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**Sustainable financing
of protected areas in
Cambodia:
Phnom Aural and
Phnom Samkos
wildlife sanctuaries**

**Maryanne Grieg-Gran
Derek de la Harpe
John McGinley
James MacGregor
Ivan Bond**

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International Institute for Environment and Development (IIED)

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Corresponding author

Maryanne Grieg-Gran (corresponding author)
Director, Environmental Economics Programme
International Institute for Environment and Development (IIED)
3 Endsleigh Street
London WC1H 0DD
Tel: +44(0)20 7388 2117
maryanne@iied.org

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Acronyms and abbreviations

ACI	Agrifood Consulting Inc.
ADB	Asian Development Bank
BEA	Bureau of Economic Analysis
CDM	Clean Development Mechanism
CDRI	Cambodia Development Resource Institute
CITES	Convention on International Trade in Endangered Species
DBH	Diameter at breast height
DEFRA	Department for Environment, Food and Rural Affairs (UK)
CMWSP	Cardamom Mountains Wildlife Sanctuaries Project
FAO	Food and Agriculture Organization
GoC	Government of Cambodia
IFSR	<i>Independent Forest Sector Review</i>
IPCC	Inter-governmental Panel on Climate Change
ITTO	International Tropical Timber Organisation
MIME	Ministry of Industry, Mines and Energy
MoE	Ministry of Environment
NGO	Non-Governmental Organisation
NTFP	Non-timber forest product
PA	Protected area
PAWS	Phnom Aural Wildlife Sanctuary
PSWS	Phnom Samkos Wildlife Sanctuary
REDD	Reducing Emissions from Deforestation and Degradation
SCW	Save Cambodia's Wildlife
UNFCCC	United Nations Framework Convention on Climate Change

Executive Summary

The Phnom Aural and Phnom Samkos wildlife sanctuaries in the Cardamom Mountains of Cambodia were established by Royal Decree in 1993. Covering nearly 600,000 ha, they have diverse geography, extensive forests, and many endemic and globally-threatened species. As a result they are considered to be highly important for biodiversity conservation. The two wildlife sanctuaries are home to about 30,000 people who rely on subsistence agriculture, cattle raising, and collection of non-timber forest products for their livelihoods. These communities are among the poorest in Cambodia.

Under the Cardamom Mountains Wildlife Sanctuaries Project (CMWSP), a joint project of the Cambodian Ministry of Environment and Fauna and Flora International, zoning plans have been developed for both sanctuaries through participatory consultation with local stakeholders. However, the sanctuaries face threats from clearance of land by in-migrating settlers and the granting of economic concessions.

The government has been increasing support for protected area management but still relies extensively on donor and NGO assistance for implementing effective management, and there is continuing concern about post project sustainability. The core problem facing the Phnom Samkos and the Phnom Aural wildlife sanctuaries is to develop long-term sustainable finance for their management. Part of this challenge involves demonstrating the value to Cambodia of continuing to protect the two sanctuaries.

For this reason Fauna and Flora International commissioned IIED to conduct a study with two main components:

1. Ecological services valuation — an assessment of the economic value of the direct and indirect ecosystem services provided by the two sanctuaries, and the potential costs/benefits of allowing continuing land conversion and illegal logging.
2. Protected area financing — an assessment of the costs of maintaining management activities and recommendations for generating funds.

Ecological services valuation

The study on valuation (Part II of this report) examines the value to society of maintaining the wildlife sanctuaries in their protected state in accordance with the management provisions of the zoning system. It does not attempt to put a monetary value on the global biodiversity conservation benefits of protecting the wildlife sanctuaries as this is beyond the scope of the study. Instead, the valuation examines the extent to which the monetary value to society of benefits such as carbon storage, non-timber forest products (NTFPs), and sustainable forest management — which are more readily estimated in monetary terms — would be sufficient to justify protection. Part II of this report therefore compares the returns to these land uses under protection with the returns in an unprotected situation in which forest clearance and illegal logging continue.

The valuation focuses on provisioning services (timber, NTFPs and agriculture), and regulating services (carbon storage). Other services are likely to be affected under both scenarios but there are insufficient data available to model the linkages and make the estimates. This applies particularly to watershed protection services.

Costs and benefits from the two scenarios are compared over 25 years. A discount rate of 10% is used to convert returns from land uses (such as agriculture and exploitation of NTFPs) that yield a stream of returns over time to a common year. This makes it possible to compare their value with that of unsustainable timber harvesting which yields benefits only in the first year.

The “protection scenario” is based on the permitted land and resource uses for each of the management zones. The direct use values associated with these uses are estimated, as well as the indirect use value of carbon storage. For the “non-protection scenario” it is assumed that in the absence of any management, all the existing forest will be converted to agriculture so that there would be a one-off benefit from timber harvesting and a stream of benefits over time from agricultural production.

Table 1: Direct and indirect use values examined in the 2 scenarios

Zone	Protection scenario*	Non-protection scenario
Community zone	Timber harvesting from forest conversion. Agriculture.	Timber harvesting from forest conversion. Agriculture.
Sustainable use zone	Sustainable forest management. NTFPs. Carbon storage.	
Conservation zone	NTFPs. Carbon storage.	
Core zone	Carbon storage.	

*Includes only values that were quantifiable in the scope of this study.

Approach

Direct use values were estimated using the market price approach. The market value of timber or of agricultural products was estimated and the costs of production and transport to the market were deducted.

Total commercial timber volumes in the sanctuaries under one-off harvesting in the non-protection scenario, and under sustainable forest management in the protection scenario, were estimated by matching up and adjusting the Cambodia Development Resource Institute (CDRI’s) published estimates of unit volume per ha for evergreen, semi-evergreen, and deciduous forests in Cambodia with characteristics and areas of different forest types in the

sanctuaries. Tropical timber prices have increased considerably over the last two years and seem likely to stay high. This report's estimates of the standing value of timber in the sanctuaries are therefore high relative to previous studies such as Boscolo (2004) and Hansen and Top (2006) which were based on significantly lower timber prices.

For agriculture, the study assumes that the main activity would be low technology wet season rice production and that the returns would be heavily dependent on soil fertility. To estimate the returns to rice production, the MoE's calculations for areas of low, medium, and high fertility in the sanctuaries, and data on yields, costs and prices from socioeconomic studies of the sanctuaries and a diagnostic of agriculture in Cambodia (ACI (Agrifood Consulting International), 2006) were used.

Estimates of value of NTFPs are based on CDRI's estimates of NTFP income per family and population statistics for the sanctuaries.

Carbon stocks in the forests in the wildlife sanctuaries were approximated by matching up published estimates for biomass for different forest types in Cambodia with the characteristics and areas of forest types in the sanctuaries. The value of a unit of carbon storage was based on recent estimates from the IPCC Working Group III of the carbon price necessary to bring about sufficient mitigation to reduce global greenhouse gas emissions down to a safe level. The Working Group's 'Summary for Policymakers' suggests that this price lies between US\$73 and US\$183 per tonne of carbon. This report uses the midpoint of this range for the central estimate of the value of carbon storage under the protection scenario.

Results

Results for the central estimate show that the value of the protection scenario exceeds that of the non-protection scenario by a small margin, primarily because of the high value of carbon storage. The value of timber harvesting in the non-protection scenario is also high, reflecting the surge in timber prices over the last two years. Values of the scenarios are highly sensitive to the assumptions made about the timber price in the case of the non-protection scenario, and the carbon price in the case of the protection scenario. Taking the lower bound of the IPCC Working Group III's carbon price range is enough to make the non-protection scenario more valuable than the protection scenario. On the other hand, if the price of Malaysian meranti at the end of 2005 is used instead of the early 2007 price, the protection scenario becomes more valuable.

Timber harvesting and carbon storage dominate the comparison of the scenarios. Values for agriculture, sustainable forest management, and NTFPs are relatively minor when viewed in the aggregate. These values are, however, important for local communities.

The conclusion to be drawn is that the value of carbon storage is high enough to make the case for the protection scenario, with biodiversity conservation as an important co-benefit. However, the net present value of carbon storage is very close to that of unsustainable timber harvesting and estimates are very sensitive to assumptions about carbon prices and timber prices.

Sustainable financing

Part II of this report demonstrates the economic value of the two sanctuaries in terms of their ecological services, and justifies their ongoing conservation. Part III of the report focuses on the financing of the areas and the opportunities for improving these finances.

Management costs

The costs of managing and conserving the sanctuaries have been computed and tabulated in their respective financial plans. These are supplements to the sanctuaries' management plans, developed under the auspices of the Cardamom Mountains Wildlife Sanctuaries Project (CMWSP). The management plans have been well-structured and logically presented. The detailed operational plans contained in the management plans have been presented under three different funding scenarios:

- Scenario 1: Minimal funding, allowing minimal levels of management and conservation.
- Scenario 2: Medium levels of funding, allowing adequate levels of management and protection activity.
- Scenario 3: Maximum funding, allowing enhanced levels of management and protection.

A set of operational activities, consistent with each of these scenarios, has been defined in the operational plans and then costed in the financial plans. These plans suggest a funding requirement for each sanctuary of approximately US\$200,000 per annum for Scenario 1, escalating to nearly US\$500,000 per annum for Scenario 3.

Funding of the sanctuaries

The sanctuaries presently receive funding from two main sources:

1. Fauna and Flora International (FFI), through CMWSP;
2. The Government of Cambodia (GoC) through the Ministry of Environment.

Details of GoC funding, and the use/s of these funds, for the sanctuaries were unavailable at the time of preparing this study. The report therefore only considered the funding through FFI. These funds have amounted to approximately US\$200,000 per annum, for each sanctuary, during the 2005 and 2006 calendar years.

The data reviewed have a number of defects but, in spite of these, it is possible to conclude that existing levels of funding are adequate only to cover activities under Scenario 1. Given the many challenges to the sanctuaries, these levels of funding are inadequate to promote sustainable pathways being followed by all stakeholders.

Options for improving funding of the sanctuaries

Having concluded that existing levels of funding are inadequate, Part III of this report then investigates opportunities for improving these levels. Whereas Part II of the paper (the ecological services valuation) focuses on empirical aspects of valuation, Part III investigates practical mechanisms for converting these values into usable funding. The following options were considered:

- **Tourism.** The sanctuaries do have attributes which are suitable for attracting tourism and it is possible that the industry could contribute to their finances through visitor entry and concession fees. However, there are presently a number of issues constraining development of nature-based tourism in the sanctuaries and these will remain for the medium term.
- **Hunting.** Although there is presently no hunting industry in Cambodia, there is an initiative to develop a new hunting operation in the north of the country. A number of legislative barriers exist, and the conservation community would almost certainly be hostile to this concept. In addition, densities of animals in the sanctuaries are so low that it is questionable whether a sustainable and viable offtake could be made.
- **Angling.** It is reputed that a species of fish suitable for sport angling occurs in the rivers of the sanctuaries. A field trip to confirm this was unsuccessful, but possibly there is potential in the medium term.

The three options above could all have potential in the medium to long term, but none or little exists at the present time. Part III of this report therefore goes on to consider the two extractive industries presently underway in the sanctuaries:

- **Mining.** The legal basis for existing mineral exploration and extraction operations in both sanctuaries is questionable. Nonetheless, these activities are underway and there seems to be little prospect of GoC preventing these operations from proceeding, regardless of the fact that they are clearly undesirable in these areas. It is theoretically possible that a royalty for sanctuary funding could be levied on these operations. However, this is likely to be a remote possibility and the higher priority is to regularise the legal and environmental management framework for these operations.
- **Logging.** Part II of this paper establishes the value of the standing timber in the sanctuaries and it is theoretically possible to make sustainable use of this timber and to use the proceeds for management and conservation. However, use of this timber would be in violation of existing Cambodian laws and would be criticised by the international and conservation communities. It is therefore unlikely to be an option in the short or even the medium term.

Having established that none of these more practical options has any realistic potential in the short term, the paper goes on to consider the possibility of raising funding through mobilising and trading in credits for carbon stored in the forests. At the present time there is no basis for doing so, but this situation is believed to be changing rapidly and it is possible that pilot project funding might be available in the reasonably short term, in the build up to the 2012 renewal of the Kyoto Protocol.

Part III then goes on to evaluation other sustainable financing options:

- Endowment. This is strictly a mechanism for managing funds, rather than raising them. Nonetheless, because of the interest in this, it was considered in the course of preparing this paper. Endowments have been used to manage funds for conservation in other parts of the world and it is possible that some donors will favour this mechanism for use in Cambodia. The major factor counting against endowments is the fact that, because of the need to protect the capital and compensate for inflation, it is a comparatively inefficient mechanism for raising funds available for immediate 'consumption'. Many donors will prefer to see their funding applied more aggressively.
- Government grant. The economic case for conserving these areas is demonstrated in Part II of this paper; it should therefore be possible to convince GoC to increase levels of funding. Nonetheless, it is recognised that fiscal pressures on the government are such that it is most unlikely that additional funds will be forthcoming, regardless of the economic argument for doing so.
- Donor funding. Investigating this topic was outside the scope of this report, which focused instead on identifying sustainable financing mechanisms. Nevertheless, it is recorded that donor funding is theoretically available to assist in funding management and conservation of the sanctuaries. At the same time, it is noted that the governance weaknesses identified during this study will militate against attracting funding from some of the potential donors.

Institutional matters

Efforts to attain sustainable financing of protected areas are frequently constrained by weaknesses in the governance framework. These are difficult to circumvent when they pervade the government concerned. This matter was also outside the study's terms of reference but, in the course of researching this paper, it was possible to identify a number of indicators of such weaknesses. These include an apparent unavailability of financial information, as well as the inability to tackle illegal activities in the sanctuaries. These will constrain efforts to improve the situation.

Conclusions and the way forward

The ecological services valuation section of this report (Part II) confirms and establishes the economic case for conserving the sanctuaries. However, the challenge is to convert these theoretical values into financing which can be used to support the management and protection of the sanctuaries. A number of possibilities, primarily tourism, exist. Unfortunately, existing impediments are such that these possibilities have little potential in the short and possibly even the medium term. The sanctuaries are therefore likely to be dependent upon donor funding for the foreseeable future.

The greatest longer term potential is believed to exist in the rapidly developing global awareness of the value of standing forests for storing carbon, and the need to mobilise credits for these. Currently, existing mechanisms (through the Kyoto Protocol) restrict such credits to new forestation projects. But this is changing fast, and mobilising credits for carbon stored in standing forests could become a reality sooner than was previously believed. In addition, the

build up to the 2012 renegotiation of the Protocol is going to involve pilot studies for which funding is being set aside and it is possible that some of this funding could be obtained for the sanctuaries.

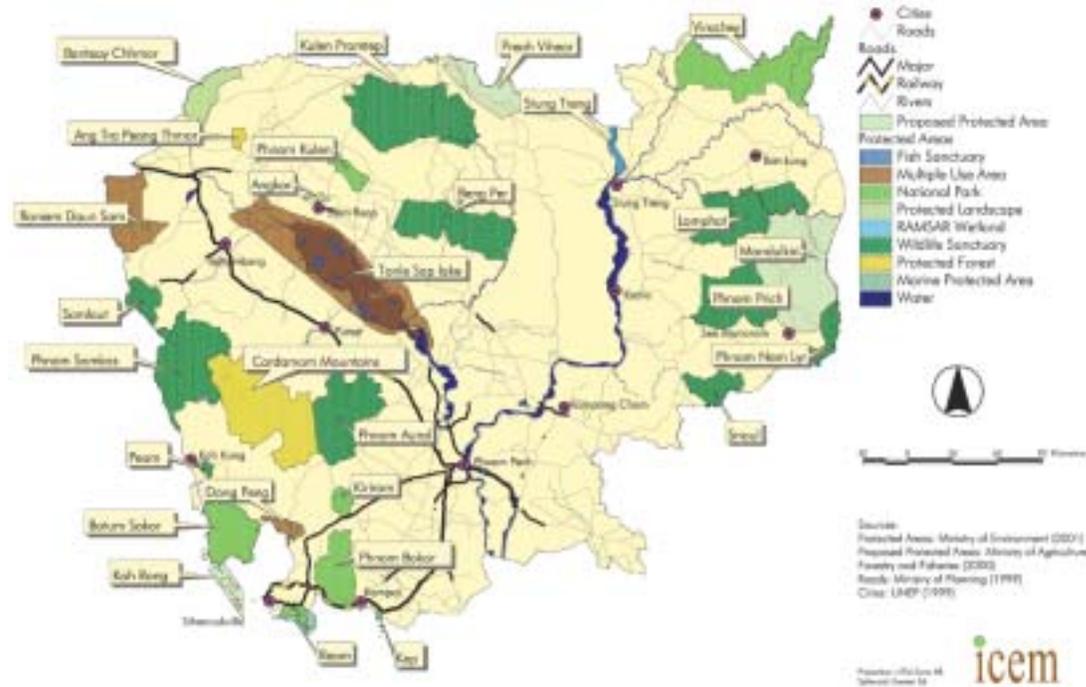
It is therefore proposed that the way forward involve efforts on four parallel 'streams' of activity:

1. Address and correct the weaknesses that presently exist in the governance and institutional framework for conservation in Cambodia.
2. Identify, manage, and thwart any existing or potential future major threats to the integrity of the sanctuaries.
3. Facilitate efforts by the private sector to develop appropriate economic activities in the sanctuaries, out of which — in the fullness of time — financing mechanisms can be established.
4. Monitor and engage in global developments on climate change — especially as they relate to the possibility of raising credits in respect of carbon stored in standing forests.

Part I: Introduction

1. Background to protected areas in Cambodia

Cambodia has a network of 23 natural protected areas managed through the Ministry of Environment (MoE). These areas cover 2.2 million hectares or 18% of Cambodia's land area and include most of its important habitats. The Forest Administration has also designated protected forests (from cancelled logging concessions) bringing the total area under protection to around 25% (more than twice the global average).

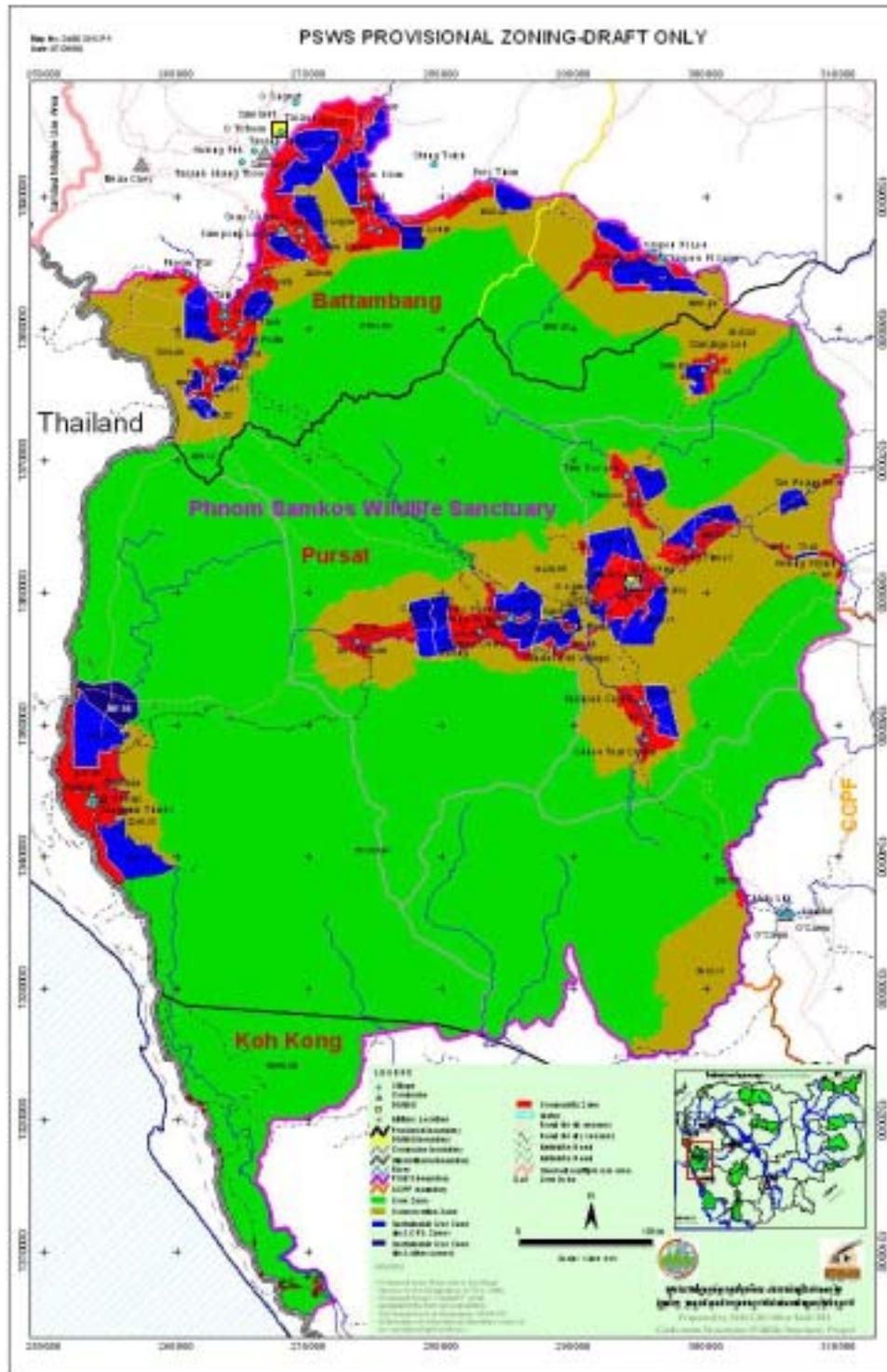


The government has been increasing support for protected area management but still relies extensively on donor and NGO assistance for implementing effective management. In order to increase protected area revenue, and as part of a drive for national economic development, the Cambodian government is starting to issue economic concessions in 'sustainable development zones' of protected areas. It is becoming clear that the preference will be for economic development unless the conservation option can be shown to bring more net benefits.

2. The Cardamom Mountains Wildlife Sanctuaries Project

The Phnom Aural and Phnom Samkos wildlife sanctuaries were established in 1993 under the *Royal Decree on the Creation and Defining of Natural Protected Areas*. They are located at the south-eastern end and north-western end, respectively, of the Cardamom Mountains. The two sanctuaries combined cover nearly 600,000 ha. Surveys carried out since 2001 have shown the special importance of the two sanctuaries for biodiversity conservation and environmental services. They have diverse geography, extensive forests, and many endemic and globally threatened species. Evergreen hill forest covers most of the two sanctuaries and is listed among the World Wildlife Fund's Global 200 Ecoregions as a priority for biodiversity conservation

The two wildlife sanctuaries are home to about 30,000 people who rely on subsistence agriculture, cattle raising, and collection of non-timber forest products for their livelihoods. These communities are among the poorest in Cambodia. Under the Cardamom Mountains Wildlife Sanctuaries Project (CMWSP), a joint project of the Cambodian Ministry of Environment and Fauna and Flora International, zoning plans have been developed for both sanctuaries through participatory consultation with local stakeholders. But the sanctuaries face threats from clearance of land by in-migrating settlers and the granting of economic concessions.



for their management. Part of this challenge is demonstrating the value to Cambodia of continuing to protect the two sanctuaries. This will help to make the case for greater government support to the management of the sanctuaries whether through financial input or through discouraging/preventing economic activities that undermine the effectiveness of protection.

3. The sustainable financing study

IIED was commissioned by Fauna and Flora International (FFI) to carry out a study to provide a set of options for the locally-derived sustainable financing of Phnom Samkos and Phnom Aural. This study has two main components:

1. Ecological services valuation — an assessment of the economic value of the direct and indirect ecosystem services provided by the two sanctuaries, and the potential costs/benefits of allowing continuing land conversion and illegal logging.
2. Protected area financing — an assessment of the costs of maintaining management activities and recommendations for generating funds.

This report sets out the approach taken and the results from the two components of the study. Part II presents the ecological services valuation. It examines the value of different kinds of ecosystem services of the two sanctuaries in their protected state, i.e., managed in accordance with the participatory zoning in management plans drawn up by the Ministry of Environment and FFI. It compares the resulting values with that of an alternative scenario in which it is assumed that the protected status of the sanctuaries is not respected (or is removed) and conversion of forest and other natural vegetation to agriculture and other land uses takes place

Part III presents the financial assessment of the sanctuaries and reviews a number of options for addressing the funding shortfall. These options include payments from tourism concessionaires, and permits for hunting and angling. Part 4 provides conclusions and recommendations.

Part II: Ecological Services Valuation of Phnom Aural and Phnom Samkos Wildlife Sanctuaries

1. Introduction

1.1 The need for valuation

Decisions on land use often fail to take into account the full impact on ecosystem services. In deciding whether it is worthwhile to harvest timber from a forest, loggers are considering whether — and by how much — the expected revenue exceeds the costs of production. They do not look at the impact on biodiversity because they are not affected directly by it. These other impacts are not captured in decision-making because they affect other stakeholders and because some of the goods and services affected are not sold in markets. Economic valuation of ecosystem services aims to express all the various benefits in monetary terms so that they can be added up and compared.

A protected area can be associated with the following types of value:

- Direct use values — the benefits of using environmental resources as an input to production or as a consumption good, e.g., the use of forests for recreation or for the harvesting of medicinal plants.
- Indirect use values — the support and protection provided to economic activity and property by natural ecosystem functions, e.g., forests are thought to play a role in controlling sedimentation which in turn can affect drinking water quality, or hydropower generation.
- Option values — these refer to uses of environmental resources which might be possible in the future, particularly as more information becomes available for example about the medicinal uses of certain plant species. They are especially relevant where loss of biodiversity is considered irreversible
- Non-use values — intangible benefits derived from the mere existence of environmental resources or quality. What distinguishes non-use values from recreational value is that people can hold these values for a site, even if they have no intention, or chance, of visiting it.

The Total Economic Value of an ecosystem is the sum of the direct use values, indirect use values, option values and non-use values. In practice, it is not possible to quantify all of these values in monetary terms in a robust way. For option values, the challenges of estimation of direct and indirect use values are compounded by the need to make predictions about future prices and preferences for environmental goods and services so these are rarely considered. However, broadening the range of values considered in land use decisions is important to give at least a minimum estimate.

1.2 Valuation in the context of the wildlife sanctuaries

The Phnom Samkos and Phnom Aural wildlife sanctuaries have been subject to a zoning process. Following consultation with local stakeholders and a series of ecological and socioeconomic surveys of the areas, a set of four zones was demarcated in each of the sanctuaries.

1. Core zone — access only for research.
2. Conservation zone — small-scale community uses of NTFPs.
3. Sustainable use zone — community sustainable use of resources including NTFPs, fuelwood collection, timber cutting, fisheries, ecotourism and agroforestry (outside of community protected area).
4. Community zone — in addition to the above, small animal trapping for subsistence use, agriculture, and livestock grazing for both subsistence and commercial objectives.

Table 2 shows the area of land in each zone in the two wildlife sanctuaries and the percentage they constitute of the total area in each case. It can be seen that in both sanctuaries no consumptive use of resources is permitted in more than 60% of the land area, and that only in 6% of the area is any agriculture permitted.

Table 2: Land use zones in the wildlife sanctuaries

Zone	Phnom Samkos		Phnom Aural	
	Area (ha)	% of total	Area (ha)	% of total
Core zone	231,708	70	151,933	60
Conservation zone	59,986	18	65,099	26
Sustainable use zone	19,130	6	23,975	9
Community zone	19,925	6	14,029	6
Total	330,751	100	255,036	100

This means that protection of the sanctuaries in accordance with the provisions of the management plans is associated with opportunity costs of land use restrictions in terms of forgone timber harvesting and conversion to agriculture. The key issue is whether the benefits to society/different stakeholders from protecting the scenarios in accordance with these agreed management plans outweigh these opportunity costs.

A number of benefits of protecting the sanctuaries can be identified in qualitative terms as shown in Table 3 below. Some important benefits are, however, difficult to quantify in monetary terms, particularly where these are associated with non-use values — as is the case for global biodiversity. Ecological surveys detailed in the management plans for the sanctuaries (MoE/FFI 2006) have demonstrated the importance of these areas for biodiversity conservation and provided evidence on the diversity of species. Local biodiversity values can be addressed by examining the value to local people of the non-timber forest products that

they use from the forest. Global biodiversity is more challenging to value in monetary terms in a credible way because it requires estimating the existence values held by individuals who often have low understanding or awareness of the concept of biodiversity. In practice, valuation studies have used proxies such as the amounts paid in ‘debt for nature’ swaps (Naidoo and Ricketts, 2006). This does not seem appropriate in this situation because part of the aim of the valuation is to examine the justification for continuing input of public or donor funds for protection.

Table 3: Use and non-use values. Source: Adapted from Hansen and Top (2006).

Use values			Non-use values
Direct use values	Indirect use values	Option values	
Timber	Carbon storage	Industrial	Landscape
Firewood	Watershed protection	Agricultural	Heritage
Medicine	Human and animal habitat	Pharmaceutical	Cultural
Construction	Erosion control	Recreational	Biodiversity
Wild meat			Bequest
Animal fodder			
Recreation			

The maintenance of watershed protection/hydrological services is believed to be an important benefit of protecting the sanctuaries. The management plans highlight the importance of the forests in sanctuaries for regulating water flow in the streams and rivers that sustain farmland and fisheries. In addition, a number of hydropower developments are planned for the region, including one located inside the Phnom Samkos Wildlife Sanctuary.

Land use in the sanctuaries may well have implications for water yield and rate of sedimentation in these hydropower projects. However, the relationships between forest cover and watershed protection are complex and site-specific as highlighted by FAO (2007) and Bruijnzeel (2004). Water flow may often increase as a result of removal of tree cover but there is considerable variation between sites and between years because of differences in rainfall and degree of surface disturbance (Bruijnzeel, 2004). There is also some evidence that removal of forest cover leads to erosion in some circumstances but much depends on local geology, topography, and the management of the land during and after removal of forest cover (Bruijnzeel, 2004). Results of valuation studies vary considerably with some (e.g., van Beukering and Cesar, 2003, in their economic valuation of the Leuser valley in Sumatra, Indonesia) finding that deforestation is associated with significant costs while others find that there are net benefits. Aylward *et al* (1999), in a study in Costa Rica, found that the costs for hydropower developments of increases in sedimentation are outweighed by the benefits of increased water yield. Extrapolation of results from other sites can therefore be misleading.

In order to model the forest/water linkages in a robust manner, a number of site-specific variables need to be examined. This is highly data intensive and therefore outside the scope of this study.

This valuation therefore concentrates on a subset of the benefits identified above and considers whether the monetary value of these would be sufficient to make the economic case for protection of the sanctuaries. It examines the value of this subset of ecosystem services of the two sanctuaries in their protected state, i.e., managed in accordance with the participatory zoning in management plans drawn up by the Ministry of Environment and FFI. It compares the resulting values with that of an alternative scenario in which it is assumed that the protected status of the sanctuaries is not respected, or is removed, and conversion of forest and other natural vegetation to agriculture and other land uses takes place.

2. Approach

2.1 Scenario-based approach

The ecological services valuation is based around two scenarios:

1. “Protection scenario”: the value of ecosystem services provided by the sanctuaries taking into account the provisions of the management plans.
2. “Non-protection scenario”: the value of ecosystem services provided by the sanctuaries if controls on land and resource use are lifted.

The study estimates the value associated with timber harvesting, collection of non-timber forest products (including fuelwood and building materials for local use, agriculture, and carbon storage under the two scenarios.

The scenarios are considered over 25 years, and a discount rate of 10% is used to convert returns from land uses (such as agriculture and exploitation of NTFPs) that yield a stream of returns over time to a common year. This makes it possible to compare their value with that of unsustainable timber harvesting which yields benefits only in a short time span. This rate has been used in other valuation studies in Cambodia (de Lopez, 2003) with the justification that it is the rate used by the Asian Development Bank (ADB) in project appraisal. All prices and cost data have been expressed as 2006 US\$ using the GDP deflator (BEA).

Sources of information

A number of ecological and socioeconomic studies were carried out to inform preparation of the management plans for the two sanctuaries. The valuation contained within this report draws primarily on data from these existing studies rather than primary data collection. However, some primary collection of data on NTFPs was carried out by IIED/FFI to cross-check information in existing studies. In addition, mapping overlay techniques were used by the Ministry of Environment to calculate the area of different forest types and soil fertility in each of the management zones.

2.2 The scenarios

The “protection scenario” is based on the management zones and permitted land and resource uses set out in the management plans.

1. Core zone — access only for research.
2. Conservation zone — small-scale community uses of NTFPs.
3. Sustainable use zone — community sustainable use of resources including NTFPs, fuelwood collection, timber cutting, fisheries, ecotourism and agroforestry (outside of community protected area).
4. Community zone — in addition to the above, small animal trapping for subsistence use, agriculture, and livestock grazing for both subsistence and commercial objectives.

It is assumed that the community zone is entirely given over to agriculture, given the needs of the growing population. Carbon storage is assumed to take place in the core zone and conservation zone. There will also be some carbon storage in the sustainable use zone but somewhat less on a per hectare basis as timber harvesting on a sustainable basis is permitted in this zone. As the sustainable use area is relatively small, the partial carbon storage in this zone is excluded from the estimates.

The “non-protection scenario” assumes that any constraints on land use and forest conversion are removed. The formulation of the scenario draws from the analysis of threats to the two sanctuaries set out in the management plans and other studies of the area.

The management plan for Phnom Samkos Wildlife Sanctuary highlights clearance of land by the existing population and in-migrating settlers, as well as planned conversion for various unauthorized plantations and cattle raising enterprises (MoE/FFI, 2006a). It also mentions illegal logging for timber sales outside the sanctuary, both selective logging for luxury species and logging for low-value timber during clearance for establishment of chamkas (shifting agriculture sites). The management plan for Phnom Aural Wildlife Sanctuary mentions similar threats as well as charcoal-making (MoE/FFI, 2006b).

The non-protection scenario assumes that all commercial timber in the two sanctuaries is harvested regardless of the management zone, and that conversion to agriculture takes place. In the conversion process, the availability of NTFPs, timber and fuelwood for harvesting by the local community is lost. The alternative agricultural activity considered is rice production. This is because of its importance to rural livelihoods and also because data are available on returns to rice growing. With conversion of forests, carbon will be released so there is no carbon storage in this scenario.

For ease of comparison it is assumed that the logging and conversion of forests takes place in a very short time span of a year. In reality it would take several years. Table 4 sets out the environmental goods and services examined in each zone in the two scenarios.

Table 4: Ecosystem services included in the valuation in the two scenarios

Zone	Protection scenario	Non-protection scenario
Community zone	Timber harvesting from forest conversion. Agriculture.	Timber harvesting from forest conversion. Agriculture.
Sustainable use zone	Sustainable forest management. NTFPs. Carbon storage.	

Conservation zone	NTFPs. Carbon storage.	
Core zone	Carbon storage.	

2.3 Estimation of returns to land uses

2.3.1 Timber harvesting

The value of the provisioning service of the forest in the wildlife sanctuaries in providing commercial timber is given by the stumpage value, i.e., the market value of the timber less the costs of harvesting and transporting the timber to the market place. Estimates of stumpage value are heavily dependent on assumptions made about the density of different species, the prices in the market, and the costs of production, as these depend on the terrain and the distance from the market.

Commercial timber volume

Estimation of commercial timber volume in the sanctuaries is based on the following elements:

- Estimates of total saleable timber m³/ha at different cut limits in evergreen, semi-evergreen, and deciduous forest in Cambodia made by CDRI based on primary inventory data collected from 39 sample plots (Heov *et al*, 2006a)
- Descriptions of different forest types in the sanctuaries given in Webb (2005) and in the management plans, which provide a basis for matching up or adjusting the estimates in Heov *et al*, 2006a.
- Calculations made by the Ministry of Environment of the area of each forest type in each of the management zones.

According to Kim-Phat (1999) the minimum DBH (diameter at breast height) accepted by the market is 40cm. For the non-protection scenario, commercial volume above DBH 40 cm is estimated even though for some species the Cambodian law stipulates a higher cut limit. Resin trees and luxury species — which are prohibited species — are also included as the non-protection scenario assumes that no restrictions are placed or enforced on resource use.

In the protection scenario, it is assumed that all forest law restrictions are respected so resin trees and luxury species are not included and the minimum diameter for commercial harvesting is 60 cm. The volumes that can be harvested sustainably under a 25 year cycle are taken from CDRI's estimates (Heov *et al*, 2006a).

Table 5: Commercial timber volume in each forest type

Forest type	Commercial volume >60cm m ³ /ha	Commercial volume >40cm m ³ /ha	Rationale for assumptions on commercial timber yield
Agriculture and bare soil.	0	0	Not applicable.
Evergreen hill forest on dacite and rhyolite.	20	32	Volume for semi-evergreen forest which is found to be similar to that of logged evergreen forest Heov <i>et al</i> (2006a). Includes prohibited luxury species and resin trees. According to Webb (2005, p.9) this forest has fewer dipterocarps than the sandstone hill forest.
Evergreen hill forest on granite.	20	32	Volume for semi-evergreen forest which is found to be similar to that of logged evergreen forest Heov <i>et al</i> (2006a). Includes prohibited luxury and resin species. According to Webb (2005, p.9) this forest has fewer dipterocarps than the sandstone hill forest.
Evergreen hill forest on sandstone.	20	32	Volume for logged semi-evergreen forest from Heov <i>et al</i> (2006a). According to Webb (2005, p.7) almost all of the low-mid elevation forest on sandstone has been logged. This type also includes areas of dwarf evergreen forest with presumably less commercial volume.
Evergreen hill forest on basalt.	39	81	Volume for evergreen forest including prohibited luxury species and resin trees from Heov <i>et al</i> (2006a). According to Webb (2005, p.8), greater abundance and diversity than sandstone forests and very tall trees and closed canopy.
High elevation woodland and grassland often with pine.	10	16	Volume for semi-evergreen forest including prohibited luxury and resin species in Heov <i>et al</i> (2006a) reduced by 50% because of mix with grassland.
Highly disturbed forest with abundant bamboo.	3	26	Volume for severely degraded deciduous forest including prohibited luxury and resin species in Heov <i>et al</i> , 2006a.
Low elevation of woodland and grassland.	10	16	Assume half the volume for semi-evergreen forest including prohibited luxury and resin species in Heov <i>et al</i> (2006a) as it is both mixed with grassland and at a lower density. Webb (2005, p.12) mentions dominance of <i>Shorea siamensis</i> and <i>Dipterocarpus obtusifolius</i> but that trees are short.
Lowland forest: large crowned, low elevation	20	32	Volume for semi-evergreen forest including prohibited luxury and resin species from

forest with high proportion of deciduous tree species			Heov et al (2006a). According to Webb (2005, p.9) Hopea trees have been logged in some locations.
Montane forest.	0	0	Assumed that not commercially valuable. Webb (2005) states that consists of small pole-sized trees with height less than 15m. Management plans refer to trees here as stunted and gnarled.

Table 6: Forest types in the Phnom Samkos Wildlife Sanctuary (PSWS) in 2003. Source: calculations by Ministry of Environment, Cambodia.

Type	Total in PSWS (ha)	Core zone (ha)	Conservation zone (ha)	Sustainable use zone (ha)	Community zone (ha)
Agriculture and bare soil.	755.00	451.12	87.17	4.19	212.52
Evergreen hill forest on dacite and rhyolite.	60,687.33	53,393.70	6,365.83	698.68	229.11
Evergreen hill forest on sandstone.	170,088.48	145,226.77	16,900.39	4,986.76	2,974.56
Evergreen hill forest on basalt.	5,138.97	687.06	4,444.05	—	7.86
High elevation woodland and grassland often with pine.	1,041.92	1,027.12	0.58	—	14.22
Highly disturbed forest with abundant bamboo.	6,004.97	5,299.96	524.13	139.82	41.06
Low elevation of woodland and grassland dominated by depterocap forest.	64,713.03	15,369.75	25,202.12	11,050.73	13,090.42
Lowland forest: large crowned, low elevation forest with high proportion of deciduous tree species.	23,579.59	11,026.54	6,767.57	2,251.33	3,534.15
Montane forest.	555.81	555.81	—	—	—
Grand total:	332,565.09	233,037.83	60,291.83	19,131.51	20,103.92

Table 7: Forest Types in Phnom Aural Wildlife Sanctuary (PAWS) in 2003. Source: calculations by Ministry of Environment, Cambodia.

Type	Total in PAWS (ha)	Core zone (ha)	Conservation zone (ha)	Sustainable use zone (ha)	Community zone (ha)
Agriculture and bare soil.	5,493.24	41.13	206.17	653.74	4,592.2
Evergreen hill forest on dacite and rhyolite.	17,509.36	17,390.28	119.07	0.01	
Evergreen hill forest on granite.	49,886.64	49,163.27	723.34	0.03	
Evergreen hill forest on sandstone.	13,220.91	12,457.99	732.58	29.17	1.17
High elevation woodland and grassland often with pine.	295.24	295.24	—	—	—
Highly disturbed forest with abundant bamboo.	1,519.85	774.54	570.07	154.31	20.93
Low elevation of woodland and grassland.	126,953.25	46,711.81	51,573.18	19,835.31	8,832.95
Lowland forest: large crowned, low elevation forest with high proportion of deciduous tree species.	39,727.18	24,669.97	11,173.78	3,301.91	581.52
Montane forest.	428.54	428.54	—	—	—
Grand total:	255,034.21	151,932.77	65,098.19	23,974.48	14,028.77

Market prices for tropical timber

Because of the moratorium on log exports, in place since 1996, there are no world market prices for Cambodian timber. Following the approach in Boscolo, 2004, the price of Malaysian meranti is used as an indicator of the price of evergreen timber species in Cambodia. The price for deciduous species is assumed to be 4/5 of the price for meranti based on the ratio used by Boscolo (2004). Some luxury species, logged illegally, probably command higher prices (a Global Witness report on illegal logging in Phnom Aural in 2004 cited prices ranging US\$280 and US\$400 per m³ for four luxury species in minimally processed form. As some of the species available in larger volumes are likely to have lower prices than meranti, on average the price of this species seems a reasonable proxy).

Prices for tropical timber have been increasing rapidly since 2006, reaching pre-Asian crisis 1997 levels. Prices for Malaysian meranti log exports reached US\$ 295/m³ in early 2007 (Castaño, 2007) up from US\$235/m³ at the end of 2005 (ITTO, 2005). By way of comparison, in 2003 it was estimated that Cambodian logs could sell in the export market for US\$175/m³ but the market was considered “relatively depressed” (San and Net, 2003). It is not clear whether this is part of a cycle with prices eventually falling back as the business cycle slows down, or the beginning of a new trend. According to Castaño (2006), higher prices are a reflection of restricted availability of raw materials in tropical producer countries, added costs of implementing sustainable forest management plans, and greater control of illegal logging, as well as the emergence of China, India and the Middle East as alternatives

to traditional markets. The emergence of these new markets suggests that the price rise may be the start of an upward shift in prices. However, some reaction to higher prices can be expected as plantations nearing maturity are harvested ahead of the original planned date and substitutes to wood or to tropical species are sought out.

As there has been so much variation in the timber price, sensitivity analysis is necessary. The 2007 price is used for the main estimate but for sensitivity analysis, the price at the end of 2005 (US\$235/m³) is used.

Harvesting costs

While prices are influenced by demand/market conditions, harvesting costs depend more on locally-specific factors such as terrain and species density. Two main sources of information on timber harvesting and transport costs in Cambodia have been identified and there is considerable difference between them. The World Bank (1996) gives an average of US\$96/m³ based on concessionaires' data. Updated to 2006 prices this gives US\$118.7/m³. This is somewhat higher than Boscolo's estimate of average costs at the national level (US\$58/m³, US\$63 in 2006 prices) in the *Independent Forest Sector Review* (Boscolo, 2004), which is based on concessionaires' data plus information on logging operations in other countries in the region. Because of the hilly nature of the terrain in the wildlife sanctuaries, the costs are likely to be higher than average. For this reason the World Bank cost estimates are used.

Stumpage values

With the early 2007 prices of Malaysian meranti and costs of US\$118.7/m³, stumpage values are US\$176 for evergreen species and US\$117 per m³ for deciduous species. This is considerably higher than Boscolo's estimate of US\$92/m³ for evergreen species in the *Independent Forest Sector Review* (Boscolo, 2004) even though he uses lower costs, reflecting the increases in prices since then. These values are, however, in line with the estimate by San and Net (2003) of stumpage value in 2003. This was based on 1991-1996 timber prices rather than the 2003 price as the market at the time was considered relatively depressed.

2.3.2 Agriculture

The main threat to the wildlife sanctuaries identified in the socioeconomic studies preceding their management plans is subsistence agriculture. Rice is the main crop in subsistence agriculture in Cambodia, and is mostly grown in low input and rainfed production systems (ACI, 2006). It is therefore reasonable to assume that conversion of existing forest areas in the core zone and conservation zone is likely to be predominantly for subsistence, low technology, wet season rice production.

The returns to agriculture are given by the market value of production less the costs of production, including the imputed costs of a family's own labour. Estimates depend on assumptions about yields, market prices, and costs.

Yields

In low technology wet season rice production, the major influence on yields is likely to be soil fertility. Tables 8 and 9 show the distribution of high, medium, and low fertility soils in the two wildlife sanctuaries. It can be seen that there is very little high fertility soil in the two sanctuaries, in both cases less than 10% of the total area of all the zones. There is also very little medium productivity soil, none at all in Phnom Samkos. In the core zone in particular, all of the area is low productivity soil in Phnom Samkos Wildlife Sanctuary, and over 98% in the case of Phnom Aural Wildlife Sanctuary. This suggests that conversion of forest to agriculture in this zone is not likely to yield much value after timber has been harvested. In the community zone, there is a greater proportion of high fertility soil – nearly 30% in Phnom Aural Wildlife Sanctuary and 19% in Phnom Samkos Wildlife Sanctuary, respectively.

Table 8: Soil fertility in Phnom Samkos Wildlife Sanctuary

Type	Total in PSWS (ha)	Core zone (ha)	Conservation zone (ha)	Sustainable use zone (ha)	Community zone (ha)
High productivity soil.	8,024	—	1,006	3,300	3,718
Low productivity soil.	322,727	231,708	58,980	15,831	16,207
Grand total:	330,751	231,708	59,986	19,130	19,925

Table 9: Soil Fertility in Phnom Aural Wildlife Sanctuary (PAWS).

Type	Total in PAWS (ha)	Core zone (ha)	Conservation zone (ha)	Sustainable use zone (ha)	Community zone (ha)
High productivity soil	15,493	50	6,480	4,874	4,090
Low productivity soil	232,344	151,569	57,088	17,111	6,576
Medium productivity soil	7,199	315	1,530	1,990	3,363
Grand total:	255,036	151,933	65,099	23,975	14,029

Yields in low fertility areas are assumed to be 1.0 tonne per ha. This is based on the chamka land quality ranking and paddy soil quality ranking survey of rice yields conducted in O'Som Commune, which indicated 1 tonne per ha in the poorest soils in chamka land, and 0.5 tonnes per ha in the No. 3 quality paddy soils. (Ironsides *et al*, 2002). In the medium fertility zones it is assumed that yields equate to the average yield in the provinces in which the sanctuaries are located of 1.86 t per ha (Save Cambodia's Wildlife (SCW), 2006). In the high fertility areas, yields are assumed to be 3.0 t per ha. This is based on yields for wet season rice under contract farming indicated in a recent diagnostic of agriculture in Cambodia (ACI, 2006) and is considered to be a generous estimate of the agricultural potential.

As most of the soils are of such low productivity, it is unlikely that agriculture can be maintained permanently and so fallow periods will be necessary. It is assumed that permanent production can be maintained on the high and medium productivity areas but that fallow

periods of five years are required for every one year's use of the low fertility areas. This is based on the analysis of chamka cycles in O'Som Commune (Ironsides *et al*, 2002).

Prices

The farmgate price for unmilled rice (US\$135/tonne) is taken from ACI 2006. Prices of both milled and unmilled rice have been increasing due to increased local demand and an upward trend in global rice prices (GAIN Report, 2006). The analysis by Boscolo (2004) in the *Independent Forest Sector Review* used rice prices considerably lower, at US\$90 per tonne (equivalent to US\$104.5 in 2006 prices). As with tropical timber, it is debatable whether this price rise is part of the commodity cycle or will be sustained. ACI (2006) highlighted that growth in rice production in Cambodia between 2000 and 2004 was less than the rate of population growth, suggesting that supply shortfalls might push prices up. Much depends on the global market also. FAO (2006) predicts expansion of world rice trade over the period 2006-2015 and expects world rice prices to increase slightly in real terms. This suggests that higher prices will be maintained.

There is also considerable variation in farmgate prices for rice within Cambodia, depending on location. SCW (2006) shows prices for end of 2004 ranging from 64 riels per kg to as much as 900 riels (equivalent to US\$16 to US\$225). Recent fieldwork conducted by FFI/IIED for this study found rice prices in the Phnom Samkos Sanctuary ranging between US\$80 and US\$130. The ACI average price — while broadly consistent with this countrywide range — may therefore slightly overestimate prices in the wildlife sanctuaries.

Costs

Costs of rice production are derived from ACI 2006, which estimates US\$118 per ha for a yield of 1.556 tonnes. This cost estimate includes imputed costs of a household's own labour. It is assumed that 25% of costs do not vary with yield; for example input requirements for land preparation are likely to be the same for each area of land. On this basis, the cost estimates for different yields are adjusted accordingly. This gives:

- Low fertility areas — US\$86 per ha.
- Medium fertility areas — US\$135 per ha.
- High fertility area — US\$200 per ha.

No account is taken of the impact of distance from markets on costs although this would put cultivation of the core zone at a further disadvantage. It is likely though that transport infrastructure — and hence accessibility to market — would improve over time as the forest was converted.

Margins

The resulting margins (price minus cost including cost of own labour) for rice are as follows:

- Low fertility areas — US\$49 per ha.
- Medium fertility areas — US\$ 116 per ha.

- High fertility area — US\$ 205 per ha.

The ACI (2006) diagnostic found that for an average yield of 2 tonnes/ha, gross margins vary between US\$100 and US\$200 per ha. It pointed, however, to a number of strategies for increasing value at the farm level — such as specialisation in higher quality rice (fragrant varieties, glutinous rice), double cropping of rice, and diversification into higher value products such as vegetables, fruits, soybeans and livestock. With these strategies, gross margins could increase to US\$800 to US\$2,000 per ha. This provides the basis for a second “protection scenario” for agriculture in which it is assumed that these strategies are pursued in the medium and high productivity areas in the community zone.

2.3.3 Non-timber forest products

The wildlife sanctuaries have a wide range of non-timber forest products as well as fuelwood and building materials that are used — and in some cases sold — by the local population. Some products such as cardamom, resin, and mushrooms are sold to middlemen in the villages. As with timber, the value of NTFPs is given by their price in the market (or of a similar product if not marketed) less the costs of collection including time spent in traveling to the site.

There is some information on amounts collected of the main marketed products, and prices received in a number of localities, but there are no systematic surveys covering a representative sample of the whole human population of the two sanctuaries and addressing costs of collection also.

For this reason, this paper’s valuation works with estimates of NTFP income per household from a CDRI study on the contribution of NTFPs to livelihoods in several provinces in Cambodia, including Pursat province (Heov *et al*, 2006b). This gives estimates of the income derived from a wide range of NTFPs at US\$23 per month for low income families, and US\$29 per month for medium income families. These estimates include sales of marketed products and imputed income from subsistence use of NTFPs, but appear to exclude costs of labour involved in collection and travel to and from the resource sites.

These estimates are within the range of gross monthly income reported by villagers for main NTFPS of US\$15-US\$85 in fieldwork carried out for this study in early 2007 in the communes of Pray Meay, Thmor Da, Krey Pea Pi, Along Reab and O’Sam. They are lower than estimates made for four villages in Ratanakiri (Bann, 1997), where average gross monthly income per household from fuelwood, bamboo, malva nuts and building materials ranged from US\$49 in one of the villages to US\$73 in 2006 prices. However, the CDRI estimates are considerably higher than the estimate made by De Lopez (2003) for forest resource use in Ream National Park, which works out at US\$40 per family per year in 2006 prices.

An alternative approach to estimating NTFP values is provided by Boscolo (2004) who estimates returns on a per hectare basis at a national level based on average NTFP density and sustainable harvesting rates. Returns to fuelwood, charcoal, and liquid resin are estimated at US\$16-26 per ha (in 2006 prices) including costs of labour involved in collection. Applying these estimates to the wildlife sanctuaries gives monthly income per family somewhat higher than CDRI’s estimates. These estimates are converted to income per family by multiplying

the income per ha by the number of hectares in the sanctuaries in which NTFP collection is permitted. This works out at US\$40 to US\$67 (in 2006 prices) per family per month. This likely to be an overestimate of current returns as the participatory zoning of the sanctuaries and the area in which NTFP collection is permitted takes into account some future population growth.

The CDRI estimates for low income families are taken for the main estimate.

2.3.4 Carbon storage

Avoided deforestation is not currently included in the flexibility mechanisms of the UNFCCC and Kyoto Protocol. However, it is estimated that deforestation contributes 20% to global greenhouse gas emissions. As a result it is increasingly recognized that for measures to deal with climate change to have any chance of success, they will need to tackle deforestation. The IPCC's Working Group III on Mitigation of Climate Change, in its recent contribution to the *Fourth Assessment Report*, concludes that forest-related mitigation activities can considerably reduce emissions from sources and increase CO₂ removals by sinks at low cost (IPCC, 2007). There have been a number of proposals by Papua New Guinea and by Brazil for introduction of financial incentives to avoid deforestation. The ecosystem service provided by the forests in the wildlife sanctuaries is therefore valuable to society in avoiding further impacts of climate change. It also points to a possible source of funding in future years, most likely in the next commitment period 2012 under the Kyoto Convention, if avoided deforestation is incorporated into a carbon trading framework.

Carbon stocks

Carbon stocks in the forests in the two wildlife sanctuaries were estimated from information on the areas of forests of different types in the management zones. The descriptions of the forest types given in Webb (2005) were used to link up forest types with estimates of biomass for different forest types in Cambodia given in Brown (1997). Table 10 gives more details.

Table 10: Estimates of biomass and carbon in different forest types.

Forest type	Total above ground biomass t/ha	Total carbon tC/ha	Rationale for assumptions
Agriculture and bare soil	0	0	
Evergreen hill forest on dacite and rhyolite	100	50	Based on Table 5.3 in Brown (1997) Cambodia (2) lower end of range for moist well to poorly stocked evergreen forest.
Evergreen hill forest on granite	100	50	Based on Table 5.3 in Brown (1997) Cambodia (2) lower end of range for moist well to poorly stocked evergreen forest.
Evergreen hill forest on sandstone	100	50	Based on Table 5.3 in Brown (1997) Cambodia (2) lower end of range for moist well to poorly stocked evergreen forest.
Evergreen hill forest on basalt	155	77.5	Based on Table 5.3 in Brown

			(1997) Cambodia (2) upper end of range for moist well to poorly stocked evergreen forest.
High elevation woodland and grassland often with pine.	70	35	Based on Table 5.3 in Brown (1997) Cambodia (1) estimate for open dry forest.
Highly disturbed forest with abundant bamboo	100	50	Based on Table 5.3 in Brown (1997) Cambodia (2)) lower end of range for moist well to poorly stocked evergreen forest.
Low elevation of woodland and grassland	70	35	Based on Table 5.3 in Brown (1997) Cambodia (1) estimate for open dry forest.
Lowland forest: large crowned, low elevation forest with high proportion of deciduous tree species	120	60	Based on Table 5.3 in Brown (1997) Cambodia (2) estimate for moist deciduous forest.
Montane forest	155	77.5	Based on Table 5.3 in Brown 1997 Upper end of range for moist well to poorly stocked evergreen forest.

These estimates are conservative in comparison to other existing estimates of carbon in Cambodia's forests. Sasaki (2006) gives estimates ranging from 107.1 tC/ha for conversion forests to 130.5 tC/ha for production forests and 161.1 tC/ha for protection forests while FAO (2007) gives a country average for Cambodia of 121 tC/ha.

The value of reducing carbon emissions

For the purposes of this valuation there are two ways of approaching the value of carbon emission reduction:

1. Estimating the damage caused by additional carbon emissions — the social cost of carbon.
2. Estimating the carbon price necessary to achieve the desired reduction in global carbon emissions.

Estimates made of the social cost of carbon vary widely but have tended to increase in later studies. The UK Government — based on a review of damage cost estimates in the literature — recommends £70/tonne of carbon (US\$138/tC) within a range of £35 (US\$69/tC) to £140 t/C (US\$276/tC) as a global estimate of the global damage cost of carbon emissions, rising by £1 t/C per year in real terms to reflect the increasing marginal cost of emissions over time (DEFRA website). Estimates in the *Stern Review of the Economics of Climate Change* (Stern,2007) are higher still at US\$85/t CO₂ equivalent to US\$ 311/t C¹ (at 2000 prices) for a 'business as usual' scenario.

An alternative approach is to estimate the price that would have to be put on carbon emissions in order to achieve the desired emissions reductions over time. The IPCC's

¹ One tonne of carbon equals 3.664 tonnes of carbon dioxide

Working Group III in its ‘Summary for Policymakers’ of its contribution to the IPCC’s *Fourth Assessment Report* (IPCC, 2007) suggests that real or implicit prices of 20 to 50 US\$/tCO₂ (73 to 183 US\$/tC) sustained or increased over decades could make many mitigation options in the end-use sectors economically attractive. The midpoint of this range, i.e., US\$35/tCO₂ (US\$128/tC) is taken as the unit value of reducing carbon emissions for the central estimate. The upper and lower bounds of this range are used for sensitivity analysis.

These price estimates in the latest IPCC report are considerably higher than those prevailing in current trading frameworks such as the Clean Development Mechanism and the EU emissions trading system. The average price in the CDM in 2006 was US\$10.5/tonne of CO₂ (US\$42/t C). Prices in carbon trading frameworks are heavily influenced by the emissions cap imposed by regulations. As the scientific knowledge on climate change increases, it is generally agreed that much stricter emissions reductions will be required. Prices in carbon trading frameworks are therefore set to increase. It is less clear where avoided deforestation will fit in future carbon trading frameworks i.e., whether it will be fully incorporated or addressed separately.

3. Results

The net present value of the benefits associated with each scenario over 25 years, discounted at 10%, has been calculated. The results show that the main values in monetary terms are for timber harvesting in the non-protection scenario, and carbon storage in the protection scenario. Values for agriculture, sustainable forest management, and NTFPs are relatively minor. For this reason sensitivity analysis is concentrated on variables related to timber harvesting and carbon storage as changes in variables such as agricultural prices will make very little difference.

3.1 Central estimate of value

For the central estimate, according to the assumptions set out in the text, the protection scenario is more valuable than the non-protection scenario, primarily because of the carbon storage benefits. The avoided damage costs of conserving the forests and preventing release of carbon outweigh the value of timber harvesting and subsequent agriculture.

Table 11: Central estimate of value of the wildlife sanctuaries over 25 years.

Non-protection scenario			
Net present value US\$ million	PAWS	PSWS	Total
Timber harvesting	853	1,615	2,468
Agriculture	53	39	92
Total:	906	1,654	2,560

Protection scenario			
Net present value US\$ million	PAWS	PSWS	Total
Forest conversion (community zone)	19	51	70
Sustainable forest management	3	5	7
Agriculture (community zone)	12	8	20
NTFPs	9	7	15
Carbon storage	1,320	1,840	3,160
Total:	1,362	1,910	3,272

3.2 Sensitivity analysis

Higher margins with agricultural improvement

Table 11 shows that values for land and resources uses likely to be of interest to local people, that is, agriculture, NTFP collection, and sustainable forest management, are lower in the protection scenario than under the non-protection scenario. This situation changes if it assumed that agricultural improvement programmes are introduced under the protection scenario. With an increase in margins to US\$1,400 per ha — the midpoint of the range estimated by ACI (2006) — the local benefits under the protection scenario (excluding forest conversion in the community zone) are nearly double those of the non-protection scenario (Table 12).

Table 12: Impact of agricultural improvement programmes.

Non-protection scenario			
Net present value US\$ mn	PAWS	PSWS	Total
Timber harvesting	853	1,615	2,468
Agriculture	53	39	92
Total:	906	1,654	2,560

Protection scenario			
Net present value US\$ mn	PAWS	PSWS	Total
Forest conversion (community zone)	19	51	70
Sustainable forest management	3	5	7
Agriculture (community zone)	95	48	144
NTFPs	9	7	15
Carbon storage	1,320	1,840	3,160
Total:	1,446	1,951	3,396

Lower bound for social cost of carbon

The results are very sensitive to the social cost of carbon and to the timber price. Adopting the lower end of the social cost of carbon without changing any of the other assumptions on the other land uses results in the non-protection scenario being more valuable than the protection scenario as shown in Table 13, below.

Table 13: Sensitivity analysis – lower bound for social cost of carbon.

Non-protection scenario			
Net present value US\$ million	PAWS	PSWS	Total
Timber harvesting	853	1,615	2,468
Agriculture	53	39	92
Total:	906	1,654	2,560

Protection scenario			
Net present value US\$ million	PAWS	PSWS	Total
Forest conversion (community zone)	19	51	70
Sustainable forest management	3	5	7
Agriculture (community zone)	12	8	20
NTFPs	9	7	15
Carbon storage	754	1,052	1,806
Total:	796	1,122	1,918

Timber prices

Taking a lower timber price, the end 2005 price of US\$235/t, (on the grounds that recent price trends are not likely to be sustained), but keeping the lower bound estimate for the social value of carbon makes the protection scenario value higher again than the non-protection scenario – as shown below.

Table 14: Sensitivity analysis — end 2005 timber prices and lower bound for social cost of carbon

Non-protection scenario			
Net present value US\$ mn	PAWS	PSWS	Total
Timber harvesting	535	1,049	1,585
Agriculture	53	39	92
Total:	589	1,088	1,677

Protection scenario			
Net present value US\$ mn	PAWS	PSWS	Total
Forest conversion (community zone)	11	30	41
Sustainable forest management	2	3	4
Agriculture (community zone)	12	8	20
NTFPs	9	7	15
Carbon storage	754	1,052	1,806
Total:	788	1,099	1,887

4. Conclusions

This valuation has expressed in monetary terms a subset of the benefits associated with protection of the wildlife sanctuaries. No attempt has been made to estimate global biodiversity values and these, together with other important ecosystem services such as watershed protection, have to be considered as co-benefits of those few benefits that can be quantified in monetary terms.

The aim of the valuation has been to consider whether the monetisable benefits are sufficient to make the case for protection. The answer is complicated by the recent surge in tropical timber prices which has made the returns from unsustainable timber harvesting extremely high. The economic benefits of commercial provision of timber in the non-protection scenario far outweigh the monetary value of local sustainable uses of forest resources under a protection scenario in which the sanctuaries are managed according to the provisions of the management plans. Land use incentives currently work against protection.

However, the valuation shows the importance of the global value of carbon storage as a benefit of keeping the wildlife sanctuaries in their protected state. The value to the global community of preventing further releases of carbon dioxide from deforestation and forest degradation is significant because of the high costs associated with climate change damage. Estimates of the social costs of carbon are subject to considerable uncertainty, but there is general agreement that they are not captured adequately by the prices paid for carbon emission reductions in current emission trading frameworks, and that these prices will have to rise substantially if safe levels of emissions are to be achieved. At the midpoint of IPCC Working Group III's likely future range of carbon prices, the value of carbon storage is high enough to compete with unsustainable timber harvesting and so make the case for protection. Nevertheless, the value of carbon storage and that of unsustainable timber harvesting are very close, and highly sensitive to assumptions about carbon prices and timber prices.

Benefits accruing to the local population in the protection scenario from NTFPs and agriculture are small relative to other land uses, but are important for livelihoods. It is notable that the returns from agriculture are higher in the non-protection scenario. This is because agriculture is assumed to extend over such a large area in this scenario. This highlights the importance of increasing benefits for the local population under the protection scenario. If it is assumed that agricultural improvement programmes increase margins to the midpoint of the range indicated by ACI (2006), the benefits to the local population from agriculture under the protection scenario exceed the returns under the non-protection scenario.

There is considerable uncertainty about the social cost of carbon. In addition, the estimate of both timber yields and carbon stocks relies on approximations rather than specific field measurements. If any attempt is made to access future payment mechanisms for reducing emissions from deforestation, more accurate measurement will be needed of carbon stocks in the wildlife sanctuaries.

Part III: Sustainable financing

1. Introduction

This report now presents the results of a review, conducted by the International Institute for Environment and Development (IIED) of behalf of Fauna and Flora International (FFI), of the finances of the Phnom Samkos and Phnom Aural wildlife sanctuaries. The purpose of the review was to identify options by which the finances of these reserves can be improved sustainably.

The review is based on a visit to Phnom Penh, as well as the sanctuaries, and consultations with key staff of the Government of Cambodia (GoC) and various NGOs, including FFI. Key players in the private sector in Cambodia were also consulted. A number of project reports and other pieces of documentation were examined.

It is important to note that developing sustainable means of financing their operations is one of the key challenges facing protected areas in the world today. Even in developed countries, there are funding challenges and crises. These are merely exacerbated in developing countries, which have serious challenges in financing even basic services such health and education. Such countries find it difficult to justify diverting funding from these services to less pressing needs such as conservation, even if the economic case for doing so is well justified. In many developing countries, weaknesses in the governance framework result in available funding being wasted on low priorities such as defence or, worse still, lost through waste and even fraud.

To date, much of the burden has been carried by a number of donor organisations. However, this is not sustainable and has other (sometimes undesirable) side effects — such as the fact that it makes the recipient country/organisation subject to the value systems of the donor. This has presented particular problems in southern and eastern Africa.

The other major drawback with donor funding is its lack of predictability. Developing sustainable protected areas and management institutions requires stable flows of funds. This cannot be created and sustained in an organisation that suffers the disruptions associated with changing from donor to donor, and existing ‘hand to mouth’ while unsupported by them. Where this is going to occur, it would arguably be better for the institution to develop without external financing, matching the size and scope of the institution to the available resources.

2. Existing finances of the sanctuaries

Theoretically speaking, a review such as this should proceed in the following stages:

1. In the first instance, the management plans for the sanctuaries should be converted into a working budget. This will identify what funding and other resources are needed to manage and conserve the sanctuaries in accordance with their management plans.
2. Existing sources of funding for the sanctuaries should then be identified and quantified.
3. The relationship between costs and funding should then be established.
4. The final stage is to ascertain whether any funding shortfall/s can be bridged by either increasing funding (from existing or new sources) or reducing operating costs.

This review has attempted to follow this process and the results are presented in the remainder of this report. As will be seen, issues have arisen.

2.1 Management plans for the sanctuaries

The recognized approach to ascertaining the costs of managing and conserving a sanctuary is to develop a strategy and management plan. The management plan should then be costed and revised in an iterative process until it “fits” with available funding. Following this process will ensure that the management plan is realistic and capable of being implemented. In reality this seldom happens. Many protected area management plans are prepared without any reference to available resources. The result is that the management plan is often unrelated to available funding. This is the primary reason why so many protected area management plans are not implemented or even much referred to after they have been completed.

This is not the case for the wildlife sanctuaries in the Cardamom Mountains. Each sanctuary has a management plan; these plans are the joint output of FFI’s Cardamom Mountains Wildlife Sanctuaries Project and GoC’s Ministry of the Environment. They are signed by the Minister and represent an authoritative statement of GoC intentions for the sanctuaries.

The management plans are time-bound and follow a logical sequence as follows:

1. Firstly, the sanctuary is described in detail.
2. The sanctuary is then evaluated in terms of its conservation significance and the issues and threats facing it.
3. The operational plan is then spelled out.
4. A financing plan, complete with various scenarios, is then presented.

The operational plan for the sanctuary is, for the purposes of this report, the most important section. In the plans reviewed, this comprises the following sections:

- Mission statement.

- Purpose of the sanctuary.
- Zoning plan, including an explanation of the various activities allowed in each zone.
- Management programmes.

The real detail of the plan is contained in the last section on management programmes. These are logically structured and then divided into sub-programmes, as shown below:

Table 13: Relationship between management programmes and sub-programmes in the operational plans of the sanctuaries.

Management programmes	Sub-programmes
Protected area management and administration.	Wildlife sanctuary administration, personnel, equipment and infrastructure.
	Stakeholder involvement in management.
	Area planning.
	Legal processes.
	Financial management and sustainability.
Conservation and protection of species, habitats, ecosystems and landscapes.	Law enforcement.
	Special protection for species, habitats and ecosystems of conservation concern.
	Maintaining landscape and environmental quality in populated and culturally important areas.
Communities and livelihoods.	Settlements and land use.
	Use of natural resources.
	Community livelihoods and welfare.
	Community participation in natural resource management.
Communication, information, awareness and education.	Awareness of value, use and conservation of natural resources, laws and regulations.
	Awareness of value of Cardamom Mountains landscape.
Research and monitoring.	Management orientated research and monitoring of biodiversity and ecosystems.
	Management orientated research and monitoring of socio economic conditions, livelihoods and impact of support activities.
	Monitoring of management effectiveness and implementation of the management plan.

This is a logical and well-structured approach to adopt. The objective of each sub-programme is spelt out and then a work plan for each is presented. The work plan comprises a number of tasks, each with:

- Indicators.
- Zones.
- Priority (from 1 to 3).

- Timings.
- Implementation partner.

It should be noted that the scope of this study did not extend to a review of the content of these work plans, and is therefore not possible to present a view as to their adequacy. Nevertheless, the unusually logical and well-structured approach followed is probably indicative of a set of well-prepared work plans.

2.2 Financial plans

As mentioned above, the final section of each management plan is the financial summary. This is a high level overview of the financial plan for each sanctuary, (the financial plan is presented in a separate and more detailed document). The financial summary continues with the logical and well-structured approach adopted for the management plan. It provides estimates under three funding scenarios, developed jointly by FFI and GoC:

- Scenario 1: minimal available funding, with activities and costs reduced to provide the minimum desirable level of wildlife sanctuary protection and management. Priorities 2 and 3 are excluded from this scenario and only activities assigned Priority 1 are included.
- Scenario 2: medium level of available funding, with a set of activities designed to provide an adequate level of wildlife sanctuary protection and management. Activities listed as Priority 1 or 2 are included and allocated full budgets.
- Scenario 3: maximum level of available funding, with a set of activities designed to provide an enhanced level of wildlife sanctuary protection and management. All activities are included and allocated full budgets.

The specifics of the financial plans are presented in a separate and detailed document. Each activity is costed in three categories:

1. Salaries and sub-contracts.
2. Capital.
3. Maintenance and operational costs.

These costs are shown by year of the project.

The scope of this report did not extend to a critical examination of the quantities and costs included in the financial plans, and it does not, therefore, contain views as to their adequacy or arithmetical accuracy. But the logical approach followed in preparation suggests a rigorous attempt will have been undertaken.

2.3 Management costs

The table below outlines the budgets for the sanctuaries, over a five-year period in US\$:

Table 14: Five-year budgets for the sanctuaries (US\$).

Phnom Aural Wildlife Sanctuary	2007	2008	2009	2010	2011	Total:
Scenario 1	182,558	154,411	166,125	168,087	175,198	846,379
Scenario 2	465,196	381,324	451,997	388,419	424,489	2,111,425
Scenario 3	497,696	428,464	490,882	440,451	465,409	2,322,902

Phnom Samkos Wildlife Sanctuary	2007	2008	2009	2010	2011	Total:
Scenario 1	182,557	154,411	166,125	168,087	175,198	846,378
Scenario 2	465,996	384,474	451,997	388,419	424,489	2,115,375
Scenario 3	498,746	432,927	507,657	441,889	465,709	2,346,928

2.4 Sources of funding for the sanctuaries

The two sanctuaries presently secure funding from two main sources:

1. FFI, through the Cardamom Mountains Wildlife Sanctuaries Project.
2. The Government of Cambodia, through the Ministry of Environment.

For a complete evaluation of the finances of the sanctuaries, it would be necessary to summarise both sources of funding. However, it has not been possible to ascertain the extent or the use/s of GoC funding, despite this information having been requested by FFI. For this reason, the remainder of this report considers only the funding derived from FFI and must therefore be considered incomplete.

Table 15: FFI funding to the sanctuaries, US\$.

Phnom Aural Wildlife Sanctuary	2005 (actual)	2006 (actual)	2007 (budget)
Personnel	96,201	79,721	No data
Equipment	24,569	70,774	"
Operational costs	38,988	34,194	"
Management overheads	29,180	17,825	"
Total:	188,938	202,514	"

Phnom Samkos Wildlife Sanctuary	2005 (actual)	2006 (actual)	2007 (budget)
Personnel	103,541	108,724	No data
Equipment	45,065	10,044	"
Operational costs	38,369	31,158	"
Management overheads	23,825	24,323	"
Total:	210,800	174,249	"
Total for both sanctuaries:	399,738	376,763	"

Any attempt to compare the above data on actual expenditures with what is needed, as identified in the financing plans, suffers from a number of defects:

- The above expenditure details are for the 2005 and 2006 financial years, whereas the financial plans only begin with the year 2007, making it impossible to compare like with like. The one year where there theoretically is a crossover of data is 2007. A request was made for FFI's data on budgets for 2007 and actual expenditures for the year to date, but these have not been forthcoming.
- There is no way, short of conducting an efficiency audit, to confirm that the actual expenditures incurred and summarised above have been strictly in accordance with the management plans, and that there has been no waste or inefficiency;
- As discussed above, these data are incomplete in that they exclude funding from GoC.

Notwithstanding these shortcomings, it is clear that the levels of funding from the CMWSP are adequate only to cover Scenario 1 of the management plans, (assuming there has been no waste or inefficiency in the use of these funds²). It will be recalled that this represents the minimum desirable level of wildlife sanctuary protection and management. Given the many challenges that exist for these sanctuaries, it is unlikely that these levels of funding are adequate.

² This assumption is optimistic: even the best-managed projects inevitably incur some inefficiencies and waste.

3. Financing options for the sanctuaries

The next eight sections of this report summarise conclusions resulting from efforts to identify alternative or additional sources of funding for the sanctuaries.

3.1 Tourism

This section examines the potential for tourism to contribute to the financing of the sanctuaries.

Tourism potential

The sanctuaries have a number of attributes which are desirable for tourism, the most important of which are:

- The Cardamom Mountains are reputed to comprise the largest indigenous forest extant in South East Asia.
- The mountains are scenically spectacular.
- These areas are also biologically interesting in that there are a wide variety of habitat types, resulting from the dramatic variations in relief. There is theoretically also the prospect of seeing interesting forest mammals such as tigers, Asian elephants, fishing cats and leopard. In addition, the forests are a bird-watcher's paradise.
- These areas have the important attribute of being a substantial, and largely intact, wilderness.
- Finally, these areas also offer some cultural attractions.

A number of studies (Fox, W., 2004; Tourism Development International, 2006; FFI, 2006) have more fully documented the attributes of the area for tourism. Their findings are not repeated here.

Because of the above attributes, there undoubtedly is potential for development of a variety of tourism products in the Cardamom Mountains in general, and in the sanctuaries in particular. Such an industry could make a contribution to the financing of the sanctuaries, through fees paid by visitors and also from tourism concessions.

Earnings potential

The table that follows illustrates the earnings potential of the sanctuaries, using a variety of combinations of visitor nights sold and entry fees.

Table 16: Earnings potential of the sanctuaries

		Visitor nights sold							
		<i>500</i>	<i>1,000</i>	<i>1,500</i>	<i>2,000</i>	<i>2,500</i>	<i>3,000</i>	<i>3,500</i>	<i>4,000</i>
Daily visitor fee (US\$)	2	1,000	2,000	3,000	4,000	5,000	6,000	7,000	8,000
	5	2,500	5,000	7,500	10,000	12,500	15,000	17,500	20,000
	10	5,000	10,000	15,000	20,000	25,000	30,000	35,000	40,000
	20	10,000	20,000	30,000	40,000	50,000	60,000	70,000	80,000
	50	25,000	50,000	75,000	100,000	125,000	150,000	175,000	200,000

However, it is important to be realistic about the real potential in the short and medium terms, due to a number of limitations that exist and which are discussed in the following two sub-sections.

The above figures can thus at best be considered indicative of the potential in future, provided the various limitations have been addressed. For convenience, these limitations have been grouped, in the discussion that follows, into those relating to the nature of the product to be offered, and those that arise from the nature of the area in which the sanctuaries are located.

Product issues

The tourism product to be offered in the sanctuaries will mainly be nature-based, although there is some potential to offer cultural and adventure products as well. However, the product will not be like an African game-viewing experience because the animals occur in small numbers and are difficult to see due to the dense vegetation. For these reasons, the product offered will always be somewhat specialised and probably dependent upon delivery by specialist guides.

There are also some national tourism product limitations in that most existing tourists to Cambodia come from Korea and Japan. Visitors from these countries are mainly interested in cultural tourism. Development of tourism in the sanctuaries thus requires access to markets that are interested in the products on offer. The main markets for these products come from North America, Western Europe, and Australia. (Given the proximity of the latter, this is the logical starting point for any initiatives to market nature-based tourism in Cambodia.) Penetration of these markets is presently weak and a major change in marketing focus is thus required.

It is important to recognize that putting Cambodia as a country onto the nature tourism map probably requires an internal critical mass of tourism products and services, which do not exist at the present time.

Finally, it should be noted that other countries with nascent tourism industries have experienced difficulty with developing this sector until they have improved their infrastructure and support sectors.

Detailed limitations

The sanctuaries themselves also exhibit a number of factors that will, at least in the short term, inhibit development of tourism. The most important of these limitations are:

- Access to the sanctuaries, and then within them, is difficult.
- There is also a (valid, in some cases) concern regarding security. This concern is mainly focused on the numbers of landmines and other unexploded devices remaining from various conflicts.
- At the present time there is a real lack of products on offer, in terms of both places to stay and skilled guides.

See the studies referred to previously (Fox, W., 2004; Tourism Development International, 2006; FFI, 2006) for more detailed discussions of the limitations on tourism in the Cardamoms Mountains.

Therefore, even if there was a demand for visits to the sanctuaries, it would be difficult to organise them. This is indicative of a “chicken-and-egg” situation that bedevils all fledgling tourism destinations: no demand for tourism can exist until suitable products have been developed for sale; but no tourism developer will make the necessary product investments until a demand for them exists. At some point it is necessary to make interventions to break this cycle.

Conclusions on tourism

There is unquestionably potential, in the long term, for tourism to contribute to the sustainable financing of the sanctuaries. Unfortunately, a number of national and local product limitations exist, and these are such that this potential will not be realised for some time.

There is a danger that pursuit of tourism potential in the short term could distract management attention and resources from more compelling and immediate priorities. For this reason, we recommend that efforts to develop tourism in the sanctuaries focus, in the short and possibly the medium term, on developing market awareness of the sanctuaries and their potential. One of the most obvious ways to achieve this is by facilitating visits by interested parties, particularly tour operators. The initiative by Conservation International to bring a group of tour operators into the Cardamom Mountains to show them around is important, and FFI should support this process and other private sector engagement initiatives.

3.2. Hunting

There is at present no established hunting industry in Cambodia. Any “hunting” presently taking place in the country is illegal and should more correctly be referred to as “poaching”. Nonetheless, because of the role that hunting plays in financing conservation in Africa, and because there have been indications of a fledgling initiative to commence safari operations, this possibility was briefly considered.

Legislative environment

Currently all commercial hunting is illegal in Cambodia. Significant legislative barriers would have to be removed in order to permit commercial safari-style hunting. Achieving this would first entail overcoming considerable bureaucratic and political inertia. More importantly, the conservation NGOs in the country are believed to largely be opposed to hunting and can be expected to endeavour to thwart any such initiatives.

It is therefore likely that the legislative environment would represent a significant barrier to any initiatives in this regard.

Hunting potential

There is believed to be demand for trophy hunting in some of the sanctuaries of Cambodia. Species such as gaur and banteng are in demand as trophies but only limited supplies of animals are available — many of those that are hunted are exotics introduced to northern Australia, and a more authentic product involving indigenous animals in their natural environment would have appeal to the market. It is likely that a demand for trophies of tiger and elephant would also exist, provided hunting these was legal.

It is at present not possible to ascertain whether any offtakes of trophies from these areas would be sustainable. The existing indications of very low animal numbers, and the fact that few of the management staff have ever seen any of these animals, would suggest not. Having said this, it should be recognized that viable (in both ecological and financial senses) offtakes of animals can occur at much lower densities than would normally be required for wildlife tourism.

Existing initiatives

NSOK Safaris, a commercial trophy-hunting company from Spain, has been attempting to gain a concession to hunt in central and north eastern Cambodia, specifically in the Lomphat and Beng Per wildlife sanctuaries. They have proposed to the Ministry of Environment that they explore hunting-related tourism in these areas. It has been documented that the concept had progressed as far as company representatives making site visits with the Director of the Department of Nature Conservation and Protection (Wildaid, 2005).

It is difficult to gain a clear picture of the present status of NSOK's concession application. Unofficial reports have suggested that the Ministry of Environment has rejected the proposal, but that the Forest Administration is still exploring commercial hunting in reserved forests outside of those controlled by MoE.

Subsequent interviews have revealed that, in December 2005, the Council of Ministers granted approval in concept of a pilot project. The first step in this process was a field study in the proposed area of Ratanakiri in the north east by the Ministry of Forestry and Fisheries (specifically, the Wildlife Protection Office and the Forest Administration). The findings of this study, coupled with a feasibility study funded by NSOK³, formed the basis of an investment proposal which was recently submitted to the Council of Ministers by NSOK.

³ It has not been possible to obtain a copy of this feasibility study.

Assuming that this process is taken further, it will be interesting to see how both the GoC and the NGO community react to the necessary attempts which will have to be made to amend current legislation, and what would be the contractual and financial basis for any concessions.

Earnings potential

Given the impediments outlined above to the development of hunting in Cambodia, let alone within the Cardamom Mountains sanctuaries, it seems premature to speculate on the potential for hunting to contribute to financing of these areas. At this stage it is sufficient to recognize that, in other parts of the world where viable trophy-hunting operations exist, these operations frequently make a major contribution towards the costs of managing and conserving the areas in which they occur.

It is interesting to note that NSOK has committed to donating 20% of the trophy fees charged to anti-poaching initiatives and/or community development.

Conclusions on hunting

There is demand for hunting trophies of animals occurring in Cambodia and thus there is potential (theoretically) to create a hunting industry and for this industry to contribute to the financing of protected areas. However, the following factors will militate against this potential:

- Such an operation would currently be illegal and there would be considerable bureaucratic and political inertia working against any effort/s to change the legislation.
- It is probable that the NGO community would also be most unhelpful in any efforts to change the legislation.
- It is also questionable whether any hunting efforts would be sustainable in both ecological and financial terms.

For these reasons, it is probably safe to conclude that this is not a financing option with any potential in the short term, and perhaps even the medium term. However, this is not to say that this option should be completely ignored. Progress with the Spanish proposal should be monitored. In the event that any major changes to policy or legislation result from that initiative, this matter should be revisited.

3.3 Angling

There is presently no established freshwater angling industry in Cambodia. (There is, however, some big-game fishing at the coast.) It has been suggested that certain fish species, with game angling potential, might exist in the sanctuaries. The potential to create an industry based on these species was therefore briefly considered.

Angling potential

For the purpose of this review, angling is considered to be a potentially high-end, low impact 'eco-tourism' activity. Fishing as a livelihood and source of community income — and its wider implications, both environmentally and economically — is not considered at this point.

Both sanctuaries are well watered as a result of their high rainfall. A number of rivers run year round and have large, deep pools. There are at present no water impoundments in the sanctuaries⁴.

Arowana or *Scleropages formosus* are believed to occur in the Cardamom Mountains, south of the Aural River in the Phnom Aural Wildlife Sanctuary, as well as in the Stung Koy River in the southern Phnom Samkos Wildlife Sanctuary. This species is reputed to be in demand for angling in other parts of South East Asia and is related to the saratoga or spotted barramundi *Scleropages leichardti*. This latter species is a favoured angling species in northern Australia.

Arowana are also much in demand as an aquarium species, especially in China where they are thought to bring good fortune. Fishing pressure, and loss of habitat, has brought the local population to the brink of extinction in other parts of its range, and the species is listed on Appendix I by CITES (one of only eight fish species listed on this Appendix). This status might preclude game fishing as a potential source of income for the protected areas.

The same factors that presently are inhibiting development of tourism in Cambodia would also serve to slow down development of any angling industry in the country.

Practical issues

A field trip was undertaken in early 2007 into the protected areas to view the potential for freshwater angling. In the particular area where the heaviest populations of arowana were said to exist, a local small-scale commercial fisherman was hired to act as guide.

This guide reported that this was the second time in three years he had taken foreigners on his boat to look for fish, the first time being an FFI fish survey. Three days were spent in the forest looking for this or any other species of fish that could be caught using traditional angling methods. There were no sightings or any other evidence of these fish. Netting is the traditional fishing method and there is a lack of any local knowledge at this point on how to accommodate any potential freshwater anglers.

Conclusions on angling

It is premature to consider sport angling as a source of income for the protected areas. No industry exists at present and it is questionable if suitable angling species occur in numbers that can be harvested sustainably (or even caught using 'catch and release'). It also seems possible that there could be legislative barriers to such use/s.

As with trophy hunting, a watching brief should be maintained in case this situation changes. As the country opens up to tourism and visitor numbers grow, the more adventurous anglers will begin investigating angling opportunities in Cambodia. Those presently angling in Thailand and possibly Vietnam might be the first to show such interest. In that event, it would be useful for management of the sanctuaries to facilitate a few more exploratory visits to see what species exist and whether there is sport angling potential. Should such potential prove to

⁴ Although a major hydro-electric dam is reported to be presently under consideration by a Chinese company and the Government of Cambodia.

exist, it would be necessary to investigate the legislative issues, and also the measures needed to ensure that any angling conducted is sustainable.

It is useful to note at this point that any major artificial impoundments created might change this environment and increase the potential for sport angling (as well as for commercial fishing). This might in turn create opportunities for measures to contribute to the financing of the sanctuaries. At the same time, it should be noted that the creation of such impoundments might also create conservation issues for the indigenous riverine fishes of these areas.

3.4 Mining

In spite of the fact that mining is probably an undesirable activity in the sanctuaries, it seems unlikely that GoC would prohibit this in the event that viable deposits were located. This being the case, it would perhaps be more realistic to accept that mining of viable mineral deposits will occur and to use this as an opportunity to ensure that:

- Mining activities are conducted in a responsible manner, and negative environmental impacts are mitigated; and
- Some kind of royalty is extracted to contribute to financing of the sanctuaries.

Current status of mining in the sanctuaries

Currently there are mining operations in both sanctuaries. The legal status of these operations is unclear:

- Currently Southern Mining Co Ltd is operating under a ministerial Prakas (regulation) allowing them the right to explore, but not the right to extract, antimony and chromium within Phnom Samkos Wildlife Sanctuary.
- The company, Future Environment, is operating in Phnom Aural Wildlife Sanctuary but its legal status is even less clear. It is unlikely that Future Environment has obtained a legal right to extract minerals. This would require development of a legal instrument equivalent to a Royal Decree. To date no such instrument has been legally recognized.

It is thus probable that the mining companies operating within the Cardamom Mountain protected areas are currently not acting in full accordance of the law.

Earnings potential

For as long as these mining operations remain outside legal provisions it is unlikely that any sustainable financing mechanisms can be developed. It has been suggested that the operators must already be paying some form of royalty to operate within these areas. However, whether these royalties are being captured by GoC revenue systems is unknown.

At this stage a number of important questions exist:

1. What is the legal status of the mining operations in the sanctuaries?
2. What is the contractual and financial basis for these operations?

3. What, if any, environmental management measures are in place?
4. Are the operators obliged to adopt any measures to mitigate negative environmental impacts arising from their operations and to rehabilitate mining sites on cessation of operations?

Given the nature of these protected areas, we suggest that the latter considerations are the most important, and that care should be taken not to prejudice any chances of regularising these matters through introducing the additional complicating consideration of royalties.

Brief discussions were held with Southern Mining Co Ltd. During these discussions the potential for the mining operator to contribute financially towards the management of the protected areas was explored. A senior representative of the company stated that in the future, once in extraction phase, Southern Mining Co Ltd might (potentially) be open to further discussions on this topic. However, at present they are only in exploration phase and are therefore not drawing an income from the protected areas.

Conclusions on mining

Minerals are already being explored for and extracted from the Cardamom Mountains. It is quite possible that the rate of exploration and extraction will expand. GoC is apparently committed to this expansion, given the role that this could play in development of the Cambodian economy. This represents both a threat and an opportunity for management of the sanctuaries.

It is essential that the protected area authorities engage with the Ministry of Industry, Mines and Energy (MIME) regarding the present and future mining operations in the sanctuaries (and in other protected areas in Cambodia). It is probably sensible that this engagement occurs in two phases:

Phase 1: create a suitable regulatory environment. The first phase should be aimed at ensuring that any mining operations within protected areas occur within an appropriate regulatory framework, having regard to the economic, environmental, and social implications of such operations;

Phase 2: develop suitable financing mechanisms. Once the regulatory framework has been clarified, it is possible to move onto the question of financing mechanisms.

It seems unlikely that the protected area authorities will make progress in these matters without the strong support and cooperation of the mining authorities. Developing this relationship must therefore be the first step in the process.

3.5 Logging

In 1994, a ministerial Prakas (regulation) was issued, prohibiting logging in protected areas. In addition, Chapter 15 of the 2002 *Forestry Law*, including Article 98, made all logging, processing, and timber transportation illegal within protected area zones. These illegal activities carry penalties of one to five years in prison and/or fines from US\$2,000 to \$25,000.

There is therefore no legal framework under which logging, selective or otherwise, can be utilised as a potential financing option for the sanctuaries. As with hunting, significant legislative barriers would need to be overcome to permit even controlled logging. It is also possible that there would be considerable — if not total — resistance to this activity from the NGO and international communities (as well as from the current stakeholders in the apparently existing illegal logging trade in Cambodian wildlife sanctuaries).

Notwithstanding the legal framework, a recent report published by the NGO Global Witness claimed that large-scale institutionalised illegal logging was, in fact, being undertaken in Phnom Aural Wildlife Sanctuary. There were further allegations that these logging activities were under the control of the Royal Cambodian Armed Forces.

It was stated in Global Witness's 2005 report *Taking a Cut, Institutionalised corruption and illegal logging in Aural Wildlife Sanctuary*: "The illegal timber industry in Phnom Aural sanctuary focuses on extraction of commercial grade wood for use in construction and luxury timbers to make furnishings. Much of the luxury timber and a proportion of the commercial grade wood cut in the wildlife sanctuary are exported to Vietnam."

There is no doubt that timber of high commercial value exists in the protected areas. But it is difficult to see how logging of any kind could generate sustainable flows of financing to the sanctuaries under the existing legal and governance framework. Should this change, there must be considerable potential.

3.6 Carbon credits

Part II of this report identified the considerable value of carbon stored in standing forests within the sanctuaries. This section of the report now briefly considers the potential for unlocking these values and thus mobilising funding for conservation of the sanctuaries.

Existing carbon credits under the Clean Development Mechanism and the Kyoto Protocol are presently available only for new forestation initiatives and not for standing forests. There is therefore no potential — until the existing Kyoto Protocol has been amended (presently scheduled for 2012) — for obtaining funding under this mechanism. However, global awareness of the value of these standing forests and the need to prevent any further deforestation is developing rapidly. It is likely that the revised Kyoto Protocol, or its successors, will include mechanisms for credits for standing forests. Given the values demonstrated in Part II of this report, it seems possible that this will in time become a major source of funding for conservation of the sanctuaries and other, similar, areas.

In recognition of these developments, over the last few months a number of multilateral agencies and governments have made available funding for pilot projects to explore their potential. These are occurring under the so called REDD framework (Reducing Emissions from Deforestation and Degradation). There may be potential to attract some of this funding for the sanctuaries, and this process should be monitored closely for developments of interest.

The voluntary market for carbon credits was also briefly considered. There have been considerable developments in this regard in recent years and there are a surprising number of facilities in existence in this market. Notwithstanding these developments, this market is still new and developing and there are credibility and governance issues. It is unlikely that there is

any potential in the short term but, once again, this situation should be monitored for favourable developments.

3.7 Endowment

The scope of this review also included investigating the possibility of using an endowment to contribute to financing of the sanctuaries. This arose for two reasons:

1. Endowment funds have been used in other parts of the world to contribute to financing of conservation.
2. There has been preliminary discussion regarding the creation of such a fund for conservation in Cambodia.

Strictly speaking, an endowment fund is a mechanism for managing funds that have been raised for conservation, rather than a source of funding *per se*. Nonetheless, given the interest in this mechanism, it is considered at this point.

The theory behind an endowment is that a (donated) capital sum is invested to produce an ongoing revenue stream. Conventional wisdom suggests that use of this mechanism is desirable because the capital is not consumed and only the income derived from it is used. In theory, this means that the capital sum will produce the income stream in perpetuity. However, there are two issues that arise:

1. In order to ensure the ongoing income stream in perpetuity, it is necessary to invest the funds in low risk investment vehicles. Low risk investments invariably produce small returns, in percentage terms.
2. Inflation erodes the 'value' of the capital sum. Therefore, if the buying power of the endowment is to be maintained in absolute terms, it is necessary to set aside part of the income stream to compensate for this. This reduces the amount of income that is then available for consumption and use.

If an endowment of US\$1 million is invested in instruments generating a return of 10% per annum in an economy with inflation occurring at 5% per annum, in the first year, of the US\$100,000 generated, a mere US\$50,000 will be available for use and consumption. This is because the other US\$50,000 must be added to the principal to compensate for inflation and ensure that the purchasing power of the principal is maintained. In subsequent years, the amount available for consumption will increase in nominal terms but its purchasing power will stay the same.

It must be conceded that 5% per annum is a high rate of inflation for developed world economies (at least at the present time); conversely, 10% per annum is a comparatively high rate of return for secure investments in such an economy.

An endowment fund is therefore a comparatively inefficient mechanism for financing conservation. A margin of 5% between the rate of interest on a financing mechanism and the rate of inflation would be considered generous in a developed world economy. Yet, such a margin will create a usable amount of only \$50,000 (in real terms) for every \$1 million invested. It is likely that donor organisations would like to see considerably more impact

arising from their funding and thus would prefer to see the funding used in a more aggressive manner. This will result in the principal being eroded and eventually consumed.

3.8 Government grant

As mentioned above, it has not been possible to obtain data on existing levels of GoC support to the sanctuaries (however, levels of support are reputed to be small). Nonetheless, it will be clear that one of the options available to improve the finances of the sanctuaries is for the GoC to increase its levels of support. The economic case for doing so has been convincingly provided in Part II of this report. Notwithstanding this, it is doubtful that this additional GoC funding will be forthcoming.

3.9 Donor funding

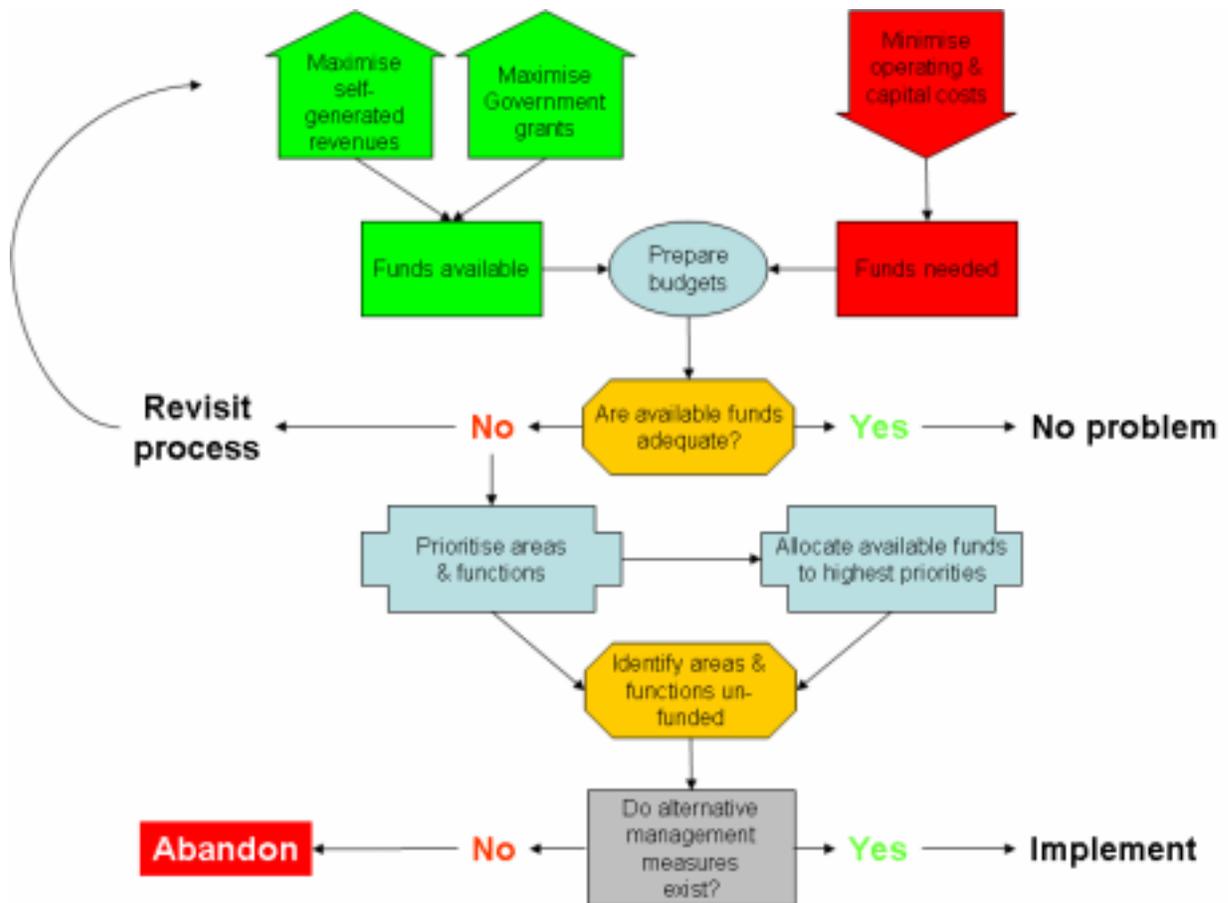
If additional funding is not available from GoC or FFI, it is of course theoretically possible that other donors might be able to assist with further funding.

However, it should be noted that donor funding is not sustainable. Investigating the prospect of securing additional funding from other donors was therefore outside the scope of this report.

4. Bridging the gap

When the process of computing the costs of managing a protected area, and identifying the sources of available funding, has been completed and a gap between the two exists, the next question is: how can the gap between them be bridged? The question is best answered by the diagram below:

Figure 1: Decision Tree on Protected Area Financing



The first step is to ensure that self-generated funds and government and donor grants have been maximised. At the same time, it is necessary to minimise the operating and capital costs needed to manage the protected area. The available funds can then be compared with what is needed and the extent of the surplus or shortfall calculated. Where there is a surplus, no problem exists.

It is much more likely that this process will result in a shortfall being identified. Where this is the case, it is necessary to enter an iterative process aimed at repeating the above steps until no further progress can be made. Assuming that the available funds are still inadequate, the next step is to prioritise the areas and functions being considered and to allocate the available funds to the highest priorities. (The alternative is to pro-rate the available funds across all areas and activities with the result that all are under-funded: high and low priority items being accorded equal “opportunity”. This is a frequent outcome but completely unsatisfactory because it results in low priorities being accorded equal treatment to high priorities.)

Once the process of prioritisation and allocation of funds has been completed, this will result in a list of areas or functions that have no available funding. Where this occurs, it is necessary to ascertain whether alternative management mechanisms (such as sub-contracting or outsourcing) exist. If this is the case, then these mechanisms should be implemented.

There will be situations where such alternative mechanisms do not exist. In these situations, the agency is presented with no option but to abandon the area or function concerned. This is most undesirable but is a better option than under-funding all areas.

5. Governance issues

It is also important to note that governance failures and other institutional weaknesses are often a hindrance to sustainable financing of protected areas. These are particularly difficult to circumvent when such weaknesses pervade the government as a whole. Appraising issues relating to governance was outside the remit of this review; nonetheless, the fact that it was not possible to ascertain the sources, amounts, and uses of GoC funding for the sanctuaries was not encouraging. In addition, the ongoing existence of apparently institutionalised illegal logging in the sanctuaries is not indicative of a sound governance framework.

There is one final issue to be considered: globally, many protected areas do generate a flow of funds that contribute to sustainable management and conservation operations. However, these funds do not have this result as they are either:

- Captured by central government and used for other purposes.
- Used to cover the overheads of the agency or sometimes even other protected areas.
- Lost through fraud or waste.

There is thus no guarantee that, even if the funds are being generated, they will have the desired result. For these reasons, any efforts to generate flows of sustainable funding must be coupled with efforts to ensure that the institutional framework is also supportive of this.

Part IV: Conclusions

1. Concluding remarks

The ecological services valuation in Part II of this report has demonstrated the potential benefits of protecting the two wildlife sanctuaries and preventing further deforestation. In addition to the significant (but non-monetisable) biodiversity benefits of the sanctuaries, the global value of carbon storage is particularly high. But the valuation has also highlighted how land use incentives currently work against protection. While non-timber forest products are important for local livelihoods, their monetary value is tiny in comparison with that of timber harvesting and forest conversion. Rising tropical timber prices make the task of protection all the more challenging. Nonetheless, fiscal pressures facing GoC are such that it is unlikely additional funding will be available for this purpose in the foreseeable future.

Part III of the report focused on identifying practical measures by which the funds needed can be generated. A few possibilities with potential in the medium term, but not the short term, were identified. These will have to be monitored as the situation develops, in case opportunities arise in the future.

The most promising potential appears to lie in the rapidly developing global interest in preventing any further deforestation, and the need to create and develop appropriate credit mechanisms for carbon stored in intact standing forests. Until recently, it seemed unlikely that any such mechanisms would come into existence prior to the amendment or renewal of the existing Kyoto Protocol (which ends in 2012). However, the 2007 report of the IPCC has galvanised awareness that suitable credit mechanisms will have to be developed for standing forests, and a number of multilateral agencies and governments have in the last few months earmarked funding to be used for pilot projects in this regard. It is possible that funding for the sanctuaries could be mobilised from these funds and this situation should be monitored carefully.

In the meantime, it is clear that the sanctuaries will, for the foreseeable future, remain dependent upon donors for ongoing financing.

2. Institutional matters

A number of macro-level and governance issues were identified during the course of this review. These relate to the protected area network as a whole, and the national governance framework.

2.1 The protected area network

The PA network in Cambodia is enormous in relation to the size of the country (20% of the country). It is most unlikely that a poor country such as Cambodia can “afford” to protect and conserve a network of this size using conventional measures. (This is not to suggest that the retention of these PAs is not justified on economic—in the widest interpretation of this term—grounds. The point is that the funds needed to finance essential management activities are not available.) If this is the case, then it is essential that conservation efforts in Cambodia are subject to a national-level planning and coordination effort. Unless this is in place there will be competition between NGOs, and even between the NGOs and GoC, for the same funding resources. It is also distinctly possible, if not probable, that some of the available resources will be directed to activities and areas which are low in priority. These two factors will in turn inevitably lead to a situation where high priority areas and activities are not funded.

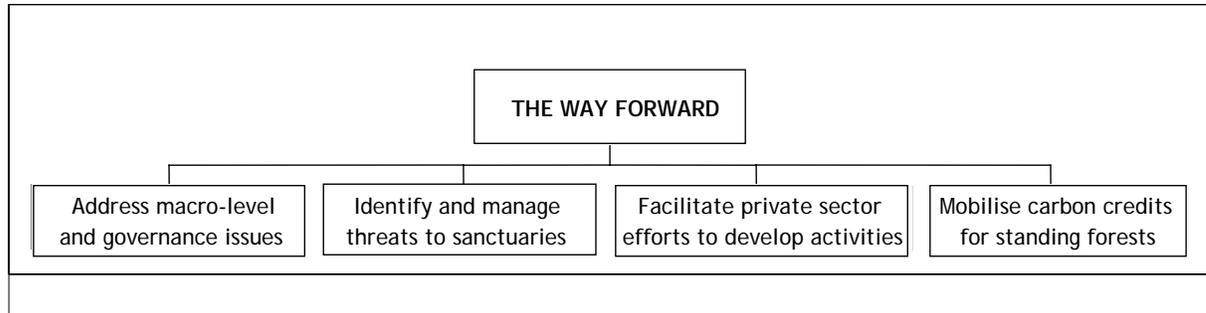
2.2 Governance framework

During the compilation of material for this report, it was clear that there a number of weakness or anomalies in the governance framework for management of PAs in Cambodia. These are primarily reflected in a lack of transparency and accountability in the network. Some of this will be a function of the lack of coordination and priority-setting referred to above. However, there are additional matters — such as the number of illegal activities underway in Pas (Global Witness,2006), as well as the lack of information on GoC funding of PAs, and where this funding has been used/spent.

Until these larger issues have been resolved it will be difficult, if not impossible, to address more micro-level matters such as the financing of individual PAs. In addition, these weaknesses will preclude some efforts to secure donor funding. Finally, it should also be noted that any initiatives to mobilise credits for carbon stored in standing forests will be contingent upon stringent governance and accountability requirements.

3. The way forward

In view of the findings of this report, it is suggested that future efforts be concentrated in four parallel ‘streams’ of activity:



Stream 1: Address macro-level and governance issues.

The first of these streams requires attending to and resolving the macro-level issues of governance and accountability, and national-level planning and coordination. This latter requirement will involve the development of suitable institutions including (but not limited to):

- Developing a suitable vehicle/s for communication and coordination of the activities of the various GoC and NGO agencies involved in conservation and PA management in Cambodia.
- Developing a national conservation strategy that will serve as the basis for priority identification and priority-setting in the sector. Once this has been done, it will be possible to direct the use of available resources and the activities of the many players more effectively.

Stream 2: Identify and manage threats to the sanctuaries.

This review has identified a number of serious threats to the future integrity of certain protected areas. These include illegal activities such as logging, but also further threats such as unregulated mining and plans to create hydro-electric dams. These threats will have to be monitored and remedial action taken, where this is needed, otherwise the integrity of the PAs might be compromised.

The second stream of activity therefore entails taking the necessary measures to identify, manage, and (if possible) thwart any existing and future threats to the integrity of the PAs. To a certain extent, this will flow logically from the strategic and coordination activities referred to in ‘Stream 1’, above.

Stream 3: Facilitate private sector efforts to develop appropriate economic activities.

Thirdly, PA managers should continue to facilitate efforts by other players — primarily the private sector — to develop appropriate economic activities in the PAs. Going

forward, the private sector should maintain a watching brief in case some of the financing options identified in this study become viable.

Stream 4: Mobilise carbon credits for standing forests.

Finally, the fourth stream of activity requires that GoC and the conservation community engage in the rapidly developing global initiatives to mobilise credits for carbon stored in standing forests and prevent further deforestation. These initiatives are believed to hold considerable potential to contribute to future financing of the sanctuaries and other similar areas. Until recently, this was only believed to be a distant prospect. However, interest is now rapidly escalating at a global level, and it is possible that this will become viable before the presently scheduled 2012 renewal or revision of the Kyoto Protocol. In particular, the funding presently being mobilised for pilot projects might contribute to sanctuary financing earlier than might once have been expected.

To the extent that further funding is available for continuation of this review process, this can most productively be used for efforts to further develop this important opportunity.

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**International Institute for
Environment and Development**
3 Endsleigh Street
London
WC1H 0DD, UK

Tel: +44 (0)20 7388 2117
Fax: +44 (0)20 7388 2826
E-mail: environ.econ@iied.org
Internet: <http://www.iied.org>

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