numerous and/or have a major impact on the forest and the decisions of the intervention
Socio-cultural setting	68	Major ethnic group use of the forest	The main product used, if any, by dominant group in the area
	69	Ethnic minority use of forest	1=little use of the forest 3=ethnic minority groups use the forest for some products 5=ethnic minority groups use the forest as their main source of income and livelihood
	70	Female forest use	Overall dominant forest product collected by women
	71	Male forest use	Overall dominant forest product collected by men
	72	Conflicts among stakeholders	Stakeholders include government, industry, businesses, local residents and NGOs 1=very little conflict amongst groups, 3=some conflicts between stakeholder groups, 5=many frequent disputes between stakeholders over resources and land
	73	Current influence of former large scale conflicts	1=people are not currently impacted by former conflicts 3=conflicts still remembered amongst elders, and some impacts are still noticeable, 5=conflicts are still damaging to the community

Group	Var	Measured variable	Measurement (2007 current estimate)
	74	Cultural attitudes towards conservation of forest	Cultural attitudes are those formed through traditional values/religious practices/tradition and have a long-term history: 1=little cultural value; 3=some cultural value; 5=high cultural value
	75	Social attitudes towards conservation of forest	Social attitudes are those formed more recently, often influenced by the wider society 1=people want to cut the forest and see little reason to conserve its resources; 3=people want to use the forest but also see its importance in terms of protecting the species for future use; 5=people do not wish to cut the forest for resources because of the value of protecting the habitat for future sustainable use
Livelihoods	76	Level of poverty	Level of poverty across the landscape as compared to the regional levels: 1=very low (few in poverty; generally less than 10%) 2=low (some poverty; generally between 10% and 20%) 3=medium (generally between 20% and 30%) 4=high (a third to half in poverty; generally between 30% and 50%) 5=very high (most in poverty; generally above 50%)
	77	Income	Average household income per year
	78	Income from agriculture	Measured as a proportion, out of 10, of the total incomes
	79	Income from forest (legal)	Measured as a proportion, out of 10, of the total incomes
	80	Income from forest (illegal)	Measured as a proportion of the total incomes (out of 10). This may be excluded in some cases. Na = data not available.
	81	Non-farm income	Measured as a proportion, out of 10, of the total incomes
	82	Level of dependence on forest products	Scale 1-5 for subsistence and cash income for entire population, based on the percentage of livelihoods that depend on forests: 1=very low (less than 10%) 2=low (between 10% and 40%) 3=medium (between 40% and 60%) 4=high (between 60% and 90%) 5=very high (above 90%)
	83	Tourism revenue	Rank of tourism revenue between sites. NA = no formal tourism established.
	84	Tourism revenue (local)	1=some of the revenue goes to local people and there is a mechanism to do so 0= little revenue goes to local people
	85	Homestays	Are there homestays in the area? Yes/No
	86	National tourists	number of national tourists visiting per year. Measured as a proportion out of 10.
	87	Foreign tourists	number of foreign tourists visiting per year. Measured as a proportion out of 10.
	88	Landless people	Rate of landless people in the area: 0= not many landless 1= many landless people

Group	Var	Measured variable	Measurement (2007 current estimate)
	89	Conservation implications on livelihoods	1=people have been badly affected by forest conservation 2=livelihoods are negatively affected by forest conservation 3=forest conservation has had little effect on local people 4=livelihoods have been positively affected by forest conservation 5=people have greatly benefited from the conservation activities
	90	Increase in economic output	1=decrease in population and decrease in productive output, 2=stable productive output and no growth in population, 3=normal productive increase and normal growth rate, 4=high production and higher than normal growth rate, 5=intensive production, high output and high growth rate
	91	Economic potential of conserved area	1= low economic potential (eg. few valuable tree species, ntfp species and tradable wildlife species; poor agricultural potential) 3=medium potential (eg. some valuable timber species; ntfp species present in reasonable quantity; wildlife is hunted to some extent for trade; soils, topography and climate are reasonable for some agriculture) 5=high potential (eg. many valuable timber species; many ntfp species; large amount of traded wildlife species; good quality soils on reasonable topography with good climatic conditions)
	92	Long-term landscape sustainability	Whether the landscape will continue to be sustainable at the current level of activities, without a decrease in fertility or increase in environmental damage. 1=highly unsustainable activites are common; 3=sustainability questioned, activites are not sustainable at current levels; 5=activities are sustainable at current levels for the forseeable future
Infrastructure	93	Access to safe water	households with safe water during the dry period: 1 = most houses are without access to safe water 2 = some houses are without access to safe water 3 = nearly all houses have access to safe water
	94	Access to health services	1=few pharmacies and clinics in area; 3=clinics are available to most; 5=everyone has access to clinics
	95	Access to schools	1=few primary schools in area; 3=primary schools are available to most, secondary schools are available to some; 5=nearly all children have access to primary and secondary schools
	96	Access to electricity	1=electricity unavailable in most of the area; 3=electricity available to approximately half of the households; 5=nearly all households have electricity
	97	Access to information	1=some radios, phones and tvs; 3=many people have radios, phones and tvs; 5=most people have radios, mobile phones, tvs and some have internet

Group	Var	Measured variable	Measurement (2007 current estimate)
	98	Transport	Dominant type of transport (on foot; motorbike; car)
	99	Road length	Length (km) of main roads in the area, including highways, provincial roads etc. Not tracks.
	100	Distance to markets	Average time (in hours) taken to access nearest connected market
	101	Distance to forests	Average time for locals to get to forests (core or buffer) to use available products: animals, collect bamboo, rattan and other NTFPs or cut logs.
	102	Distance to major ports	Measured by Google Earth, distance from the largest nearest city/town, such as Phnom Penh, Vientiane, Danang, HCMC, Paxse and Hanoi.
	103	Investment in infrastructure	1=no investment, 3=some investment by government and industry, 5=high intensity of investment by government and industry

Table A1-3 Variables for institutional characteristics in the 15 conservation areas.

Group	Var	Measured variable	Measurement (2007 current estimate)
Laws and policies	104	PA gazettement	Year the conservation area was formalised
	105	Buffer zone status	0 = Unofficial - intervention may work in communities around the area, but not in a formal buffer zone 1 = Official - by formal government recognition;
	106	Presence of conservation regulations	Vertical' presence of conservation regulations which apply to the site: 1=National law 2=Provincial regulations 3=Conservation area regulation 4=District regulations NB: The corresponding number is the smallest scale regulation available. Conservation regulation is one specific to the area.
	107	Capacity to implement policy	This includes national, provincial and local capacity to implement policies such as forest strategies, poverty reduction strategies etc. 1=low capacity 3=medium capacity 5=high capacity NB: This is measured at the national level, unless more specific information is available.
	108	Harmony beteween written regulations	Includes horizontal and vertical harmony and a consideration for the conflicts between these - eg. horizontal harmony: national law (land law and forestry law), local regulations (District and protected area regulations); vertical harmony: local regulations built (hunting restrictions) on national law (wildlife law). 1= Frequent conflict 3= Some conflict 5= Harmonious
	109	Presence of national programs	Active presence of national programes at the landscape level. National programes include such programs such as the Seila programme (in Cambodia), Program 661 (in Vietnam), the Poverty Reduction Fund (in Laos): 1= low presence 2= medium presence 3= high presence
	110	Local compliance to legislation	1=There are many problems with people not complying with the laws 3=There are some problems with people not complying with the laws 5=People mostly comply with the law and there are few issues of non-compliance
	111	Strength of the judicial system	1=the judicial system is weak, with few perpetrators prosecuted 3=the judicial system is has some problems, some perpetrators prosecuted 5=the judicial system is strong, nearly all perpetrators prosecuted
	112	Land tenure status	owner/user rights in place in the landscape (category: full ownership, communal ownership; communal use; full access rights; partial use; residential use; no formal arrangement)
	113	Land tenure certification	0 = little or no land titles in the area 1 = land titling is present, at least in some settlements

Group	Var	Measured variable	Measurement (2007 current estimate)
Enforcement	114	Law enforcement size	Number of enforcing agents in the conserved area
	115	enforcement capability	This variable is based on the amount of training received and the experience of the rangers/enforcing agents. It also measures the effectiveness of the forest guards at dealing with the level of particular threats: hunting, logging, fire, encroachment, illegal mining and land grabbing. The force needs to be big enough to cover the area and comunities, be capable of finding the violators (ie. Experienced, fit, perceptive) and capturing/charging them (ie. Transparent, understand the laws, be cooperative and accountable): 1= enforcement is disorganised and agents are not capable of dealing with many violations 2= enforcement deals with some violations for some activities, but not frequently; 3 = Enforcement can deal with some level of violations and does so often; 4 = enforcement deals with most violations, but some activities are not under control; 5= enforcement is highly organised and the agents are exceptional, with a notable decrease in the number of violations over recent years.
	116	Existence of customary rules	1=few local rules to regulate customary activities; 3=some local rules to regulate customary activities; 5=many local rules to regulate customary activities
	117	Conflicts between formal law and customary rules	1=NA; 2=the difference between customary rules and laws are minor; 3=many customary rules are similar to laws, but some cause conflict in legislation and between different stakeholder groups; 4=some customary rules are similar to laws, but many cause conflict in legislation and between different stakeholder groups; 5=customary rules are different to the laws present and both are often broken, causing conflicts between stakeholder groups
Civil Society	118	Activity of community/mass organisations (inc. NRM groups/unions)	1=there are few or no organisations run by local people and if there are some, they rarely run well; 3= there are some organisations and NRM bodies are run by local people, but they have little power and are poorly managed; 5= there are some strong organisations and nrm bodies, they influence the decisions made by other stakeholders in the landscape and are well managed
	119	Presence and investment of NGOs in area	1=few organisations and no investment; 3= some organisations but little investment and influence; 5=many organisations with a lot of investment and influence over the landscape
	120	Number of known organisations	Number of known conservation and/or development organisations working in the same area

Table A1-4 Variables for characteristics of the interventions managing the 15 conservation areas.

Group	Var	Measured variable	Measurement (2007 current estimate)
Management features	121	Conservation or development	1=conservation, 3=integrated conservation and development links, 5=development
	122	Clear focus and objective	1=objective is confusing; 5=objective is concise and clear, with measurable targets
	123	Target area in core zone	Proportion of the target area (out of 5) where the intervention operates in the core zone, including villages frequented and patrolling areas.
	124	Target villages in buffer zone	Proportion (out of 5) of villages/communities the intervention targets in the buffer zone.
	125	Length of intervention	# years since started implementation
	126	Yearly financial budget	$ for previous year
	127	Total budget	$ total for intervention 2003 to 2007
	128	Source of funding	1=intervention is donor funded only, 2 =intervention receives most of its funds from donor and some from government, 3=intervention receives equal amount of funds from donor and government, 4 =intervention receives most of its funds from government and some from donors, 5=intervention is government funded only.
	129	Government investment	$ per year invested by the national government
	130	Managing body	1=intervention is managed by an organisation, **not** related to the government 3=intervention is managed through an equal partnership between the government and an organisation 5=intervention is managed by the government
	131	Staff in intervention	Number of full-time or equivalent staff in previous year
	132	Staff from government	Number of full-time or equivalent staff in previous year
	133	Intervention operating mechanisms	1= weak management, operations, outputs delayed, 5=strong management, timely outputs
	134	Reporting mechanisms	1=no reporting mechanisms; 3=some internal reports; 5=internal reports frequent and clear, external agencies are reported to periodically
	135	Monitoring and evaluation	Monitoring and evaluation procedures of the intervention and its activities are: 1=weak, untimely and scarce, and do not feed back into further implementation 5=very strong, are carried often and have good feedback loops in place
	136	Gains from research	Degree to which research recommendations have been put into practice: 1=no change, 3=some research recommendations have been trialled, 5=most research recommendations have been put into practice and there is a strong mechanism to do so
	137	Sustainability of intervention	1=intervention not sustainable 3=intervention partially sustainable 5=intervention is sustainable

Group	Var	Measured variable	Measurement (2007 current estimate)
Activities	138	Research	% effort: combination of financial and human resource cost Could include: - socio-economic studies - biological studies - feasability studies - research projects
	139	Education and training	% effort: combination of financial and human resource cost Could include: - projects to improve education and awareness of local people; - training courses to improve capacity of local people and/or staff members.
	140	Local economic initiatives	% effort: combination of financial and human resource cost Could include: - projects to improve the incomes of local people via provision of materials; - implementation of local associations or community-based commercial operations
	141	Support and infrastructure development	% effort: combination of financial and human resource cost Could include: - projects to improve sanitation, health care and services; - building of roads, bridges and water facilities
	142	Tourism	% effort: combination of financial and human resource cost Could include: - tourism operation - interpretation centres - tourism development - improvements to infrastructure for tourism
	143	Land-use planning	% effort: combination of financial and human resource cost Could include: - Participatory Land Use Planning (PLUP) - Planning of and delineation of community protected areas, forestries or fisheries
	144	Institutional development	% effort: combination of financial and human resource cost Could include: - efforts to change the market system - efforts to change the legal system
	145	Law enforcement	% effort: combination of financial and human resource cost Could include: - operation of a law enforcement team - implementation of community patrols - support to the current law enforcement teams
	146	Conservation payments	% effort: combination of financial and human resource cost Could include: - payments for information provided by local people - payments for community monitoring teams

Group	Var	Measured variable	Measurement (2007 current estimate)
	147	Other conservation activities	% effort: combination of financial and human resource cost Could include: - projects to aid populations of wildlife (ie. Captive breeding) - projects to improve forest quality - monitoring of wildlife and forest
Integrated Conservation and Development activities	148	Environmental education	If the intervention implements education programmes for local people, is it attempting to tradeoff or synergise conservation and development? NA = no local education 1 = tradeoff development and conservation (eg. improving teacher numbers; capacity building for trade) 2 = small synergies between conservation and development (eg. health education) 3 = synergising conservation and development (eg. awareness raising, environmental education programmes)
	149	Income generation	If the intervention implements income generation for local people, is it attempting to tradeoff or synergise conservation and development? NA = no income generation 0 = small synergies between conservation and development (eg. agriculture intensification to reduce reliance on forest) 1 = strong connection between conservation and development (eg. market improvement for NTFPs, NTFP nurseries, fodder production to remove livestock from forest)
	150	Local involvement in enforcement and monitoring	Do the enforcement and monitoring teams involve local people? 0 = no 1 = yes
Collaboration	151	Stakeholder consultation	Degree to which stakeholders have been consulted in the intervention activities: 1=Very few of the potential stakeholder groups have been consulted 2 =Some stakeholder groups have been consulted 3=Many stakeholder groups have been consulted 4 =Most stakeholder groups have been consulted 5=All stakeholder groups have been consulted
	152	Local participation	Degree of participation by local people: 1 = Local people do not participate in activities of the intervention 2 = The intervention involves local people in some activities 3 = The intervention often involves local people in several activities 4 = The intervention involves local people in most activities 5 = Local people are an integral part of the intervention activities
	153	Mass media attention	1=no media attention 3=media reports often appear annually 5=media reports often appear monthly

Group	Var	Measured variable	Measurement (2007 current estimate)
	154	Collaboration with local organisations	1=organisation works alone, 3=government has some links with the organisation and ngos are collaborating on some interventions, 5=the government and organisation have a strong management link and many ngos work with the organisation for similar goals
Outcomes	155	Progress towards achieving biodiversity conservation objectives	1=not relevant, 2=no progress, 3=little progress towards achieving targets, 4=close to achieving targets, 5=objectives on target
	156	Progress towards achieving livelihood improvement objectives	1=not relevant, 2=no progress, 3=little progress towards achieving targets, 4=close to achieving targets, 5=objectives on target
	157	Progress towards achieving institutional building objectives	1=not relevant, 2=no progress, 3=little progress towards achieving targets, 4=close to achieving targets, 5=objectives on target
	158	Overall Progress	1 = no progress 2 = Little progress, not much has been done 3 = Some progress to achieving targets 4 = Close to achieving targets, but a few hinderances 5 = Objectives on target
Outputs	159	Wildlife populations and natural areas	1=populations and habitats are degrading rapidly 3=populations and habitats are stable 5=populations and habitats are increasing
	160	Attitudes to conservation	1=attitudes of local people have deteriorated 3=attitudes of local people are stable 5=attitudes of local people have improved
	161	Local livelihood status	1=Livelihood status has deteriorated 3=Livelihood status is stable 5=Livelihood status has improved
	162	Collaborations	1=Reduction in collaboration; 3=Collaborations have not been built nor broken; 5=Many collaborations have been built
	163	Institutions	1=Institutions have deteriorated 3=Institutions are stable 5=Institutions have improved
	164	Publications	number of widely diseminated publications per year

Table A1-5 Characteristics of the 'other interventions' in the forest conservation areas.

Var #	Variable name	Measurement (2003 to 2007; or current)
Var1	Conservation or development	1=conservation, 3=integrated conservation and development links, 5=development
Var2	Target area	Size of the target area where the intervention operates: 1 = small area - 1 to 3 villages (or approximate area) 2 = medium area - Multiple communes or 4-10 villages (approximately 500 to 5000 ha) 3 = medium-large area - some communes or couple of districts (approximately 5000 to 20 000 ha) 4 = large area - Covers some districts (approximately 20 000 to 50 000 ha) 5 = landscale area - many districts or sub-province (greater than 50 000 ha)
Var3	Budget	Average dollars per year since the intervention started, in the target area: 1=1-10k 2=10-50k 3=50-100k 4=100-200k 5=over 200k
Var4	Length of intervention	# years since implementation
Var5	Research	% effort: combination of financial and human resource cost Could include: - socio-economic studies - biological studies - feasability studies - research projects
Var6	Education and training	% effort: combination of financial and human resource cost Could include: - projects to improve education and awareness of local people; - training courses to improve capacity of local people and/or staff members.
Var7	Local economic initiatives	% effort: combination of financial and human resource cost Could include: - projects to improve the incomes of local people via provision of materials; - implementation of local associations or community-based commercial operations
Var8	Support and infrastructure development	% effort: combination of financial and human resource cost Could include: - projects to improve sanitation, health care and services; - building of roads, bridges and water facilities
Var9	Tourism	% effort: combination of financial and human resource cost Could include: - tourism operation - interpretation centres - tourism development - improvements to infrastructure for tourism
Var10	Land-use planning	% effort: combination of financial and human resource cost Could include: - Participatory Land Use Planning (PLUP) - Planning of and delineation of community protected areas, forestries or fisheries

Var #	Variable name	Measurement (2003 to 2007; or current)
Var11	Institutional development	% effort: combination of financial and human resource cost Could include: - efforts to change the market system - efforts to change the legal system
Var12	Law enforcement	% effort: combination of financial and human resource cost Could include: - local enforcement
Var13	Other conservation activities	% effort: combination of financial and human resource cost Could include: - projects to aid populations of wildlife (ie. Captive breeding) - projects to improve forest quality
Var14	Stakeholder involvement	Degree to which stakeholders have been consulted in the intervention activities: 1=Very few of the potential stakeholder groups have been consulted with and/or participate in the intervention 3=Many stakeholder groups have been consulted and/or participate in the the intervention 5=All stakeholder groups have been consulted with and/or participate in the intervention
Var15	Progress towards achieving biodiversity conservation objectives	1=not relevant, 2=no progress, 3=little progress towards achieving targets, 4=close to achieving targets, 5=objectives on target
Var16	Progress towards achieving livelihood improvement objectives	1=not relevant, 2=no progress, 3=little progress towards achieving targets, 4=close to achieving targets, 5=objectives on target
Var17	Progress towards achieving institutional building objectives	1=not relevant, 2=no progress, 3=little progress towards achieving targets, 4=close to achieving targets, 5=objectives on target
Var18	Overall Progress	1 = no progress 2 = Little progress, not much has been done 3 = Some progress to achieving targets 4 = Close to achieving targets, but a few hinderances 5 = Objectives on target
Var19	Environmental education	If the intervention implements education programmes for local people, is it attempting to tradeoff or synergise conservation and development? NA/0 = no local education 1 = tradeoff development and conservation (eg. improving teacher numbers; capacity building for trade) 2 = small synergies between conservation and development (eg. health education) 3 = synergising conservation and development (eg. awareness raising, environmental education programmes)

Var #	Variable name	Measurement (2003 to 2007; or current)
Var20	Income generation	If the intervention implements income generation for local people, is it attempting to tradeoff or synergise conservation and development? NA/0 = no income generation 1 = tradeoff development and conservation (eg. Plantation and crop growing) 2 = small synergies between conservation and development (eg. agriculture intensification to reduce reliance on forest) 3 = strong connection between conservation and development (eg. market improvement for NTFPs, NTFP nurseries, fodder production to remove livestock from forest)

Appendix 2 – STELLA model

This appendix details the STELLA model developed for use in Chapter 6. The model structure in STELLA is made up of four layers, 1) the interface, 2) the map, 3) the model, and 4) the equation. This appendix will describe the interface, map and model layers, then present each of the equations used in the model. Additional supporting information is found in the online version of the model. See attached CD to view the STELLA model of Cat Tien National Park.

The interface (Figure A2-1) is the location where a user can change the assumptions of the model using sliders and switches, then see the results of the model runs on the graphs provided. The interface layer also presents the different sectors within the model and the links that are made among all the sectors. In the Cat Tien model, there are 12 sectors, three sliders and two switches (described in Chapter 6).

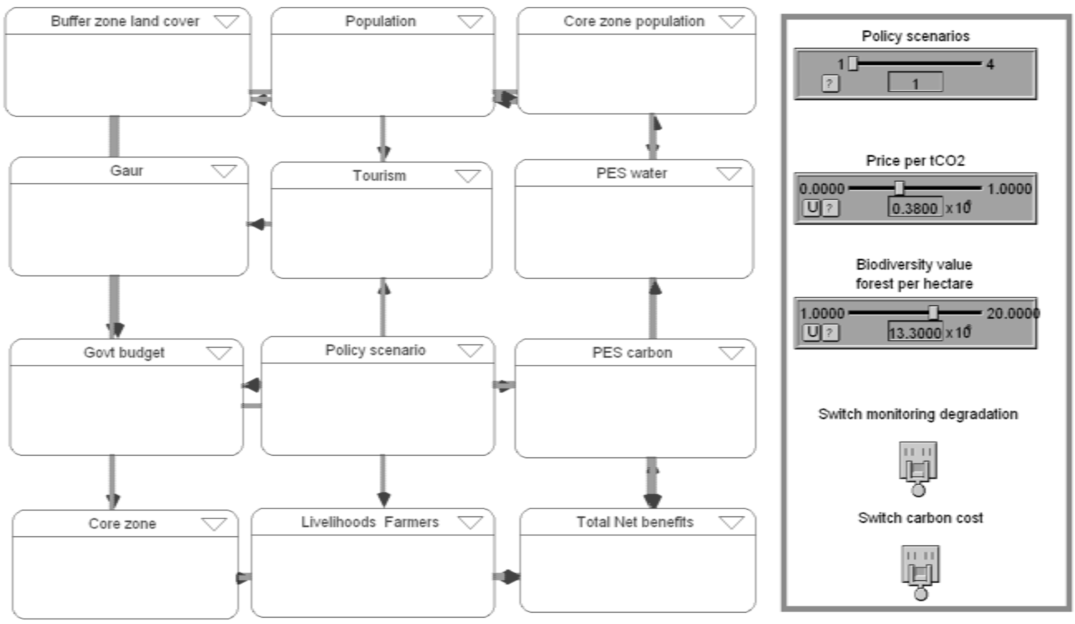

Figure A2-1 Interface layer for the Cat Tien model. The model has 12 sectors, three sliders and two switches.

The map and model layers are similar; both show the components of the model. The map layer shows the relationships among components and the qualitative information in the system, where the user can document an explanation for each component. In the model layer, the user can input the equations and data for each component. Each of the sectors encapsulates a set of components that are defined in the model layer.

There are four types of components in the model, called 1) stocks, 2) flows, 3) converters and 4) connectors. Stocks are the components that represent quantity in the model (such as population, forest area or money). Flows enter and exit from the stocks, changing the quantity held within the stock (such as births/deaths, regrowth/deforestation or income/expenditure) as a function of time (t), which for the Cat Tien model is 1 year. Flows can also be conveyors, where the quantity (such as new forest) enters the flow for a set period of time (such as 5 years) before going out to the next stock (such as mature forest). Converters are components that add pieces of information to the model (such as carrying capacity, rate of agriculture encroachment to forests or income from forestry). Connectors link the components, which allow for a mathematical function in the equation (such as adding, subtracting, multiplication or division). All of the components come together to form a string of equations that are represented in the equation layer.

An example of a sector is the core zone population in Figure A2-2. This sector represents the growth or relocation of the people within the core zone. The quantity of interest is the population of inhabitants within the core zone, represented in the stock 'CZ Population'. If the policy option (in the policy scenario sector) is set to '4' (the Environment scenario) then people will be removed from the core zone and relocated to the buffer zone, represented by the ghost (a converter within another sector that has been copied into this sector) of ‘Core zone relocation’. This affects the rate of increase and decrease of the population (shown by the connectors). The population under scenarios 1-3 will grow at a constant rate (represented by ‘Pop growth rate’). The ‘CZ population increase’ is the flow into the ‘CZ population’, which is a function of the number of people already within the core zone and the population growth rate, represented by two thin arrows (connectors).

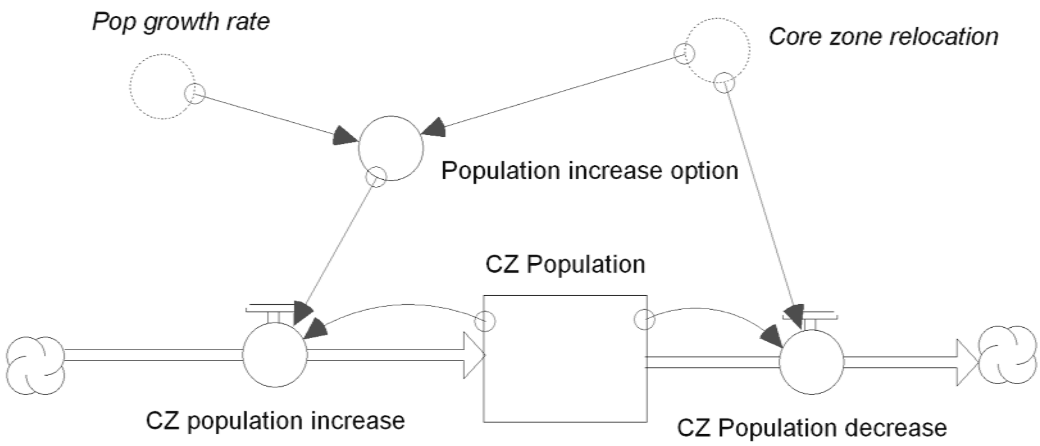

Figure A2-2 The model layer diagram of the sector 'core zone population' for Cat Tien National Park.

Detailed model equations

The equations and qualitative description of the model is presented in this section by sector, in alphabetical order. Further descriptions for each component can be found in the electronic version of the model.

Buffer zone land cover

The buffer zone is 251 000 ha, with the main land-uses of agroforest (predominantly cashew, but also other plants such as coffee, pepper, orange and a variety of fruit trees), natural forest (both land within State Forest Enterprises and a small area of local forest), plantations (both state and locally owned plantations, primarily *Acacia*, *Eucalyptus*, rubber and teak species), annual crops (including corn, cassava, sweet potato, sugar cane and a variety of other vegetables for subsistence and cash incomes) and small areas of rice and infrastructure. The main changes anticipated in the future are between annual crops, agroforest and plantations and clearing of natural forest (both legal and illegal clearing for agriculture and plantations). The initial numbers for the stocks of each land cover and the rates of change between agricultural land uses were estimated during a workshop with T.V. Tran and H.T. Dang.

Agroforest_land(t) = Agroforest_land(t - dt) + (Annual_to_agroforest + Forest_to_agroforest - Agroforest_to_Plantation) * dt

Agroforest_land(0) = 30000

Annual_to_agroforest = if Policy_scenarios = 1 then Annual_crop_land*0.02 else if Policy_scenarios = 2 then Annual_crop_land*0.04 else if Policy_scenarios =

3 then Annual_crop_land*0.03 else if Policy_scenarios = 4 then Annual_crop_land*0.01 else 0

Forest_to_agroforest[66] = if Policy_scenarios = 1 then 300 else if Policy_scenarios = 2 then 500 else if Policy_scenarios = 3 then 200 else if Policy_scenarios = 4 then 50 else 0

Agroforest_to_Plantation = If Policy_scenarios = 1 then Agroforest_land*0.015 else if Policy_scenarios = 2 then Agroforest_land*0.03 else If Policy_scenarios = 3 then Agroforest_land*0.02 else If Policy_scenarios = 4 then Agroforest_land*0.01 else 0

Annual_crop_land(t) = Annual_crop_land(t - dt) + (Forest_to_annual_crops - Annual_to_agroforest) * dt; INIT: Annual_crop_land = 20000

Forest_to_annual_crops = if Policy_scenarios = 1 then 300 else if Policy_scenarios = 2 then 500 else if Policy_scenarios = 3 then 200 else if Policy_scenarios = 4 then 50 else 0

Infrastructure_land(t) = Infrastructure_land(t - dt) + (Forest_to_infrastructure) * dt;

Infrastructure_land(0) = 10000

[66] In a deforestation study by Dan Slayback (Draft - February 2010), the rate of clearing of natural forest in a 10-km buffer zone was 102.4 (2.8, 6.4 and 93.2) km^2 between 2002 and 2008. Most of this was illegally cut forest in the buffer zone. This equates to approximately 1700 ha per year. Results from interviews suggest that this period had a relatively high period of clearing because of the increase in population in the buffer zone, particularly in the corridor. The projection of this in the future is assumed to be less because there is less arable land left and policies are becoming stricter. So, if a BAU scenario, we assume approximately 900 ha per year is converted. If a development scenario, we assume close to the current rate at 1500 per year. If an E&D scenario, then this will drop to 600 ha per year. If strict protection, then it will be negligable at 150 ha per year. These figures are assumed equal for conversion to plantations, crops and agroforest: 300, 500, 200 and 50 for scenarios 1,2,3 and 4 respectively.

Forest_to_infrastructure = if Policy_scenarios = 2 then Infrastructure_land*0.1 else Infrastructure_land*0.03

localforest_land(t) = localforest_land(t - dt)

localforest_land(0) = 1000

Mature_local_plantations(t) = Mature_local_plantations(t - dt) + (Growing_local_plantations) * dt

Mature_local_plantations(0) = 10000

Growing_local_plantations = Conveyor (5 years)

Mature_SFE_plantation_land(t) = Mature_SFE_plantation_land(t - dt) + (Growing_Govt_plantations) * dt

Mature_SFE_plantation_land(0) = 10000

Growing_Govt_plantations = Conveyor (5 years)

Natural_Forest_land(t) = Natural_Forest_land(t - dt) + (- Forest_to_govt_Plantation - Forest_to_infrastructure - Forest_to_local_plantations - Forest_to_annual_crops - Forest_to_agroforest) * dt

Natural_Forest_land(0) = 148000

Forest_to_govt_Plantation = if Maximum_plantations = 0 then Conversion_rate_per_year_to_plantations else 0

Forest_to_infrastructure = if Policy_scenarios = 2 then Infrastructure_land*0.1 else Infrastructure_land*0.03

Forest_to_local_plantations = if Policy_scenarios = 1 then 300 else if Policy_scenarios = 2 then 500 else if Policy_scenarios = 3 then 200 else if Policy_scenarios = 4 then 50 else 0

Rice_land(t) = Rice_land(t - dt)

Rice_land(0) = 20000

Total_converted_to_plantations(t) = Total_converted_to_plantations(t - dt) + (Timexconverted) * dt

Total_converted_to_plantations(0) = 0

Timexconverted = Forest_to_govt_Plantation

Young_local_plantations(t) = Young_local_plantations(t - dt) + (Agroforest_to_Plantation + Forest_to_local_plantations - Growing_local_plantations) * dt

Young_local_plantations(0) = 2000

Transit time = 5

Young_SFE_Plantation_land(t) = Young_SFE_Plantation_land(t - dt) + (Forest_to_govt_Plantation - Growing_Govt_plantations) * dt

Young_SFE_Plantation_land = Conveyor (5 years)

Conversion_rate_per_year_to_plantations = if Policy_scenarios = 1 then Coversion_rate_BAU else

If Policy_scenarios = 2 then Conversion_rate_Dev else 0

Maximum_plantations = if Policy_scenarios = 2 then if Total_converted_to_plantations<50000 then 0 else 1 else

If Policy_scenarios = 1 then if Total_converted_to_plantations<20000 then 0 else 1 else 1

Conversion_rate_Dev = GRAPH(TIME)[67]

(0.00, 2620), (2.00, 3000), (4.00, 3280), (6.00, 3380), (8.00, 3380), (10.0, 3300), (12.0, 3200), (14.0, 3020), (16.0, 2840), (18.0, 2600), (20.0, 2340)

Coversion_rate_BAU = GRAPH(TIME)[68]

(0.00, 860), (2.00, 1300), (4.00, 1560), (6.00, 1620), (8.00, 1480), (10.0, 1300), (12.0, 1100), (14.0, 860), (16.0, 620), (18.0, 400), (20.0, 200)

Core zone

The majority of the core zone is covered by natural forest, but there are also small areas of agriculture and infrastructure. Some of the natural forest is still regenerating from the impacts of the Vietnam war. One of the few deforestation threats to the core zone is agriculture encroachment from the buffer zone and from the people living within the core area, but the rate is low, at roughly 20 hectares per year (T.V. Tran pers comm..).

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[67] This rate is a parabolic curve from 2620 to 3380 ha per year, to calculate the conversion from natural forest to government plantations.

[68] This rate is a parabolic curve from 860 to 1620 ha per year, to calculate the conversion from natural forest to government plantations.

Agriculture_and_infrastructure_CZ(t) = Agriculture_and_infrastructure_CZ(t - dt) + (Conversion_Natural_Forest_to_agriculture - Conversion_Agriculture_to_Regenerating_Forest_CZ) * dt

INIT Agriculture_and_infrastructure_CZ = 370

Conversion_Natural_Forest_to_agriculture = Agricutural_area_per__person*CZ_population_increase+Agriculture_encroachment_from_buffer_zone

Conversion_Agriculture_to_Regenerating_Forest_CZ = Agricutural_area_per__person*CZ_Population_decrease

High_quality_forest(t) = High_quality_forest(t - dt)

High_quality_forest (0) = 687

Natural_forest_CZ(t) = Natural_forest_CZ(t - dt) + (regeneration - Conversion_Natural_Forest_to_agriculture) * dt

Natural_forest_CZ (0) = 66300

Reforesting_Natural_Forest_CZ(t) = Reforesting_Natural_Forest_CZ(t - dt) + (Conversion_Agriculture_to_Regenerating_Forest_CZ - regeneration) * dt

Reforesting_Natural_Forest_CZ = Conveyor (15 years)

Regeneration = conveyor outflow

Wetlands_and_grassland(t) = Wetlands_and_grassland(t - dt)

Wetlands_and_grassland (0) = 4000

Agricutural_area_per__person = 0.2

Core zone population

Only 600 people live in the core zone (T.V. Tran pers. comm..), less than the past due to previous relocation. If the Env scenario occurs, then the remaining people will be removed.

CZ_Population(t) = CZ_Population(t - dt) + (CZ_population_increase - CZ_Population_decrease) * dt

CZ_Population (0) = 600

CZ_population_increase = Population_increase_option * CZ_Population

CZ_Population_decrease = if Core_zone_relocation =1 then CZ_Population else 0

Population_increase_option = if Core_zone_relocation = 1 then 0 else Pop_growth_rate*1.5

Gaur

Gaur (*Bos gaurus*) population dynamics are used here as an indicator for the conservation value of the National Park. There are currently approximately 95 individuals in the park (2008 park survey estimated up to 120 individuals) and we assume that approximately 10 are born per year and 5 die per year from natural causes (estimated by the technical department staff – interview NP4). The main threat to the gaur populations is hunting.

Gaur_population(t) = Gaur_population(t - dt) + (Gaur_increase - Gaur_decrease) * dt

Gaur_population(0) = 95

Gaur_increase = (Gaur_population_increase_rate*Gaur_population)*(1-(Gaur_population/Carrying_capacity))

Gaur_decrease = hunting

Gaur_population_increase_rate = (Births-Deaths)/100

Carrying_capacity = 600[69]

Births = 10

Deaths = 5

Hunting = if Policy_scenarios = 2 then 0.08*Gaur_population else if Policy_scenarios = 1 then 0.05*Gaur_population else if Policy_scenarios = 3 then 0.03*Gaur_population else 0[70]

Govt budget

The government budgets are divided here into National Park funding and district government budgets, including revenue from State Forest Enterprises. The central government pays approximately 10 billion VND per year to Cat Tien

[69] Carrying capacity is unknown, but from the estimate of area of 'good quality habitat' by the staff at Cat Tien National Park is 24 500 ha, and 'poor quality habitat' is 37 500 ha (interview NP4). Assuming a carrying capacity is approximately one animal per hectare, estimated from Pasha et al. (2004).

[70] Gaur live for up to 24 years (Thomas *et al.* 1996) but natural death rate is unknown. An optimistic estimate is about 5 deaths per year (interview NP4). Hunting under Dev doubles this rate, E&D halves this rate and strict protection is effective at stopping all hunting.

National Park, but there is also income from donors, tourism and PES payments (Tran, T.V. pers comm.). The district government receives approximately 28 billion VND per each of the 8 districts in the buffer zone (Tran, T.V. pers. comm.). The government receives revenue also from selective logging, plantations and PES (which includes a proportion of taxes from the National Park and local people – approximately 10%; Dang, H.T. pers. comm., interviews SFE 1 and 2).

Central_Gov_budget_to_park = 10000000000

Government_budget =
Normal_govt_budget+Total_PES_Payments__to_government + Revenue_from_plantations + Revenue_from__selective_logging

Logging_revenue_per_hectare = 7300000[71]

Normal_govt_budget = 128000000000

Park_Funding =
Central_Gov_budget_to_park+Donors+income_from_tourism_to_Park+Total_PES_payments_to_national_park

Revenue_from_plantations =
(Mature_SFE_plantation_land/7)*Timber_revenue_per_hectare*(if Policy_scenarios = 2 then 1.5 else 1)[72]

[71] Estimate based on interview NP4, SFE1 and SFE2.

[72] Rotate every 7 years, so 1/7 of the total area harvested per year. The SFEs have currently stopped cutting plantations and commenced protection in Vinh Cuu Nature Reserve. If they removed this regulation, then they would continue growing plantations but natural forest would still be protected (Tran, T.V. pers. comm. And interview with SFE1 and SFE2).

Revenue_from__selective_logging =

((Natural_Forest_land*0.3*Logging_revenue_per_hectare)/30)*(

if Policy_scenarios = 1 then 1 else

if Policy_scenarios = 2 then 2 else

if Policy_scenarios = 3 then 0.7 else

if Policy_scenarios = 4 then 0.3 else 0)

Timber_revenue_per_hectare = 20000000[73]

Total_PES_payments_to_national_park = Total_Water_Payment*0.1 + (if Policy_scenarios > 2 then Money_dispersed_from_CO2_Core*0.15 else 0)

Total_PES_Payments__to_government = Total_Water_Payment*0.1 + (if Policy_scenarios >2 then Money_dispersed_from_CO2_SFE*0.7 + Money_dispersed_from_CO2_Core*0.05 else 0)

Livelihoods Farmers

Local people receive incomes from a variety of sources, and have the potential to also receive income from PES payments under different scenarios. The main income source is from plantations, annual crops and agroforests. Other secondary sources are from non-farm and off-farm work (such as factories), livestock and NTFP collection. The rates of income here are estimated by Dang Thanh Ha, based on a report: household survey of Da Tek commune in 2007, by the

[73] Four types of timber: *Acacia mangium*, Teak (*Tectona grandis*), *Aphzelia* sp. and *Dipterocarpus* sp. Estimate based on interview NP4, SFE1 and SFE2.

economics department of Nong Lam University. The incomes are assumed to shift from farm and NTFP incomes to off-farm labour at different rates under the four scenarios.

Average_income_annual_crops_per_ha = 6500000

Average_income_plantation_per_ha = 10000000

Avg_income_AF_per_ha = 11400000

Income_Agroforest =

(Agroforest_land/Total_Households)*Avg_income_AF_per_ha*Percent_increase_in_productivity

Income_annual_crops =

((Annual_crop_land+Rice_land)*Average_income_annual_crops_per_ha*Percent_increase_in_productivity)/Total_Households

Income_nonfarm_and_off_farm_work = if Policy_scenarios = 1 then

initial_income_NFOFW*Percent_increase_in_productivity else

if Policy_scenarios = 2 then

NFOFW_Dev*initial_income_NFOFW*Percent_increase_in_productivity

else

if Policy_scenarios = 3 then

NFOFW_E&D*initial_income_NFOFW*Percent_increase_in_productivity

else

if Policy_scenarios = 4 then

NFOFW_ENV*initial_income_NFOFW*Percent_increase_in_productivity

else 0

Income_NTFP_and_illegal_activities = if Policy_scenarios = 1 then

2000000*Percent_increase_in_productivity else

if Policy_scenarios = 2 then

2000000*NTFP_Dev*Percent_increase_in_productivity else

if Policy_scenarios = 3 then

2000000*NTFP_E&D*Percent_increase_in_productivity else

if Policy_scenarios = 4 then

2000000*NTFP_ENV*Percent_increase_in_productivity else 0

Income_PES_water = (Total_Water_Payment*0.8) /Total_Households

Income_plantations =

(Mature_local_plantations/Total_Households)*Average_income_plantation_

per_ha*Percent_increase_in_productivity

Initial_income_livestock = 3500000

Initial_income_NFOFW = 5600000

Livestock_income_per_HH =

Initial_income_livestock*Percent_increase_in_productivity

Other =

Income_nonfarm_and_off_farm_work+Income_NTFP_and_illegal_activities

+Livestock_income_per_HH

CO2_payments_to_local_people = Money_dispersed_for__local_reduced_degradation/Total_Households

Money_dispersed_for__local_reduced_degradation = if Money_CO2_local >15000000000 then Money_CO2_local - 15000000000 else 0

Money_CO2_local(t) = Money_CO2_local(t - dt) + (Payments_from_CTNP_and_SFEs - Money_dispersed_for__local_reduced_degradation - Cost_from_no_gain__of_local_carbon) * dt

INIT Money_CO2_local = 15000000000[74]

Payments_from_CTNP_and_SFEs = Money_dispersed_from_CO2_Core*0.8+Money_dispersed_from_CO2_SFE *0.3[75]

Cost_from_no_gain__of_local_carbon = Money_per_year_from_CO2_local

Area_under_protection = if Policy_scenarios < 3 then 8800 else 0

Income_Forest_protection = (area_under_protection/Total_Households)*protection__payment_per_ha

protection__payment_per_ha = 100000

Income_PES_water = (Total_Water_Payment*0.8) /Total_Households

[74] Initial amount (15 billion Dong) is to show the loss of funds from not gaining carbon in local people's lands, especially in the first year. This is offset by the payments from SFE and National Park in following years.

[75] Interview result suggests National Park would pay approximately 80% to local people. The SFE or government might pay a lot less, possibly 30% (T.V. Tran pers. comm., interviews SFE1 and SFE2).

Total_household_incomes = Livestock_income_per_HH + Income_annual_crops + Income_Forest_protection + Income_nonfarm_and_off_farm_work + Income_NTFP_and_illegal_activities + Income_Agroforest + Income_PES_water + Income_plantations + CO2_fixed_payments + CO2_performance_payments

NFOFW_Dev = GRAPH(TIME)

(0.00, 1.00), (2.00, 1.05), (4.00, 1.10), (6.00, 1.15), (8.00, 1.20), (10.0, 1.25), (12.0, 1.30), (14.0, 1.35), (16.0, 1.40), (18.0, 1.45), (20.0, 1.50)[76]

NFOFW_E&D = GRAPH(TIME)

(0.00, 1.00), (2.00, 1.02), (4.00, 1.04), (6.00, 1.06), (8.00, 1.08), (10.0, 1.10), (12.0, 1.12), (14.0, 1.14), (16.0, 1.16), (18.0, 1.18), (20.0, 1.20) [77]

NFOFW_ENV = GRAPH(TIME)

(0.00, 1.00), (2.00, 0.98), (4.00, 0.959), (6.00, 0.94), (8.00, 0.919), (10.0, 0.899), (12.0, 0.88), (14.0, 0.859), (16.0, 0.84), (18.0, 0.821), (20.0, 0.8) [78]

NTFP_Dev = GRAPH(TIME)

(0.00, 1.00), (2.00, 1.10), (4.00, 1.20), (6.00, 1.29), (8.00, 1.40), (10.0, 1.49), (12.0, 1.59), (14.0, 1.71), (16.0, 1.81), (18.0, 1.91), (20.0, 2.00) [79]

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[76] Graph shows a gradual change in incomes from non-farm and off-farm work. In this, the economy is good so people switch to off-farm work for better cash incomes.

[77] Graph shows a gradual change in incomes from non-farm and off-farm work. In this, the economy is better than BAU, but agriculture is still productive, so only some people switch to non-farm and off-farm work.

[78] Graph shows a gradual change in incomes from non-farm and off-farm work. In this, the economy is not so good, so people get more money from agriculture and less from non-farm and off-farm work.

[79] Graph shows a gradual change in incomes from non-timber forest products. In this, enforcement is poor so people use the forest more.

NTFP_E&D = GRAPH(TIME)

(0.00, 1.00), (2.00, 0.948), (4.00, 0.9), (6.00, 0.848), (8.00, 0.797), (10.0, 0.748), (12.0, 0.7), (14.0, 0.652), (16.0, 0.603), (18.0, 0.552), (20.0, 0.502) [80]

NTFP_ENV = GRAPH(TIME)

(0.00, 1.00), (2.00, 0.915), (4.00, 0.82), (6.00, 0.73), (8.00, 0.64), (10.0, 0.541), (12.0, 0.456), (14.0, 0.37), (16.0, 0.28), (18.0, 0.19), (20.0, 0.1) [81]

PES carbon

Rates of carbon accumulation and payments are calculated for three groups – the CTNP management board, the State Forest Enterprises and local people. Carbon payments can come from agroforests, plantations and natural forests (including its regeneration and degradation). The rate of payment is calculated from the difference in carbon dioxide milliequivalents between the Env and E&D scenarios and the baseline from the BAU scenario, using a variable price per tonne of carbon (using a slider). The loss from the removal of carbon in the Dev scenario is also calculated.

Average_tC_agroforest_land(t) = Average_tC_agroforest_land(t - dt) +

(Rate_of_C_increase_AF - Difference_in_average_from_new_agroforest) * dt

Average_tC_agroforest_land (0) = 120

[80] Graph shows a gradual change in incomes from non-timber forest products. In this, enforcement is better and people get paid not to use forest resources, so this activity decreases.

[81] Graph shows a gradual change in incomes from non-timber forest products. In this, enforcement is the best and more money and training reaches local people to reduce dependence on forest resources, so this activity decreases.

Rate_of_C_increase_AF = GRAPH(Average_tC_agroforest_land)

(0.00, 0.51), (11.0, 3.54), (22.0, 5.04), (33.0, 5.67), (44.0, 5.91), (55.0, 5.97), (66.0, 6.00), (77.0, 6.00), (88.0, 5.91), (99.0, 5.67), (110, 5.28), (121, 4.56), (132, 3.60), (143, 2.58), (154, 1.77), (165, 1.32), (176, 0.93), (187, 0.63), (198, 0.45), (209, 0.39), (220, 0.33)[82]

Difference_in_average_from_new_agroforest = Average_tC_agroforest_land-New_average_agroforest_from_new_area

tC_per_ha_NF_core(t) = tC_per_ha_NF_core(t - dt) + (Rate_of_C_increase_NF - Degradation_NF_core - Decrease_in_avg_from_new_NF) * dt

tC_per_ha_NF_core (0) = 160

Rate_of_C_increase_NF = GRAPH(tC_per_ha_NF_core)

(0.00, 0.28), (12.5, 2.32), (25.0, 5.52), (37.5, 7.36), (50.0, 7.80), (62.5, 7.92), (75.0, 8.00), (87.5, 7.96), (100, 7.92), (113, 7.72), (125, 7.44), (138, 6.64), (150, 5.56), (163, 4.12), (175, 3.24), (188, 2.48), (200, 2.00), (213, 1.56), (225, 1.32), (238, 1.12), (250, 1.00)[83]

Degradation_NF_core = Max_degradation_NF_core*Park_protection

Decrease_in_avg_from_new_NF = Change_avg_tC_core

tonnes_C_per_ha_forestland_buffer(t) = tonnes_C_per_ha_forestland_buffer(t - dt) + (Rate_of_C_increase_forestland - Degradation_of_forestland_buffer) * dt

[82] The rate of increase is in proportion to the number of tonnes per hectare. The curve here starts out low, then reaches a peak of 6.00 and drops back to 0.33.

[83] The rate of increase is in proportion to the number of tonnes per hectare. The curve here starts out low, then reaches a peak of 8.00 and drops back to 1.00. Maximum is estimated at over 250 tonnes of carbon per hectare.

tonnes_C_per_ha_forestland_buffer (0) = 130

Rate_of_C_increase_forestland = GRAPH(tonnes_C_per_ha_forestland_buffer)

(0.00, 0.56), (12.5, 3.24), (25.0, 6.76), (37.5, 7.68), (50.0, 7.92), (62.5, 8.00), (75.0, 7.96), (87.5, 7.72), (100, 7.40), (113, 7.12), (125, 6.64), (138, 6.16), (150, 5.56), (163, 4.76), (175, 4.00), (188, 2.96), (200, 2.12), (213, 1.64), (225, 1.28), (238, 1.08), (250, 1.00) [84]

Degradation_of_forestland_buffer =

SFE_protection__and_PES_effect*Max_degradation_NF_buffer

Change_avg_tC_core = tC_per_ha_NF_core-

Total_carbon_core/(Conversion_Agriculture_to_Regenerating_Forest_CZ+Total_ha_NF_core)

CO2_gained_core = if Switch_monitoring_degradation = 1 then

Total_Carbon_dioxide_core - High_baseline_Core else

Total_Carbon_dioxide_core - Low_baseline_Core

CO2_gained_local = if Switch_monitoring_degradation = 1 then

Total_Carbon_dioxide_local - High_baseline_Local else

Total_Carbon_dioxide_local - Low_baseline_Local

CO2_gained_SFE = if Switch_monitoring_degradation = 1 then

Total_Carbon_dioxide_SFE - High_baseline_SFE else

Total_Carbon_dioxide_SFE - Low_baseline_SFE

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[84] The rate of increase is in proportion to the number of tonnes per hectare. The curve here starts out low, then reaches a peak of 8.00 and drops back to 1.00. Maximum is estimated at over 250 tonnes of carbon per hectare.

Costs_of_carbon_loss = if Policy_scenarios = 2 then -

1*Total_money__from_CO2_SFE - Total_money__from_CO2_core -

Total_money_from_CO2_local else 0

Incremental_CO2_gained_core = CO2_gained_core-delay(CO2_gained_core,1)

Incremental_CO2_gained_Local = CO2_gained_local-delay(CO2_gained_local,1)

Incremental_CO2_gained_SFE = CO2_gained_SFE-delay CO2_gained_SFE,1)

Switch_monitoring_degradation = 1

Max_degradation_NF_core = if Switch_monitoring_degradation = 1 then 4 else 1[85]

Max_degradation_NF_buffer = if Switch_monitoring_degradation = 1 then 6 else 2[86]

New_average_agroforest_from_new_area =

total_C_agroforest/(Annual_to_agroforest+Agroforest_land)

Price_per_tCO2 = 500000[87]

tC_per_ha_mature_plantation = 70

tC_per_ha_young_plantation = 50

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[85] This is one of the more difficult calculations in the model because no monitoring has been carried out, hence it is inserted here as a variable switch. Factors such as habitat type are important. Bamboo, for example, is a sign of degradation and takes a long time to regenerate back to other types of forest. The switch has been included to show the difference in outcomes from the degradation estimates.

Includes: NTFP collection (Bamboo) = 20% landless, 80 000 people surrounding NP; 100 kg per day for 100 days of the year. Roughly 2t/ha.

Logging: 10 000 tonnes/y. Approximately 0.2 t/ha

Weeds: inhibit the growth of the forest. Impossible to calculate, so equate to about 0.5t/ha

Fire: approximately 20 ha per year burnt; assuming half is lost = 2000 t = 0.2 t/ha

Tourism: likely to cause a small amount of damage to habitats from trekking etc.

[86] Similar to the core zone degradation rate, this is difficult to calculate. There are added impacts here from illegal and selective logging of the SFEs. Considering the forest has become more degraded over the past few years, the maximum rate of degradation is higher than that of the carbon accumulation potential.

[87] This component is a slider for VND. According to the recent trends in the carbon markets, the current rate is approximately \$7 (133 000 VND) per tonne of carbon dioxide equivalents (Hamilton *et al.* 2009).

Total_carbon_core = tC_per_ha_NF_core*Total_ha_NF_core

Total_Carbon_dioxide_core = Total_carbon_core*3.67

Total_carbon_dioxide_local = Total_carbon_local*3.67

Total_carbon_dioxide_SFE = Total_Carbon_SFE_land*3.67

Total_carbon_local =

Total_carbon_localforest+total_C_agroforest+total_C_local_plantation

Total_carbon_localforest = localforest_land*tonnes_C_per_ha_forestland_buffer

Total_carbon_NF_SFE = tonnes_C_per_ha_forestland_buffer*Natural_Forest_land

Total_Carbon_SFE_land = Total_carbon_NF_SFE+total_C_SFE_plantation

Total_C_agroforest = Agroforest_land*Average_tC_agroforest_land

Total_C_local_plantation = Mature_local_plantations*tC_per_ha_mature_plantation + Young_local_plantations*tC_per_ha_young_plantation

Total_C_SFE_plantation =

Mature_SFE_plantation_land*tC_per_ha_mature_plantation+Young_SFE_Plantation_land*tC_per_ha_young_plantation

Total_ha_NF_core =

High_quality_forest*1.2+Natural_forest_CZ+Reforesting_Natural_Forest_CZ*0.5

Money_per_year_from_CO2_local =
Price_per_tCO2*incremental_CO2_gained_Local

Money_per_year__from_CO2_core = incremental_CO2_gained_core*Price_per_tCO2

Money_per_year__from_CO2_SFE = Incremental_CO2_gained_SFE*Price_per_tCO2

Total_money__from_CO2_payments = Money_per_year__from_CO2_SFE+Money_per_year_from_CO2_core+Money_per_year_from_CO2_local

High_baseline_Core = GRAPH(TIME)

(0.00, 3.9e+007), (1.00, 4e+007), (2.00, 4e+007), (3.00, 4e+007), (4.00, 4.1e+007), (5.00, 4.1e+007), (6.00, 4.1e+007), (7.00, 4.1e+007), (8.00, 4.2e+007), (9.00, 4.2e+007), (10.0, 4.2e+007), (11.0, 4.2e+007), (12.0, 4.2e+007), (13.0, 4.2e+007), (14.0, 4.2e+007), (15.0, 4.3e+007), (16.0, 4.3e+007), (17.0, 4.3e+007), (18.0, 4.3e+007), (19.0, 4.3e+007), (20.0, 4.3e+007)[88]

High_baseline_Local = GRAPH(TIME)

(0.00, 1.7e+007), (1.00, 1.7e+007), (2.00, 1.8e+007), (3.00, 1.8e+007), (4.00, 1.9e+007), (5.00, 1.9e+007), (6.00, 2e+007), (7.00, 2.1e+007), (8.00, 2.1e+007), (9.00, 2.1e+007), (10.0, 2.2e+007), (11.0, 2.2e+007), (12.0, 2.3e+007), (13.0, 2.3e+007), (14.0, 2.4e+007), (15.0, 2.4e+007), (16.0, 2.4e+007), (17.0, 2.5e+007), (18.0, 2.5e+007), (19.0, 2.6e+007), (20.0, 2.6e+007)

[88] All baseline estimates are taken from the run of the BAU scenario and input into the graph manually.

High_baseline_SFE = GRAPH(TIME)

(0.00, 7.3e+007), (1.00, 7.4e+007), (2.00, 7.4e+007), (3.00, 7.4e+007), (4.00, 7.4e+007), (5.00, 7.4e+007), (6.00, 7.3e+007), (7.00, 7.3e+007), (8.00, 7.3e+007), (9.00, 7.2e+007), (10.0, 7.2e+007), (11.0, 7.2e+007), (12.0, 7.1e+007), (13.0, 7.1e+007), (14.0, 7e+007), (15.0, 6.9e+007), (16.0, 6.9e+007), (17.0, 6.9e+007), (18.0, 6.8e+007), (19.0, 6.8e+007), (20.0, 6.7e+007)

Low_baseline_Core = GRAPH(TIME)

(0.00, 3.9e+007), (1.00, 4e+007), (2.00, 4.1e+007), (3.00, 4.2e+007), (4.00, 4.3e+007), (5.00, 4.3e+007), (6.00, 4.4e+007), (7.00, 4.4e+007), (8.00, 4.5e+007), (9.00, 4.5e+007), (10.0, 4.6e+007), (11.0, 4.6e+007), (12.0, 4.7e+007), (13.0, 4.7e+007), (14.0, 4.7e+007), (15.0, 4.8e+007), (16.0, 4.8e+007), (17.0, 4.8e+007), (18.0, 4.9e+007), (19.0, 4.9e+007), (20.0, 4.9e+007)

Low_baseline_Local = GRAPH(TIME)

(0.00, 1.7e+007), (1.00, 1.7e+007), (2.00, 1.8e+007), (3.00, 1.8e+007), (4.00, 1.9e+007), (5.00, 2e+007), (6.00, 2e+007), (7.00, 2.1e+007), (8.00, 2.1e+007), (9.00, 2.2e+007), (10.0, 2.2e+007), (11.0, 2.2e+007), (12.0, 2.3e+007), (13.0, 2.3e+007), (14.0, 2.4e+007), (15.0, 2.4e+007), (16.0, 2.5e+007), (17.0, 2.5e+007), (18.0, 2.5e+007), (19.0, 2.6e+007), (20.0, 2.6e+007)

Low_baseline_SFE = GRAPH(TIME)

(0.00, 7.3e+007), (1.00, 7.5e+007), (2.00, 7.7e+007), (3.00, 7.8e+007), (4.00, 7.9e+007), (5.00, 8e+007), (6.00, 8.1e+007), (7.00, 8.1e+007), (8.00, 8.1e+007), (9.00, 8.2e+007), (10.0, 8.2e+007), (11.0, 8.2e+007), (12.0, 8.2e+007), (13.0, 8.1e+007), (14.0, 8.1e+007), (15.0, 8.1e+007), (16.0, 8e+007), (17.0, 8e+007), (18.0, 8e+007), (19.0, 8e+007), (20.0, 7.9e+007)

Money_CO2_core(t) = Money_CO2_core(t - dt) + (Money_from_Core - Money_dispersed_from_CO2_Core) * dt

Money_CO2_core (0) = 0

Money_from_Core = Money_per_year_from_CO2_core

Money_dispersed_from_CO2_Core = if time=0 then Money_CO2_core else if time=1 then Money_CO2_core else if time=2 then Money_CO2_core *0.3 else if time=3 then Money_CO2_core*0.3 else if time=4 then Money_CO2_core*0.3 else if time=5 then Money_CO2_core*0.3 else if time=6 then Money_CO2_core*0.3 else if time=7 then Money_CO2_core*0.31 else if time=8 then Money_CO2_core *0.32 else if time=9 then Money_CO2_core *0.34 else if time=10 then Money_CO2_core *0.36 else if time=11 then Money_CO2_core *0.39 else if time=12 then Money_CO2_core *0.42 else if time=13 then Money_CO2_core *0.45 else if time=14 then Money_CO2_core *0.5 else if time=15 then Money_CO2_core *0.56 else if time=16 then Money_CO2_core *0.63 else if time=17 then Money_CO2_core *0.71 else if time=18 then Money_CO2_core *0.8 else if time=19 then Money_CO2_core *0.93 else Money_CO2_core[89]

[89] This time-based equation is to smooth out the release of funds, so a large chunk of money is not received immediately by the national park.

Money_CO2_SFE(t) = Money_CO2_SFE(t - dt) + (Money_from_SFE - Money_dispersed_from_CO2_SFE) * dt

Money_CO2_SFE (0) = 0

Money_from_SFE = Money_per_year__from_CO2_SFE

Money_dispersed_from_CO2_SFE = if time=0 then Money_CO2_SFE else if time=1 then Money_CO2_SFE else if time=2 then Money_CO2_SFE*0.3 else if time=3 then Money_CO2_SFE*0.3 else if time=4 then Money_CO2_SFE*0.3 else if time=5 then Money_CO2_SFE*0.3 else if time=6 then Money_CO2_SFE*0.3 else if time=7 then Money_CO2_SFE*0.3 else if time=8 then Money_CO2_SFE *0.3 else if time=9 then Money_CO2_SFE *0.32 else if time=10 then Money_CO2_SFE *0.34 else if time=11 then Money_CO2_SFE *0.37 else if time=12 then Money_CO2_SFE *0.39 else if time=13 then Money_CO2_SFE *0.42 else if time=14 then Money_CO2_SFE *0.45 else if time=15 then Money_CO2_SFE *0.5 else if time=16 then Money_CO2_SFE *0.55 else if time=17 then Money_CO2_SFE*0.6 else if time=18 then Money_CO2_SFE*0.7 else if time=19 then Money_CO2_SFE*0.8 else Money_CO2_SFE[90]

PES water

Payments for water are already provided in the buffer zone, but are likely to increase under E&D and Env scenarios. The increase in payments will come both from an increase in area under contract and an increase in price.

[90] This time-based equation is to smooth out the release of funds, so a large chunk of money is not received immediately by the state forest enterprises.

Total_Area_under_PES_water = If Policy_scenarios <3 then

0.1*Natural_Forest_land+0.5*Agroforest_land+localforest_land else

If Policy_scenarios =3 then

0.2*Natural_Forest_land+Agroforest_land+localforest_land else

If Policy_scenarios =4 then

0.15*Natural_Forest_land+0.7*Agroforest_land+localforest_land else 0

Total_Water_Payment = Total_Area_under_PES_water*Water_payments_scenarios

Water_payments_per_hectare = 300000[91]

Water_payments_scenarios = if Policy_scenarios = 1 then

Water_payments_per_hectare else

if Policy_scenarios = 3 then 2*Water_payments_per_hectare else

if Policy_scenarios = 4 then 1.5*Water_payments_per_hectare else 0

Policy scenario

The Policy Scenarios are represented as a slider, with the values of 1 (Business as usual - BAU); 2 (Development - Dev); 3 (Environment and development - E&D); and 4 (Environmental - Env). This slider affects a large set of components in the model; some of the key components are captured here: agricultural encroachment, tourism, core zone relocation, donor funding, park and SFE protection and productivity increase for agriculture. Other components are affected, but the 'Policy scnarios' converter is ghosted to the relevant sectors. H.T.

[91] From H.T. Dang pers. comm.

Dang and T.V. Tran estimated the values for each of these scenarios during the workshop.

Agriculture_encroachment_from_buffer_zone[92] = if Policy_scenarios = 1 then 30 else

if Policy_scenarios = 2 then 60 else

if Policy_scenarios = 3 then 15 else 5

Annual_tourist_increase = if Policy_scenarios = 1 then 500 else

if Policy_scenarios = 2 then 500 else

if Policy_scenarios = 3 then 3000 else

if Policy_scenarios = 4 then 1500 else 0

Core_zone_relocation = if Policy_scenarios = 4 and time >2 then 1 else 0

Donors = if Policy_scenarios = 1 then 3600000000 else

if Policy_scenarios = 2 then 2500000000 else

if Policy_scenarios = 3 then 4000000000 else

if Policy_scenarios = 4 then 4500000000 else 0

Income_per_tourist = if Policy_scenarios = 1 or 2 then 300000 else

if Policy_scenarios = 3 then 400000 else

[92] Satellite images show small areas of the core encroached by agriculture (Slayback Draft - February 2010). National park staff estimate small areas cleared into core zone, 30 hectares per year under the current rate (BAU). The core zone had to be redemarcated in 2003 because of illegal encroachment. There is a worry about development increasing agriculture encroachment to core zone. A development scenario is therefore higher, at 80 hectares per year. Under an E&V scenario, the encroachment will be less than BAU at 15 hectares per year and a strict protection will be very little at 5 hectares per year (T.V. Tran pers comm.).

if Policy_scenarios = 4 then 500000 else 0

Maximum_tourists = if Policy_scenarios = 3 then 80000 else

if Policy_scenarios = 4 then 50000 else 30000

Park_protection = if Policy_scenarios = 1 then 0.7 else

if Policy_scenarios = 2 then 1 else

if Policy_scenarios = 3 then 0.4 else

if Policy_scenarios = 4 then 0.1 else 0

Percent_increase_in_productivity = if Policy_scenarios = 2 then

Rapid_development_productivity_increase else

if Policy_scenarios = 4 then Little_development_productivity_increase else

Normal_productivity_increase

Percent_tourism_revenue_to_indigenous = if Policy_scenarios = 3 then 0.20 else

if Policy_scenarios = 4 then 0.15 else 0.05

Policy_scenarios = 1 (Slider)

SFE_protection__and_PES_effect = if Policy_scenarios = 1 then 0.7 else

if Policy_scenarios = 2 then 1 else

if Policy_scenarios = 3 then 0.4 else

if Policy_scenarios = 4 then 0.2 else 0

Little_development_productivity_increase[93] = GRAPH(TIME)

(0.00, 1.00), (2.00, 1.00), (4.00, 1.01), (6.00, 1.02), (8.00, 1.02), (10.0, 1.03), (12.0, 1.03), (14.0, 1.04), (16.0, 1.04), (18.0, 1.05), (20.0, 1.05)

Normal_productivity_increase = GRAPH(TIME)

(0.00, 1.00), (2.00, 1.01), (4.00, 1.02), (6.00, 1.02), (8.00, 1.03), (10.0, 1.04), (12.0, 1.05), (14.0, 1.06), (16.0, 1.06), (18.0, 1.07), (20.0, 1.08)

Rapid_development_productivity_increase = GRAPH(TIME)

(0.00, 1.00), (2.00, 1.01), (4.00, 1.02), (6.00, 1.04), (8.00, 1.05), (10.0, 1.06), (12.0, 1.07), (14.0, 1.08), (16.0, 1.10), (18.0, 1.11), (20.0, 1.12)

Population

Two populations are modelled here – indigenous and other populations, which include Kinh, the national majority ethnic group, and migrant minority groups. The main changes in population come from core zone relocation and natural growth rates.

Indigenous_Pop(t) = Indigenous_Pop(t - dt) + (Indigenous_Pop_increase) * dt

Indigenous_Pop (0) = 4000

Indigenous_Pop_increase = CZ_Population_decrease*0.85 + Indigenous_Pop*Pop_growth_rate

[93] It is assumed that there would be changes in productivity under each scenario, so these are indicated by a graph of percent increase in productivity over time (G.C. Nelson, T.V. Tran and H.T. Dang pers. comm.).

Other_Pop(t) = Other_Pop(t - dt) + (Other_Pop_increase) * dt

Other_Pop (0) = 196000[94]

Other_Pop_increase = CZ_Population_decrease*0.15 + Other_Pop*Pop_growth_rate

Pop_growth_rate = 0.02

Total_Households = (Indigenous_Pop+Other_Pop)/5

Total_pop_increase = Other_Pop_increase+Indigenous_Pop_increase

Total Net benefits

This sector is used to show the effect of the policy scenarios on the model. The components included here are the key economic indicators of conservation and development at Cat Tien National Park: total economic benefits from livelihood incomes, biodiversity value (calculated in monetary terms and included as a slider), the costs of carbon (for the Dev scenario) and government budgets for the National Park and district governments.

Benefit_Cash_livelihoods = Total_household_incomes*Total_Households

Biodiversity_value_forest_per_hectare = 270000[95]

[94] Initial population of the buffer is approximately 200 000 people, and 4000 are indigenous (interview results NP1, NP3, NP4).

[95] A slider was included here to account for the unknown factor of biodiversity value. The value of biodiversity varies considerably among different reports. The value of biodiversity markets (Madsen *et al.* 2010) suggest $390 million per year for 26 000 ha protected or restored. This equals $15 000 per hectare. Costanza et al. (1997) presents a table of the value of biodiversity for different land covers and environmental services. For tropical forests, the value per hectare per year is $1312 including environmental services of disturbance regulation, erosion control, soil formation, nutrient cycling, waste treatment, genetic resources and cultural values. This component takes into account the added value of the forests, including aspects not covered in other parts of the model such as erosion

Budgets = Government_budget+Park_Funding

Switch_carbon_cost = 1

Total_net_benefit = Value_of_biodiversity+Benefit_Cash_livelihoods+Budgets +

(if Switch_carbon_cost = 1 then -1*Costs_of_carbon_loss else 0)

Value_of_biodiversity =

Biodiversity_value_forest_per_hectare*(Natural_Forest_land+Natural_forest_CZ)

Tourism

Tourism is one of the primary activities of the National Park. The volume of tourists will increase over the next 20 years, but the rate of increase will change under the different scenarios. Incomes per tourist will also change, depending on the proportion of national and foreign tourists. The incomes from tourism also go to indigenous people in the buffer zone.

Number_of_tourists(t) = number_of_tourists(t - dt) + (Tourist_increase) * dt

number_of_tourists (0) = 20000[96]

Tourist_increase = if number_of_tourists < Maximum_tourists then Annual_tourist_increase else 0

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control to reduce sedimentation and non-monetary values of biodiversity. It also recognised the value of agriculture, agroforest and plantation lands for biodiversity.

[96] Statistics from 2009 show 17600 tourists visited the park, up from 14600 the previous year. A 2010 estimate is be 20 000 tourists.

Income_from_tourism_to_indigenous_people = (percent_tourism_revenue_to_indigenous*income_from_tourism_to_Park)/Indigenous_Pop

Income_from_tourism_to_Park = number_of_tourists*Income_per_tourist

Appendix 3 – Interview Guiding Questions

This appendix details the guiding questions used in interviews to collect qualitative data at the 15 sites as outlined in chapter 2. The interviews were used to collect data for strengthening evidence in Chapter 3, Chapter 4 and Chapter 6. Each interview was tailored to the respondent, for example: project officers were asked about policies and the project activities; forest guards were asked about hunting and logging trends and day-to-day activities in the forest; villagers were asked about their livelihoods, the education of the villagers and their use of the forest. A list of guiding questions used is provided below.

- What is the history of this protected area?
- What are the key threats to the forest area?
- How many children go to school and how many children are in the village/area?
- What is the population of the area or village?
- What crops are grown in the area?
- What is the main source of cash income to local villagers?
- Do people collect forest products?
- What do people hunt in the area?
- Who hunts?
- What are the government regulations for forest product use?

- Are there new policies in the area that have been developed by organisations?
- Where does the organization work in the conservation area?
- What activities does the organization conduct?
- What are the other organisations in the area?
- How have <conservation activities> affected local livelihoods?
- Are there any other comments you would like to make about the site or project?