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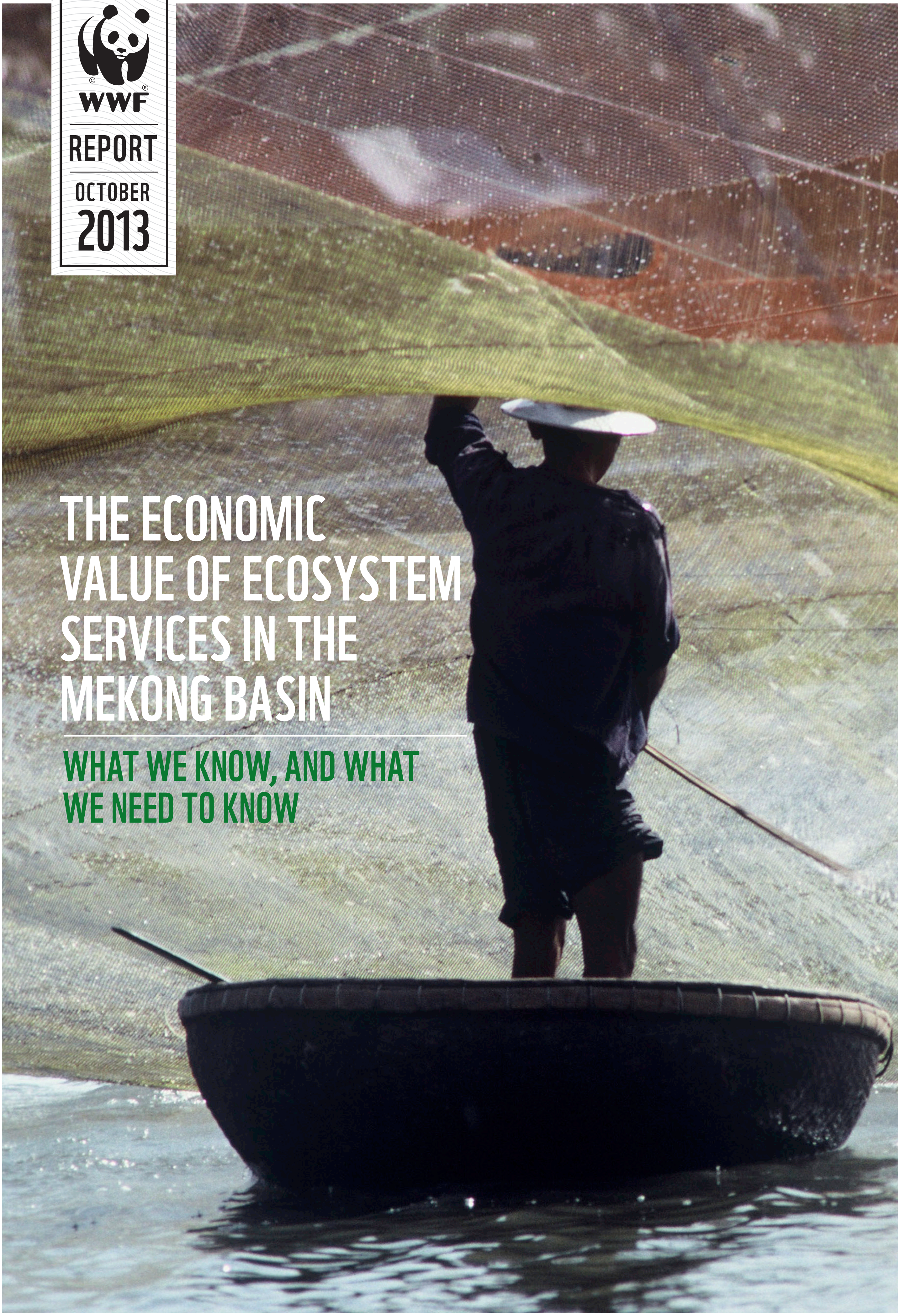

THE ECONOMIC VALUE OF ECOSYSTEM SERVICES IN THE MEKONG BASIN

WHAT WE KNOW, AND WHAT WE NEED TO KNOW

WWF is one of the world's largest and most experienced independent conservation organizations, with over 5 million supporters and a global network active in more than 100 countries.

WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

Report prepared for WWF-Greater Mekong by Ms. Lucy Emerton.

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List of abbreviations

CDM	Clean Development Mechanism
DFID	Department for International Development (UK)
FAO	United Nations Food and Agriculture Organization
FCPF	Forest Carbon Partnership Facility
FFI	Fauna and Flora International
GEF	Global Environment Facility
GIS	Geographic information system
MA	Millennium Ecosystem Assessment
NPV	Net present value
PA	Protected area
PES	Payments for ecosystem services
REDD	Reducing emissions from deforestation and forest degradation
TEV	Total economic value
UNDP	United Nations Development Programme
WCS	Wildlife Conservation Society
WHO	World Health Organization

KEY FINDINGS AND MESSAGES

In green economies, natural capital is incorporated into measurement of societal progress and equity, and recognized and managed as a fundamental pillar of economic and human well-being. The Lower Mekong region must demonstrate success in living up to commitments to maintain ecosystem integrity before claims to having ‘greened’ growth can be made. A first step in making this commitment is ensuring that there is adequate information available on the socioeconomic importance of ecosystems and the services they provide. Ecosystem services valuation is a basic component of the evidence base for decisions to invest or divest in maintaining natural systems.

1. There is a lack of information on almost all ecosystem values in the region, including most ecosystem types and categories of ecosystem services. At the very least, efforts should be made to generate new primary data on the key values, particularly supporting and provisioning services, for representative ecosystems in the region. A major gap also exists in terms of linking ecosystem and economic scenario modelling to a thorough analysis of the drivers of ecosystem change in the region. Investment is required in generating more information on the economic value of ecosystem services in order to implement effectively the national green growth strategies and policies under development in the Lower Mekong countries.

2. Although primary data and figures are needed, filling these information gaps requires more than just numbers. To carry out a credible scenario modelling exercise and associated economic analysis also demands a much broader-based dialogue with key stakeholders and experts in the region. Only through this wider consultation and input can realistic scenarios of future development, conservation and ecosystem trends be built up. Most ecosystem valuation estimates have a weak scientific basis, and the assumptions they make about the links between ecosystem status and ecosystem services are largely unsourced. The scientific and biophysical data required for both ecosystem valuation and scenario modelling needs to be identified, extracted and made available in a form that can be integrated into economic modelling and datasets.

3. The use of “off the shelf” ecosystem valuation analytical tools is not recommended. Simple, tailor-made models may be most appropriate for future work on ecosystem valuation in the Lower Mekong region.

4. Natural capital valuation is an excellent tool for policymakers in green growth planning and realisation but the dots must be joined between policy “problems”, real decision-making processes and valuation approaches in the Lower Mekong countries. Information on the economic value of ecosystem services has little relevance if it is not being communicated effectively to decision-makers, in a form that is practical, relevant and credible to them. Policy-makers must demand the information; and practitioners must be open to engage in a dialogue with end users of valuation data in order to design and produce valuation studies at the scale of decision-making and in the context of particular policy issues.

INTRODUCTION

As part of its conservation strategy for the region, the WWF-Greater Mekong Programme is building green economies and climate change resilience through integrated conservation and economic development planning and implementation. Maintaining and enhancing intact ecosystems will bring considerable benefits to the region's economic resilience.

Information on the economic value of the region's ecosystems is key to achieving these aims. Integrating these values into conservation and development indicators, planning and policies makes the benefits that ecosystems generate (ecosystem services) visible in these governance processes. This helps make a strong economic case for taking action to maintain ecosystems. To these ends, this technical study is a synthesis of the value of the region's main ecosystem services (including quantitative estimates at landscape, national and regional scales) developed to support integrated conservation and development planning in the Lower Mekong Subregion. A companion non-technical summary is also available.

This technical study[1] covers the major ecosystem services in the Lower Mekong, expressed for each of five key conservation landscapes (selected from WWF's Greater Mekong priority landscapes[2]) and four countries (Cambodia, Laos, Thailand and Vietnam), and at the regional scale (though excluding Myanmar in this edition[3]). It intends to:

- Compile, review and synthesize key statistics, messages and insights on ecosystem values from existing data;
- Develop scenarios that capture two plausible development pathways for the region;
- Describe and contrast in general quantitative terms the costs and value of achieving each scenario over a 15-40 year time horizon;
- Identify and summarise key information needs which if filled would help develop a more persuasive economic argument for the need to maintain ecosystem services;
- Evaluate and compare the range of existing ecosystem service valuation frameworks, models, and tools (and required data needs for each); and
- Recommend next steps to further improve valuation of ecosystem services in the region.

This is an ambitious study. Based only on pre-existing data and information, it represents a first attempt to value and model the region's changing ecosystem services as observed by WWF. The figures presented in this report should be understood within these limitations.

Overview

Following this introduction, the report is organized into five parts:

- **Part I on "modelling ecosystem services change"** sets out the method used in this study, detailing the structure of the model as well as key assumptions and study limitations.
- **Part II on "ecosystem values"** reviews existing literature in order to document information on ecosystem values in the Lower Mekong region.
- **Part III on "modelling the future"** describes two potential future ecosystem management and use pathways, quantifies in monetary terms the main costs of achieving them, analyses the distribution of costs and benefits, and elaborates the potential economic gains from collaborative management of ecosystems and the maintenance of key ecosystem services.
- **Part IV on "advancing ecosystem valuation"** details ecosystem valuation frameworks and tools, identifies information needs and gaps, and recommends next steps for furthering ecosystem valuation work in the region.
- The **Data Annex** presents a list of literature referred to in the report, data tables with detailed information on ecosystem costs and benefits, details of how to apply ecosystem valuation techniques, and the terms of reference for the study.

[1] The terms of reference for the study are included as an annex to this report (Annex 3).
[2] Central Annamites, Southern Annamites, Eastern Plains, Kratie to Siphandone River, and Mekong Delta.
[3] At the time this study was conducted, little information is available on ecosystems and their economic values in Myanmar. We plan to release an updated edition of this study in 2015 which will include information for Myanmar, as well as stakeholder-prescribed scenarios for changing ecosystems in the Lower Mekong countries.

What are ecosystem services?

The last decades have seen a change in the way that ecosystems are conceptualized. In particular, the publication of the Millennium Ecosystem Assessment (MA) spurred a much greater awareness of the links between ecosystem services and human well-being. And with the global dialogue on green economy over recent years, there is an increasing emphasis on the development, livelihood and human well-being outcomes of ecosystem conservation. According to the MA framework, there are four basic categories of ecosystem services: provisioning, regulating, cultural and supporting services (MA 2005). Together these generate inputs to primary productivity, vital life support services and economic production that are critical to human well-being and to the functioning of the economy.

A framework for valuing ecosystem services

It is now commonplace for conservation planners and policy-makers to conceptualize ecosystem services in the terms provided by the MA. And with this, there has been a greater demand for information on the economic value of ecosystems.

Ecosystem services are regularly taken for granted since they are delivered through the natural functions of healthy ecosystems. They are often free to access and use, without ready-made "costs" or "benefits" to describe the impact of their loss or maintenance to incorporate into the typically monetary-based decision-making tools used by government and private companies. As such, the returns on investment in maintaining or improving natural (and social) capital are not always easy to measure or materialize over longer-term horizons and across populations.[4] Nature's "economic invisibility" means that investments in maintaining biodiversity, for example, will consistently appear less worthwhile for society than, say, expanding unsustainable agricultural land use[5]. This explains in part why natural capital degradation occurs. Those causing the degradation typically do not pay the full price of their actions; and those "supplying" biodiversity and ecosystem services are often not rewarded for doing so.[6]

Valuation of the public and private goods and services delivered by ecosystems is necessary if we are to understand what is lost through inappropriate development choices, such as increasing loss of forest cover in vital watersheds, and what can be gained from pursuing development pathways that are more sensitive to maintaining natural capital. Similarly, it enhances our understanding of the opportunity cost of biodiversity conservation; that is, the potential losses incurred through choosing to conserve our natural capital through, for example, protected areas or hunting bans. In cases where land development makes sense, it helps us understand what essential ecosystem functioning needs to be kept to avoid undermining the fundamental flow of services benefiting local and other populations.[7]

There are three aspects to looking at the economic value of ecosystems:

- **Ecosystems as assets** – a stock of natural capital[8], which, if conserved and managed sustainably, *yields a:*
- **Flow of economically valuable goods and services** – the return on investments in conservation, *which in turn contributes towards:*
- **Positive economic and human well-being outcomes** – the measures and indicators which are used to judge progress in economic growth and human development.

Perhaps the clearest and most useful way to trace the relationships between ecosystem services, economic values and human well-being outcomes is to combine two frameworks. The first is total economic value (TEV), which is commonly applied by economists. The second is the ecosystem services-human well-being framework presented in the MA, which is widely used by conservation planners and decision-makers. This framework has been adopted by The Economics of Ecosystems and Biodiversity (TEEB), a global initiative that sets out the case for natural capital valuation, continues the discussion on ecosystem service classification begun by the MA and synthesizes various methods and case studies from the academic disciplines of ecological and environmental economics; TEEB recommends using TEV in valuing the economic contribution of ecosystems.[9]

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[4] With no dollar figure attached, outcomes from conserving natural capital are rarely captured in markets, and are more often considered *positive externalities.* Similarly, the costs of *negative externalities* from pollution or land conversion degrading biodiversity are unpriced and/or uncompensated.

[5] This situation is termed *market failure* – where a lack of price signals for uncompensated, harmful impacts on natural capital endowments (*negative externalities)* or for good but unrewarded outcomes from maintaining biodiversity and ecosystem services (*positive externalities*) means that resources are allocated inefficiently by the 'market'.

[6] Baumol, W.J. and Oates, W. 1988, *The Theory of Environmental Policy.* Cambridge Press, New York, USA.

[7] See Atkinson, G., Bateman, I. and S. Mourato. 2012, Recent advances in the valuation of ecosystem services and biodiversity. *Oxford Review of Economic Policy* 28(1): 22-47.

[8] See Box 1 for a definition of this term.

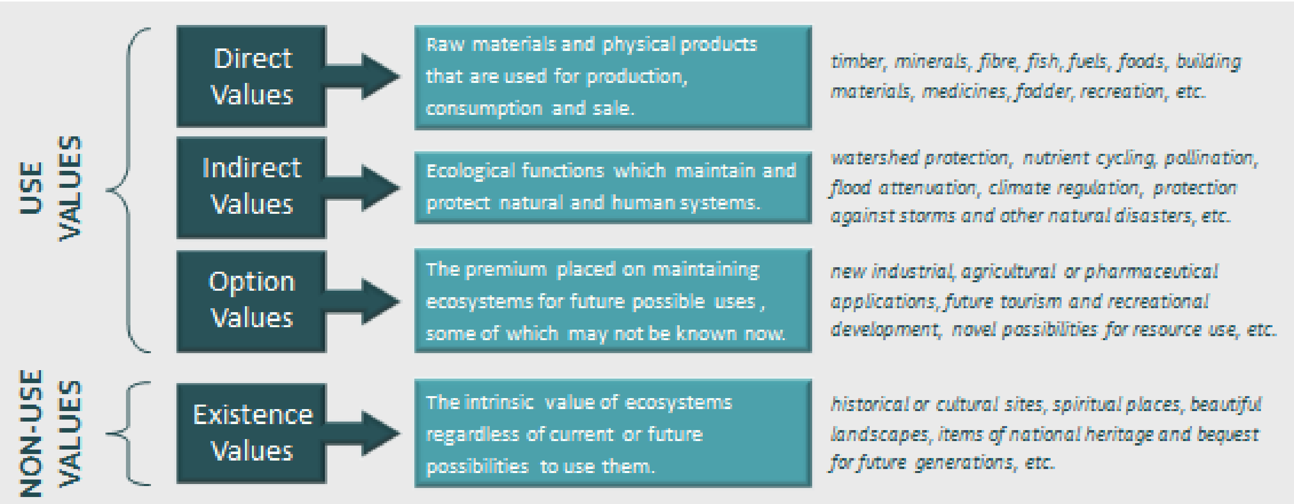
[9] Kumar, P. 2010. *The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundation*. UNEP/Earthprint, London, UK.

Since it was developed in the late 1980s and early 1990s (Barbier 1989, Pearce and Turner 1990), TEV has become the standard and most widely applied framework used by economists to categorize ecosystem values.[10] The major innovation of TEV is that it extends beyond the marketed and priced commodities to which economists have conventionally limited their analysis, and considers the full gamut of economically important goods and services associated with ecosystems. Although it is no easy matter to quantify these values, as prices and markets do not exist for many ecosystem services, economists have developed a range of methods for expressing them in monetary terms.[11]

Looking at the TEV of Lower Mekong ecosystems involves considering their complete range of characteristics as integrated systems – resource stocks, flows of services, and the attributes of the ecosystem as a whole, including (Figure 1):

- **Direct values**: the raw materials and physical products that are used directly for production, consumption and sale such as those providing income, energy, shelter, foods, medicines and recreational facilities.
- **Indirect values**: the ecological functions that maintain and protect natural and human systems through services such as maintenance of water quality and flow, flood control, microclimate stabilization and carbon sequestration.
- **Option values**: the premium placed on maintaining a pool of species and genetic resources for future possible uses, some of which may not be known now, such as leisure, commercial, industrial, agricultural and pharmaceutical applications and water-based developments.
- **Existence values**: the intrinsic value of ecosystems and their component parts, regardless of their current or future use possibilities, such as cultural, aesthetic, heritage and bequest significance.

Figure 1: total economic value (TEV) of ecosystems

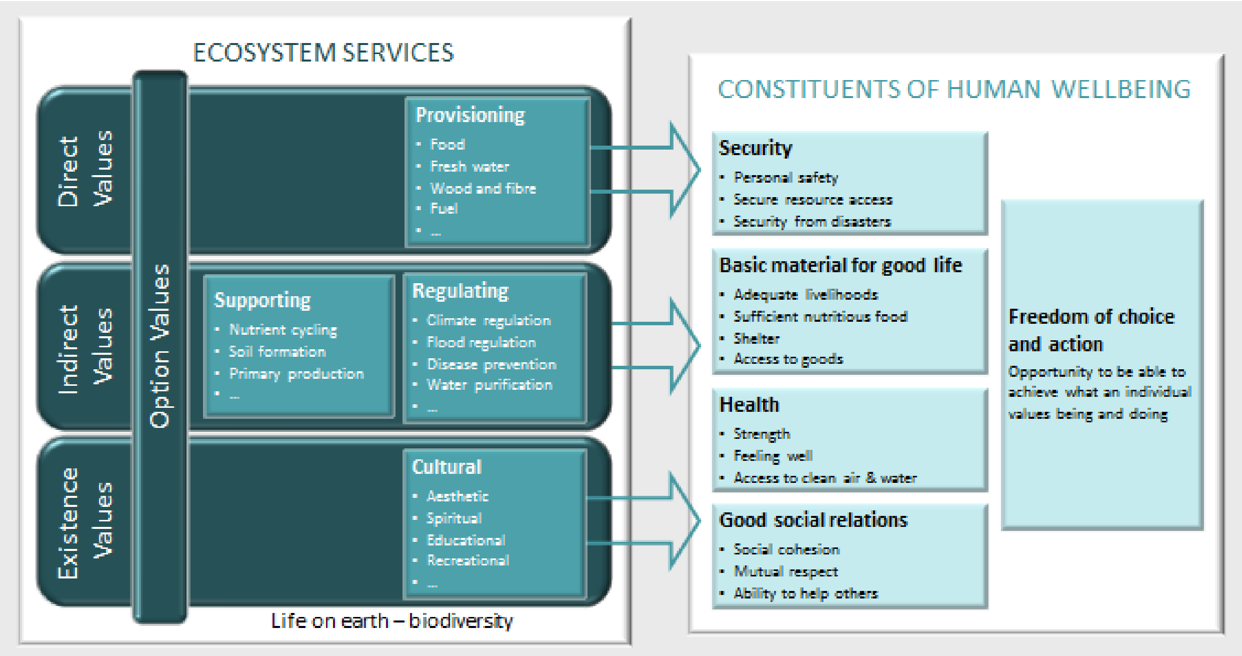


From Emerton 2006a

Each of the categories of TEV corresponds to a different component of the MA ecosystem service framework: direct values to provisioning services, indirect values to supporting and regulating services, existence values to cultural services, and option values potentially cross-cutting all four categories. The two overlapping frameworks, within which the ecosystem values of the Lower Mekong region are categorized in this report, are illustrated in Figure 2.

[10] See TEEB. 2008.
[11] Annex Chapter 2 presents further details on the requirements for applying these.

Figure 2: ecosystem services and economic values



From Emerton 2006a

The policy context for ecosystem services valuation in the Lower Mekong countries

With the exception of Thailand, countries in the Lower Mekong are emerging from a process of economic transition and transformation. They are showing a gradual shift from subsistence farming to diversified production bases, and from centrally planned economies to more open, market-based systems. Signs of pressure and stress on the region's natural capital have long been apparent alongside these rapid rates of economic growth and market development, resulting in an emerging trend of ecosystem loss in this region.

A report released in 2011 by the UN Economic and Social Commission for Asia and the Pacific (UNESCAP), the UN Environment Programme (UNEP) and the Asian Development Bank (ADB) finds that the Asia-Pacific region currently accounts for more than half of the world's total resource use. A WWF report released in 2013 indicates that escalating land, resource and infrastructure demands, combined with a rapidly growing human population and increasing integration into regional and global markets, mean that biodiversity and ecosystem services in the Lower Mekong are on a pathway of gradual decline and degradation. At the same time, climate change is affecting regional ecological productivity in ways that may encourage even greater pressures on the natural system and cause progressively greater stresses to human and economic systems.

The countries of the Lower Mekong have recognized the pressure human footprint puts on natural resource stocks: at the Greater Mekong Subregion (GMS) Environment Ministers Meeting in July 2011, they announced their regional vision of a "poverty free and ecologically rich GMS" to be achieved through "a green, inclusive and balanced economy".[12] In December 2011, the countries endorsed a new ten-year strategic framework to further enable the transition to a green economy. Most recently, during the GMS 2020 Conference on Balancing Economic Growth and Environmental Sustainability held in 2012, policy-makers from all six countries, as well as development partners, explicitly considered the issue of how best to bring about a balanced convergence between economic growth and environmental sustainability.

In green economies, natural capital is incorporated into measurement of societal progress and equity, and recognized and managed as a fundamental pillar of economic and human well-being. The maintenance, enhancement or restoration of natural capital is supported by legal and institutional infrastructure and measures. Financial flows encourage a strong business case for sustainable, responsible businesses to thrive and divest from activities that threaten natural capital.

[12] The Greater Mekong Subregion is an Asian Development Bank designation for the Lower Mekong countries of Cambodia, Myanmar, Laos, Thailand, Vietnam and two provinces of the People's Republic of China, specifically Yunnan Province and Guangxi Zhuang Autonomous Region. It is an important platform for regional decision-making on infrastructure development and transboundary environmental management, among other points of regional cooperation.

Ecosystem services valuation is a basic component of the information required to incorporate natural systems into economic decision-making, enabling green growth and development.

Already, in 2013, there are encouraging signs that good intentions on greening Lower Mekong economies are slowly being put into practice in national frameworks.[13] Wording is in place in many national development plans and is set to trickle down into the core functions of government, sectoral greening policies and initiatives. Knowledge on ecosystem services is starting to be incorporated into decision-making, economic decision-making in particular. Yet policy and legal frameworks in the region still for the most part present an unsupportive environment for producers, consumers and investors to factor biodiversity and ecosystem services into their choices. Large-scale subsidies in the agricultural, fisheries, energy, industrial and water sectors still encourage the over-exploitation and destructive use of land and resources. At the same time, products and markets which are based on the conservation and sustainable use of biodiversity and ecosystems tend not to receive this type of preferential treatment: they are accorded a lower economic policy priority, and face relatively less spending on research and development, higher tax rates, and greater difficulties in accessing credit and investment funds. The bottom line is that, for many sectors, businesses and households in Lower Mekong countries, it is more costly to act in an environmentally sustainable manner than not. As a result, most are unwilling – and many simply cannot afford – to realise green economies in practice.

As such, the fundamental challenge is to tackle the discrepancy between unsustainable short-term economic gains and long-term returns on sustainable investments. This can be achieved through establishing incentives that make sustainable investments competitive. A critical approach by government, along with conservation partners such as WWF, must be to structure economic incentives and related policies in ways that encourage good stewardship of the resource base. Removing perverse incentives and instituting positive ones, such as encouraging the sustainable use of ecosystem services through a range of policy, price and market mechanisms, should be integrated into government structures and private sector practices and norms. What is missing, however, is good information for:

- Mapping the supply and demand of natural capital stocks and ecosystem service flows, and assessing the extent to which their threatened status affects the economies of the region;
- Qualitative assessment of the contribution of these services to human well-being;
- Quantitative and monetary assessment of the contribution of these services to human well-being. The ability to measure the true impacts of further biodiversity losses or returns on investment in conservation will aid in policy decision-making and policy design for greening economies.

Box 1: definitions and explanations of key terms

Biodiversity: The variability among living organisms from all sources including, among others, terrestrial, marine and other aquatic ecosystems, and the ecological complexes of which they are a part. This includes diversity within species, between species, and of ecosystems. For the sake of this report, we focus on "wild" biodiversity over "agricultural" biodiversity, which is more often considered in national economies and decision-making than "wild' biodiversity.

Clean Development Mechanism: A mechanism from the Kyoto Protocol that allows industrialized countries to buy and trade in emissions reduction credits from certified projects.

Ecosystem: A dynamic complex of plant, animal and microorganism communities and their non-living environment interacting as a functional unit.

Ecosystem services: The benefits that people obtain from ecosystems. Although *goods*, *services* and *cultural services* are often treated separately for ease of understanding, the Millennium Ecosystem Assessment considers all these benefits together as "ecosystem services".

Natural capital: A society's living and non-living natural resources. Natural capital resources can be renewable (e.g. living species, biodiverse ecosystems, potable water, fertile soils), non-renewable (e.g. petroleum, minerals) or cultivated (e.g. crops and forest plantations). These resources comprise the *stocks* of environmental goods and services that *flow* to economic production.

[13] As of June 2013, Vietnam and Cambodia have completed a roadmap and national strategy on green growth. Laos is currently beginning the process with the assistance of UNESCAP. Thailand and China have instituted some advanced legislation though they have opted not to produce a green growth or economy framework per se.

Non-timber forest products: Commodities obtained from forests that do not necessitate harvesting trees. Examples include food and medicinal plants, fruits, seeds, ferns, game animals, mushrooms, resins and oils.

Opportunity cost: A benefit, profit, or value of something that must be given up to acquire or achieve something else.

Protected area: "A clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values" (IUCN definition). Examples include national parks, wildlife sanctuaries and marine protected areas.

REDD/REDD+: An international mechanism that aims to make tropical forests more valuable standing than cut down by providing financial incentives to developing countries to maintain their forests. REDD stands for reducing emissions from deforestation and forest degradation, while the "plus" takes account of other aspects such as enhancing carbon stocks, protecting biodiversity and promoting sustainable local livelihoods.

Valuation: The process of expressing a value for a particular good or service in a certain context (e.g. of decision-making), usually in terms of something that can be counted. Values are often monetary, but can also be expressed through methods and measures from other disciplines (sociology, ecology, etc.)

Well-being: Human well-being has multiple constituents, including the basic materials for a good life, health, good social relations, and freedom of choice and action. Together these factors provide the conditions for physical, social, psychological and spiritual fulfillment. The conceptual framework for the Millennium Ecosystem Assessment posits that because people are integral parts of ecosystems, changes in human conditions are one factor that drives changes in ecosystems and thereby causes changes in human well-being.

Sources: UNCCD; CBD; Millennium Ecosystem Assessment, 2003; Millennium Ecosystem Assessment, 2005; Hassan, Scholes and Ash, 2005; Kumar, 2010.

The contribution of this report

Discussion and data synthesis on economic valuation of the Lower Mekong's ecosystem services is urgently needed. This report is WWF's contribution.

This study is concerned primarily with articulating the monetary value of ecosystem service flows and the costs and benefits of conservation investments; we are essentially concerned with the value of the Lower Mekong's natural ecosystems to local, national, regional and even international economies. It does not deal with the value of ecosystems as a stock of natural capital, except to infer the economic wisdom of investing in conservation of natural capital stocks so as to maintain the supply of economically valuable services. The value of ecosystem services as manifested through various economic and development indicators is touched upon only peripherally.

WWF has produced this report as a starting point for dialogue. Key questions include how stakeholders think ecosystems are likely to change in the Lower Mekong, and what future ecosystem services must be guaranteed if Lower Mekong countries are to achieve the economic growth and social development goals set out in their green growth strategies and policies.

PART I: MODELLING ECOSYSTEM SERVICES CHANGE IN THE LOWER MEKONG

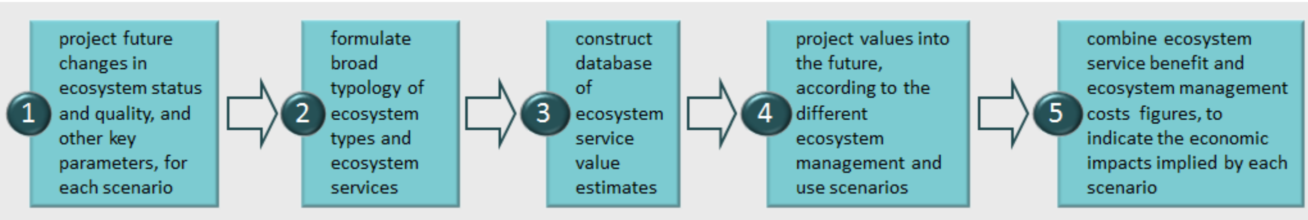
This technical report presents very simplified and generalized models of how the use of land and resources, and the area and quality of ecosystems, could change between 2010 and 2035 in the Lower Mekong according to two scenarios. **Business as Usual (BAU)** assumes current trends continue. **Green Economic Growth (GEG)** is based on successful implementation of the green growth goals currently being elaborated by the governments of the Lower Mekong countries.

A brief overview of the model structure: which ecosystems?

Four broad categories of ecosystem were chosen as the focus of this report: forests, freshwater wetlands, mangroves and coral reefs. This study takes an ecosystem area-based approach that sets a baseline for the physical coverage of forest, freshwater, mangroves and coral reefs in 2010 – and then describes scenarios for the change in that coverage and the implications this will have for the value of services those ecosystems deliver by 2035

How the value of ecosystem management and use scenarios is modelled in this report

Figure 3: steps in the analysis



Valuation of the ecosystem management and use scenarios follows a number of iterative steps (summarised in Figure 3). The following form core elements of the analysis:

1. First, it is necessary to project the future changes in ecosystem status and quality that would occur under each scenario, as well as to model their other parameters and key variables. This is described in Part III, Chapter I, on the likely future ecosystem management and use scenarios. Changes in the area under different ecosystems are related to gains, losses and trade-offs in the provision of key ecosystem services.
2. Next, a **broad typology of ecosystem types and ecosystem services** is formulated. This identifies the services generated by forest, freshwater wetland, mangrove and costal ecosystems, and identifies the key services selected for valuation.

Ideally this would be based on a thorough scientific assessment; this, however, lay outside the scope of the current study. The identification of services for further valuation was determined primarily by those for which data were available. Where key services lacked data, additional information from outside the region was sought (gap-filling is discussed below, but it should be noted that key gaps in ecosystem service values still remain).

3. A **database of ecosystem service value estimates** is built up. This is based on a comprehensive meta-analysis of the ecosystem valuation studies that have been carried out in the Lower Mekong region.

Only some of these estimates were used. Several were excluded because they could not be translated into US$/ha/year values, because the credibility of their underlying approach was questionable, or because they were not considered to be representative of broader values in the region. For the remaining estimates, mean values were taken, and used for the current analysis (this is described more fully in Part II, Chapter 1 on the value of ecosystem services).

4. These values are projected into the future, according to the two scenarios described in step 1.

Because the analysis of the region's ecosystems does not include each and every ecosystem service and their values – for which the data is limited in any case – the baseline estimate for the current contribution of ecosystem services generated in this study must be considered as only an approximate figure. As a result, and in line with best practice for economic valuation of ecosystem services, the focus of this study is more correctly on the marginal value of change under different scenarios of ecosystem management regimes over a 25-year time frame. This approach gives us a net value added – or net cost avoided – that can be ascribed to different future policy scenarios until 2035. Costs and benefits are provided for each year, and for the entire 25-year period analysis, as a net present value (NPV). In order to do this, a number of working assumptions were made. These are elaborated below.

5. Ecosystem service benefit figures are combined with those indicating the costs of ecosystem management, so as to look at the **economic impacts implied by each scenario**.

Values are calculated and expressed for key landscapes, for each of Cambodia, Laos, Thailand and Vietnam, and at the aggregated Lower Mekong regional level. This analysis looks at the *incremental* net benefit or cost implied by a GEG scenario as compared to a continuation of the status quo under BAU.

Ecosystem service variables

The analysis focuses on specific ecosystem services within each ecosystem. The aim is not to be comprehensive but to choose:

a) the services of most importance;
b) services for which information is available; and
c) services for which real revenues can be attributed, in order to focus on economic gains on the ground.

Table 1: list of ecosystem service variables included in this analysis

Variables
Forests
Local use of non-timber products
Sustainable timber
Watershed protection
Carbon sequestration
Freshwater wetlands
Local use of aquatic products
Water quality and flow services
Mangroves
Local use of aquatic products
Coastal protection
Tourism and recreation
Carbon sequestration
Support to offshore fisheries
Coral reefs
Tourism
On-site fisheries
Coastal protection

Data sources

No primary data was collected, and the analysis relied entirely on secondary information sources. This data come from many sources, and is not all reliable. The sometimes doubtful quality and accuracy of the data used and generated acts as a severe constraint. Estimates of ecosystem values in Lower Mekong countries vary widely, and many are vague and approximate. The coverage of existing studies is patchy and incomplete, and it cannot always be guaranteed that the estimates are wholly credible. With few exceptions, the figures presented in the literature are based on some form of extrapolation, many assumptions, and often unreliable or incomplete data. Unfortunately, and as has been pointed out by various other authors, it is a characteristic of many ecosystem valuation studies that data sources are not provided or, where sources are shown, they are "guesstimates" or "back-of-the envelope" calculations of questionable scientific veracity. Due to the large number of hypotheses and assumptions required to carry out this study, all data sources are fully referenced and all major assumptions are carefully explained throughout the text. It is to be hoped that as better and more accurate information becomes available, these figures can be updated and improved. We hope to carry out a more detailed and better-informed exercise via a future project (see Section IV on "advancing ecosystem valuation").

Key assumptions

Assumption 1: A 25-year time period was used for analysis. This was considered the maximum length of time that it was possible to incorporate, given the quality and scope of the information available.

Assumption 2: A linear relationship is assumed between changes in ecosystem status, ecosystem service provision and economic values. The values were approximated by applying per-hectare values of key ecosystem services to the area under different ecosystem types.

As has been mentioned above, the exact biophysical relationships between changes in ecosystem status, ecosystem service provision and economic values is unknown. In the scenario analysis, per-hectare values of key ecosystem services are modified by indexes which indicate the changes in ecosystem area, quality of ecosystem services provided, proportion of ecosystem yielding values, and levels of use under BAU and GEG. Changes in these variables and indexes are based on data provided by WWF-Greater Mekong.

Values are expressed per year, in US dollars (US$) at 2010 rates, and as NPVs over the entire period of analysis. A **discount rate** of 10 per cent has been applied to future costs and benefits. This reflects the prevailing opportunity cost of capital in Lower Mekong countries. It should however be noted that discounting environmental costs and benefits remains the focus of much debate. A high discount rate reflects a strong preference for present consumption, and a low discount rate reflects longer-term considerations and preferences. Some economists have argued that, because environmental costs tend to be short-term while environmental benefits tend to accrue far into the future, they should be subject to a low or zero discount rate. Others contend that if environmental costs and benefits are to be treated alongside other sectors of the economy, and in the same terms, then they should be subjected to the same discount rate. The latter approach is used in the current study and as such this report may undervalue, or at least conservatively estimate ecosystem service values in the Mekong region.

Assumption 3: The real value of ecosystem services does not change over time. In reality, this may not be the case. As tastes and demands change, and as particular services become more scarce, both the real and relative values of ecosystem services may change in the future. For example, the real price of certain commodities may change, or increasing urban and industrial water demands may mean an increased premium on watershed protection services. Similarly, the growing problems associated with climate change and uncertainty coupled with intensifying coastal development may increase substantially the coastal protection value of mangroves and coral reefs.

Assumption 4: Funding to conservation. Other funding, beyond public budgets, is assumed to be available for ecosystem conservation inside and outside protected areas (PAs) in both scenarios.

Assumption 5: Key outcomes of implementation of green growth planning in Lower Mekong countries are articulated under the GEG scenario, namely:

1. Primary forest area, mangrove area, freshwater wetland area and coral reef area is assumed to decline at half the projected rate for BAU, and then stabilize.
2. Changes in terrestrial PAs and in marine PAs is assumed to occur over 10 years and then stabilize.
3. Green economy policy action is assumed to increase public funding to PAs by 25 per cent in each country over a five-year timeframe, and then increase in real terms by 2.5 per cent a year thereafter.
4. Green economy policy action is assumed to increase funding to ecosystem conservation inside and outside PAs to 25 per cent of public funding to PAs in Cambodia, Laos and Vietnam, and 5 per cent in Thailand over a period of five years[14], and then increase by 5 per cent a year thereafter.

Assumption 6: No reduction in consumption levels for either BAU or GEG. Within the 25-year time period of the analysis, it is assumed that current use values can be sustained (in other words there is no decline, overall, in the absolute levels of use in a country), and that use levels increase progressively due to the rising demands of a growing human population. There is simply not the available information on the sustainability of local-level resource use to project when or where thresholds of sustainable use may be exceeded. Although there may be the local exhaustion of particular stocks of biological resources, this is compensated by use shifting to other locations or products.

[14] Relatively speaking, PA funding in Thailand is already high compared to the other countries. For this reason, a lower rate of increase is assumed for public funding allocated to protected area management in this country.

Assumption 7: In estimating the cost of achieving the GEG scenario, payments for ecosystem services and other funding based on capturing the value of ecosystem services are not treated as costs in the analysis. This is because they are not a net cost to society, but rather are transfer payments between groups. To include them in the analysis as costs would result in double counting, unless they were also deducted from the figures from ecosystem service values. They are, however, indicated in summary tables, for purposes of comparison and because they are an important component of the broader conditions that enable a particular ecosystem conservation status to be maintained.

Assumption 8: Direct public costs of PA management are used to give average costs. These are the only costs for which reliable country-level estimates are available, incorporating all ecosystem types and PA management categories. Ecosystem management costs are presented as US$/ha/year figures for each scenario. Because of the variation between funding to individual PAs, they have been calculated by dividing total public spending between the total area of PAs in each country.

Study issues and limitations

Limitation 1: No consideration of non-linear impacts or ecosystem thresholds. As interesting as the aggregate numbers presented in this report are, such figures inevitably mask some important elements of ecosystem service values, and oversimplify the complex dynamics and relationships at play when looking at the impacts of ecosystem change on ecosystem service provision and economic values. Of particular concern is the lack of information about the sustainability of current ecosystem use, and about what future levels might be supportable in different sites and for different ecosystems. Another important issue is that the calculations in this report do not account for non-linearities and threshold effects in ecosystem functioning. Ecosystems often respond to change and stress in a non-linear fashion: large changes in ecosystem size or condition may have abrupt effects on their functioning, which may not be extrapolated easily from the effect of small changes (TEEB 2008).

Limitation 2: Omission of agriculture and other natural resource uses. In terms of direct values/provisioning services, the analysis focuses on **local-level biological resource use** and largely excludes commercial agriculture, fisheries, forestry and other natural resource uses, due to a lack of reliable data. Agriculture in particular is a problematic sector. We cannot differentiate between sustainable agriculture and agriculture not conducted in accordance with best practice. As there is a significant difference in ecosystem services values delivered by the two broad approaches to agriculture practice, the margin for error is too large if this land use is included wholesale. It is recommended that this important question be considered separately.

Limitation 3: Length of study period. While a 25-year **time period** was considered the maximum length of time to incorporate with the information available, this may be too short to show the long-term implications of ecosystem change.

Limitation 4: Use of average ecosystem service values. To simplify the analysis, value estimates for indirect values/supporting and regulating services are applied to the total area of an ecosystem in a country (with the exception of watershed protection). In reality, not all areas will generate the same value of services, for two main reasons. Firstly, ecosystem quality and status varies. Secondly, the value of most supporting and regulating services is predicated on human populations directly benefiting from these services, or being directly affected by their loss. This is not always the case – for example not all coastal areas are settled and would experience increased damages from storms if mangrove ecosystems were degraded, and there are not water-dependent industries located downstream of all major forested watersheds. The estimates in this study therefore represent potential or possible values.

Limitation 5: Non-comprehensive coverage of ecosystems and ecosystem services. For direct values/provisioning services, the study does not apply value estimates to the total area of an ecosystem in a country, but only to ecosystems which are being actively utilized. Each scenario contains different assumptions about the proportion of ecosystem area that is subject to use, though both start from the same baseline.

Limitation 6: Some ecosystem service values are mutually exclusive. This is a standard consideration in ecosystem service valuation. It would not, for example, be possible to impute values for timber clear-felling, tourism and watershed catchment protection to the same area of forest. Others are **location-specific**. For instance, watershed protection values cannot be attributed to the entire area of forest in a country. This study sub-categorizes forest ecosystems into production, biodiversity protection and watershed areas. Watershed values are only applied to designated watershed forests, while commercial timber values are primarily imputed to production forests.

Limitation 7: Analysis excludes option and existence values/cultural services. These values are highly location-specific, as well as being particular to the group for whom they have been calculated. They cannot be extrapolated or transferred between sites. The quality of existing estimates is also extremely doubtful.

PART II: ECOSYSTEM VALUES IN THE LOWER MEKONG

1. What do we know about the economic value of ecosystem services in the Lower Mekong?

There is a fairly substantial, and rapidly growing, body of literature on the economic value of ecosystem services in the Lower Mekong. This chapter synthesizes available information, according to the framework proposed in the previous chapter, in order to describe and quantify in monetary terms the types of economic values associated with ecosystem services in the region. For convenience and ease of reference, the synthesis of existing information in this chapter is presented according to country, and is summarised in Table 10 in the Data Annex.

Direct values / provisioning services

Cambodia

Information on forest values can be found in a number of sources, most focusing on non-timber forest products. Hansen and Top's (2006) figures are probably the most widely cited, and are used by several other authors as the basis of their calculations (for example Grieg-Gran et al. 2008 and ADB 2010, below). Hansen and Top estimate per-hectare benefits for deciduous, semi-evergreen and evergreen forests in Cambodia, finding annual values for non-timber forest products of US$ 37, 23 and 12 respectively. They estimate sustainable timber production worth US$37 per hectare for semi-evergreen forests and US$171 for evergreen forests. Overall, they state that the total livelihood value obtained from non-timber forest products is US$280-345 per household per year.

Bann (1997a) calculates the value of non-timber forest products harvested from Tapean Forest in Ratanakiri province to be worth some US$300,691, or US$165/ha/year. ADB (2010), looking at the proposed biodiversity conservation corridor linking seven protected areas in Mondulkiri and Koh Kong provinces, estimates non-timber forest product values at US$2.7/ha. Boscolo (2004, cited in Grieg-Gran et al. 2008) presents national-level estimates of the annual local value of fuelwood, charcoal and liquid resin of US$16-26/ha or US$480-804 per household.

Various other estimates of local non-timber forest products values exist for other parts of the country. However, most are expressed in terms of income per household, not per hectare of forest. Heov et al. (2006), for example, present examples from several provinces which indicate values of US$23-29 per household per month. Grieg-Gran et al. (2008) report income from non-timber forest products of US$15-85 per household per year in communes around Phnom Aural and Phnom Samkos wildlife sanctuaries in the Cardamom Mountains in the west of Cambodia.

For freshwater wetlands, Chong (2005) presents estimates of the local livelihood value of fish, aquatic animals, water birds and building materials to the 3,000 or so households living in the Stoeng Treng Ramsar site. With an average value per household of US$3,200 a year, the total annual value of the 14,600ha wetland area is calculated at some US$9,600,000, or US$658/ha.

Data on forest and coastal ecosystem values is provided in Emerton et al. (2002a) for Preah Sihanouk (Ream) National Park. Almost all local residents depend on park resources in some way for their basic subsistence and income, to a net value of some US$1.2 million a year or US$220 for every household living in and beside the national park. Non-timber products collected from forested areas are worth just over US$190,000 or US$10/ha. Ream's mangroves yield subsistence goods worth almost US$620,000 or US$344/ha/year, while the net annual value of fisheries within the park is just over US$515,000 or US$286/ha. Bann (1997b), looking at the 63,700ha of mangroves in Koh Kong province, meanwhile estimates that local fishing benefits are worth some US$84/ha, firewood is valued at US$3.50/ha, and sustainable charcoal production US$413/ha.

Laos

Although now several years old, perhaps the most comprehensive analysis is provided by an assessment of the economic value of biodiversity, carried out as part of the National Biodiversity Strategy and Action Plan by Emerton et al. (2002b). Laos's 945,000ha of rivers, water bodies and other natural and constructed wetlands are found to provide fish and other aquatic animals worth US$101.01 million a year for household subsistence, income and small-scale trade, an average of US$106/ha. Agro-ecosystems contain indigenous varieties of crops and livestock that are worth some US$93.90 million a year to crop production and US$78.74 million for livestock production, and nature-based tourism stimulates in-country expenditure to a value of around US$58.61 million a year. It is, unfortunately, impossible to generate per hectare values for these.

The same study meanwhile finds that, across all of the recorded 11.6 million ha of forest in the country, local non-timber forest product use is worth US$159.87 million a year or US$14/ha for household subsistence and US$25.65 million or US$2.2/ha for household income (an average of US$36 per household). The domestic commercial value of non-timber forest products is US$15.25 million or US$1.3/ha, and exports are worth US$31.80 million or US$2.7/ha. Forests also yield firewood and charcoal worth US$3.77 million a year at the local level (an average of US$40 per household or US$0.3/ha) and US$0.82 million or US$0.07/ha for commercial users, and timber products to a value of US$17.05 million a year or US$1.5/ha for households and US$53.45 million or US$4.6/ha to the (legal) commercial sector.

A wide variety of other studies also looks at the economic value of forest and wetland products to household livelihood and subsistence. Rosales et al. (2003) found the annual value of non-timber forest products collected in the natural forests of Sekong province to be US$398-525 per household, or US$17-23 per hectare. ADB (2010), looking at the proposed biodiversity conservation corridor linking four protected areas in Attapeu, Champasak and Xekong provinces, estimates non-timber forest product values at US$7.1/ha/year. At a national level, Foppes and Ketphanh (2000) calculate that non-timber forest products (including aquatic resources) contribute 44 per cent of subsistence value, 55 per cent of cash income, and 46 per cent of the total household economy. In Salavan province, Clendon (2001) states that wild foods contribute up to 80 per cent of non-rice food consumption by weight, and provide an average of 4 per cent of energy intake, 40 per cent of calcium, 25 per cent of iron and 40 per cent of vitamins A and C.

Thailand

Hinsui et al. (2008) find that average cash income from non-timber forest products in one village of Chiang Mai province equates to around US$8.3/ha/year. Delang (2005) calculates the annual value of non-marketed wild edible plants collected in forests around the Thung Yai Naresuan Wildlife Sanctuary to be US$30-302 per household or US$7.26-72/ha.

Looking at the value of seasonally flooded forest in the Lower Songkhram, Khonchantet (2007) finds annual values of US$141,858 or US$4.12/ha for non-timber forest products, and US$121,912 or US$3.55/ha for fisheries. A study by Pagdee et al. (2007) addresses the economic value of freshwater wetlands in Udon Thani province. Direct resource harvests are estimated to be worth approximately US$270 per household per year, to a total gross value of US$108,000 or US$24/ha.

Studies carried out by Sathirathai and Barbier (2001) in Surat Thani province indicate that mangroves are worth some US$88/ha to the local economy, or an average of US$924 per household a year. Other estimates of the local use values associated with mangroves range between US$230/ha (Christensen, 1982) and US$1,500 (Sathirathai, 1998). Seenprachawong (2002), looking at Phang Nga Bay in Phang Nga and Krabi provinces, looks at willingness to pay to conserve the mangroves for different uses. In terms of their value for fisheries and other direct uses, he finds a total annual value of US$996,335, or US$16.5/ha to adjacent dwellers. For tour operators and tourists, the value of conserving mangroves for various recreational uses is found to be US$30.4 million, or US$504/ha.

Seenprachawong (2003) also analyses the recreational value of the 32,900ha of coral reefs found in the Phi Phi Islands. He estimates the total benefits to be US$1.47 million a year for domestic visitors and US$1.24 million for international tourists, together yielding a value of some US$82.4/ha/year.

Vietnam

Phuong and Duong (2007) find that rural households in Nghe An province gain average annual values from non-timber forest products of US$16.8 per year in subsistence use, and US$3.1-55.8 in cash income, together totalling US$20-70/ha/year. ADB (2010), looking at the proposed biodiversity conservation corridor linking seven protected areas in Quang Nam, Thua Thien Hue and Quang Tri provinces, estimates non-timber forest product values at US$4.7/ha/year.

Nama et al. (2005) assess the value of the 128ha of coral reef in Nha Trang Bay marine protected area. Recreational activities such as diving, snorkelling and boating generate values worth US$4.25 million or US$332/ha/year, including visitor consumer surplus of US$2,402,105, value added from direct expenditures of US$589,011, value added from indirect expenditures of US$642,528 and multiplier effects of US$615,528. The gross value of fisheries provided by the reef is US$1.55million/ha – or a total of US$1.99 million – per year. Tri (2000), looking at mangroves in Can Gio

Mangrove Biosphere Reserve, finds that the annual value of wood products from routine thinning is US$34,438 or US$47.5/ha, while thatch obtained from nipa palm is worth US$0.2/ha. The net benefit from the local collection of aquatic products is US$50,800 or US$2.48/ha, and trade in aquatic products is worth US$1.44/ha/year.

Indirect values / supporting and regulating services

Cambodia

Hansen and Top (2006) present figures for the value of Cambodia's forests for carbon sequestration, and soil and water protection. They suggest per-hectare annual values for deciduous forests of US$34 and US$75 respectively, for semi-evergreen forests US$40 and US$131, and for evergreen forests US$62 and US$131. For forestland in Ratanakiri, Bann (1997a) proposes that forest environmental services are worth some US$35/ha. ADB (2010), looking at the proposed biodiversity conservation corridor linking seven protected areas in Mondulkiri and Koh Kong provinces, estimates carbon storage values at US$1,743/ha/year, watershed protection at US$652/ha/year, water quality regulation at US$1,018/ha/year and soil erosion control at US$399/ha/year.

Data on coastal ecosystem values is provided by Emerton et al. (2002), who calculate that Preah Sihanouk (Ream) National Park's mangroves yield erosion prevention and carbon sequestration benefits worth US$156/ha/year.

Laos

The study carried out to calculate the economic returns from conserving natural forests in Sekong province by Rosales et al. (2003) finds watershed protection benefits worth some US$0.85 million a year (just under US$3/ha) for existing downstream fisheries, irrigation and micro-hydropower, and flood control benefits to have a value of US$26.60 million or US$92.3 per hectare. In Phou Dean Din National Biodiversity Conservation Area, Aymui and Chanhda (2009) estimate the value of ecosystem services[15] secured when natural forest is conserved rather than degraded and converted to be US$2,008 per hectare over 10 years, or an average of US$200/ha/year. ADB (2010), looking at the proposed biodiversity conservation corridor linking four protected areas in Attapeu, Champasak and Xekong provinces, estimates carbon storage values at US$1,846/ha/year, watershed protection at US$681/ha/year, water quality regulation at US$718ha/year and soil erosion control at US$380ha/year.

Gerrard (2004) describes the ways in which the 2,000ha That Luang marsh in Vientiane serves to generate economically valuable regulating services that are critical to the functioning of the city, and to the basic standard of living of its human population. She calculates flood protection and wastewater treatment services to be worth some US$2.87 million a year or US$1,436/ha to the 38,000 people living around the marsh.

Thailand

In southern Thailand, Sathirathai (1998) estimates mangrove coastline protection and stabilization services are worth up to US$3,000/ha/year, and carbon sequestration just under US$100/ha/year. Later work by Sathirathai and Barbier (2001) provides figures of US$3,679/ha/year for shoreline stabilization and coastal protection, and US$21-69/ha/year for the contribution of mangroves to offshore fisheries productivity and catch. Seenprachawong (2002), assessing local residents' and tour operators' willingness to pay for the ecological functions of mangroves in Phang Nga Bay, suggests an individual willingness to pay of US$13, which translates into an annual figure of US$22.9/ha/year.

Vietnam

MARD (2008) looks at the value of Da Nhim watershed protection services in Lam Dong province, suggesting that the downstream benefits to hydropower from 1ha of forest is US$69.07 a year, of which US$14.64 is for water regulation and US$54.43 for reduction of sediment into the reservoir. ADB (2010), looking at the proposed biodiversity conservation corridor linking seven protected areas in Quang Nam, Thua Thien Hue and Quang Tri provinces, estimates carbon storage values at US$2,085/ha/year, watershed protection at US$1,417/ha/year, water quality regulation at US$ 1,131/ha/year and soil erosion control at US$399/ha/year. Kuchelmeister (2003), looking at local forest values in Bac Giang and Lang Son provinces, provides figures for the value of forests in reducing soil erosion and settling sediments in

[15] Comprising nutrient cycling, raw materials, erosion control, climate regulation, recreation, waste treatment, food production, genetic resources, biological control, soil formation, pollination, water supply, water regulation, disturbance regulation, cultural services and gas regulation

small water reservoirs, resulting in benefits worth US$1-37/ha in terms of enhanced paddy productivity, US$14/ha for micro-irrigation, and US$42.6/ha for fish productivity in small village ponds (in 2003US$).

Studies carried out by Tri et al. (1998) in southern Vietnam show that the net present value of mangroves in protecting against extreme weather events lies at around US$500,000/ha.

The value of coral reefs for coastal protection and support to offshore fisheries

Coral reefs provide a range of extremely valuable ecosystem services in terms of their support to coastal protection and offshore fisheries. Unfortunately, no data is available for these values in the Lower Mekong region. Various values have however been calculated for the supporting and regulating functions of coral reefs in Indonesia and the Philippines (Emerton 2006a, 2009a). Rather than run the risk of excluding these important ecosystem service values, and in the absence of any estimates for the Lower Mekong region, these figures are used in the current study.

Cesar (1996) presents estimates of the value of coral reefs for the protection of coastlines against the effects of storms, waves and tidal surges. He finds that reefs adjacent to sparsely populated areas where agriculture is the main activity can be valued at US$82,900/ha (based on the value of agricultural production that would be lost), reefs adjacent to areas of higher population densities at US$5,000,000/ha (based on the cost of replacing housing and roads), and reefs in areas where tourism is the main use at US$100 million/ha (based on the cost of maintaining sandy beaches). Hargreaves-Allen (2004) presents figures for the value of coastline protection by coral reefs in Wakatobi National Park (also in Indonesia) of $47,300/ha.

Although quantitative indicators of the value of coral reefs to fish productivity and catch exist, none provide data which can be translated into per-hectare values. Work carried out by Russ and Alcala (1996) around Apo Island Reserve in the Philippines shows a sevenfold increase in the densities of large predatory reef fish after 11 years of protection through the establishment of marine protected areas, while Maypa et al. (2003) state a tenfold increase in catch per unit effort in the hook and line fishery over two decades. In Indonesia, the creation of Taka Bone Rate marine protected area has likewise been demonstrated by Cesar (2002) to have had a tangible impact in improving fish stocks and yields. Work carried out in the Philippines by McAllister (1988) also shows that sustainable fish yields from areas where coral reefs are in good condition are estimated to be more than double those from reefs in fair condition, contributing an additional 1,000 tonnes/ha/year. Similar findings come from a study by Putra (2001) in Lampung province, Indonesia, where each additional metre of coral coverage increases fishing productivity by more than 2kg a year (Putra 2001).

Non-use values / cultural services

Thailand

Seenprachawong (2002), assessing tourists', local residents' and tour operators' willingness to pay for the non-use values associated with the rare and endangered species found in mangroves in Phang Nga Bay, suggests an individual willingness to pay of US$3, which translates into an annual figure of US$7.5/ha. Seenprachawong (2003) also finds that the domestic non-use value of coral reefs at Phi Phi is US$15.85 per person, or US$15,075/ha.

Several other studies look at the non-use values associated with coastal and marine ecosystems in Thailand, but do not provide figures that can be expressed on a per unit area basis. Nabangchang (2008) determines the non-use values of a group of endangered species through eliciting Thai residents' willingness to contribute funds for conservation. She finds values of between US$8.4 million (if money were to be raised through a mandatory tax) and US$37 million a year (through voluntary payments). Jianjun et al. (2007) and Nabangchang and Thuy (2008) look at the non-use value of marine turtles to the urban population in Bangkok, indicating willingness to pay values of between US$7.06 million and US$26.69 million a year.

Vietnam

Nama et al. (2005) assess the conservation existence values of Nha Trang Bay marine protected area to domestic and international tourists, stating average figures of willingness to pay per tourist of US$3.1 and US$3.9 respectively. These translate to a value of US$18.7/ha. Do and Bennet (2007) look at the biodiversity conservation value of Tram Chim National Park. They find that the value for residents of Cao Lanh, Ho Chi Minh City and Hanoi is in the order of US$3.9 million or US$433/ha, expressed via aggregated willingness to contribute funds for improved wetland biodiversity conservation via changed dyke management.

As with Thailand, several other studies provide interesting estimates of the non-use value of ecosystems which cannot however be expressed on a per unit area basis. Jianjun et al. (2007) and Nabangchang and Thuy (2008) look at the non-use value of marine turtles to the urban population in Hanoi and Ho Chi Minh City, indicating willingness to pay values of between US$6.44 million and US$13.02 million a year. Hoa and Ly (2009) find that households in Ho Chi Minh City are willing to pay at least US$0.35 per month for the preservation of Lo Go – Xa Mat National Park, reflecting its non-use value to them. Thuy (2007) looks at the non-use benefits associated with Vietnamese rhinos found in Cat Loc Rhino Conservation Area in Cat Tien National Park, and calculates annual values (expressed through willingness to pay) of US$5.8 million.

Conclusions: what we know about the economic value of ecosystem services

- What's available? The review of existing data and studies yielded almost 100 estimates of economic values, covering various types of natural ecosystems in each of the four Lower Mekong countries. These are described in the paragraphs above, and listed in Data Annex Table 10.
- What can we use? About 60 of these estimates are useable in the current analysis: some were excluded because it was unclear just what ecosystem services they covered (and therefore they could not be combined and compared with other estimates), or because they dealt with unusual situations or user groups (and thus they were considered atypical or unsuitable for broader extrapolation). All cultural/non-use service values were also excluded, as these cannot be scaled up or extrapolated between sites.
- How much are ecosystem services worth? From the remaining data, it is possible to obtain a range of "average" ecosystem service values for the region, generalized to four broad categories of ecosystem: forests (US$1,281/ha/year), freshwater wetlands (US$1,634/ha/year), mangroves (US$2,670/ha/year) and coral reefs (US$326/ha/year). Table 2 summarises the mean economic value of ecosystem services in Cambodia, Laos, Thailand and Vietnam, according to available data and reports. These values will be used in the scenario analysis presented in Part II of this report.

Table 2: summary of ecosystem services values (US$/ha/year)

	Mean value	Maximum value	Minimum value	Standard deviation	# useable references
Forests	1,281				
Local use of non-timber products	26	165	2	38	16
Sustainable timber	104	171	37	67	2
Watershed protection	183	399	3	153	9
Carbon sequestration	968	2,085	34	929	6
Freshwater wetlands	1,634				
Local use of aquatic products	198	658	4	268	4
Water quality and flow services	1,436	1,436	1,436	-	1
Mangroves	2,670*				
Local use of aquatic products	282	1,200	4	366	8
Coastal protection	2,243	3,679	50	1,575	3
Tourism and recreation	3,000	3,000	3,000	-	1
Carbon sequestration	100	100	100	-	1
Support to offshore fisheries	45	45	45	-	1
Coral reefs	326*				
Tourism	207	332	82	125	2
On-site fisheries	155	155	155	-	1
Coastal protection+	171	500	5	233	3

**Excludes tourism and recreation. These values are highly location-specific, and the sites at which such data has been generated are for the most part already developed and well served by transport and other infrastructure. It cannot be assumed that all sites in the region have this potential, or are ever likely to do so.*
+Uses data from Indonesia.

- Is such an approach defensible? Despite the limitations set out, these estimates are undoubtedly useful. They represent the current state of knowledge on ecosystem service values in the region, and as such are the only available base from which to work. Better or more accurate figures simply do not exist. In the absence of more reliable estimates, taking these averages is, however imperfect, the best option available.

- What are the limitations? The resulting data should however be treated with extreme caution. It presents a first attempt to generate indicative and rough estimates which will give some idea of the broad magnitude of the value of the services provided by different ecosystems in the Lower Mekong region.

There is an inevitable trade-off between the need to generate practical and policy-relevant information in a situation where time, resources and data are scarce, and the presentation of a research exercise which is based on detailed primary data. A fundamental question remains as to whether it is in fact possible to envisage anything such as an "average" ecosystem service value, or to extrapolate data which has been generated in one site for a particular purpose to other locations.

As already mentioned, the quality, assumptions and overall credibility of the data sources which are available are sometimes questionable. The valuation studies that form the basis of the current analysis vary greatly in their scope, quality, methodology, and suitability for use in a regional-level assessment. Often the base data sources are not strictly comparable as they may be of a different nature or be expressed in different units, or the estimates may not be clearly related to a specific service or an area.

The estimates used in this analysis are not comprehensive, and contain many gaps – for key ecosystem services or sites, estimates of economic value simply do not exist. An example of this is the economic values ascribed to coral reefs in Table 2 – it would be absurd to conclude that coral reefs are somehow worth "less" than the other ecosystems presented in the table. Rather, a lack of data makes it difficult to reflect the full economic value of coral reef ecosystem services in the figures that are presented in this report.

In several cases, the values that are ascribed to particular ecosystem services rely on just one or two studies – they are in no way based on a significant sample of sources. These is also a great deal of variation between the estimates of ecosystem values given in different sources, even when they have been generated in similar sites. This is apparent from the standard deviation figures presented in Table 2, which show a high dispersion or spread of values about the mean, and is depicted in Figure 4, Figure 5 and Figure 6 below.

Figure 4: variation in estimates of the value of non-timber forest products

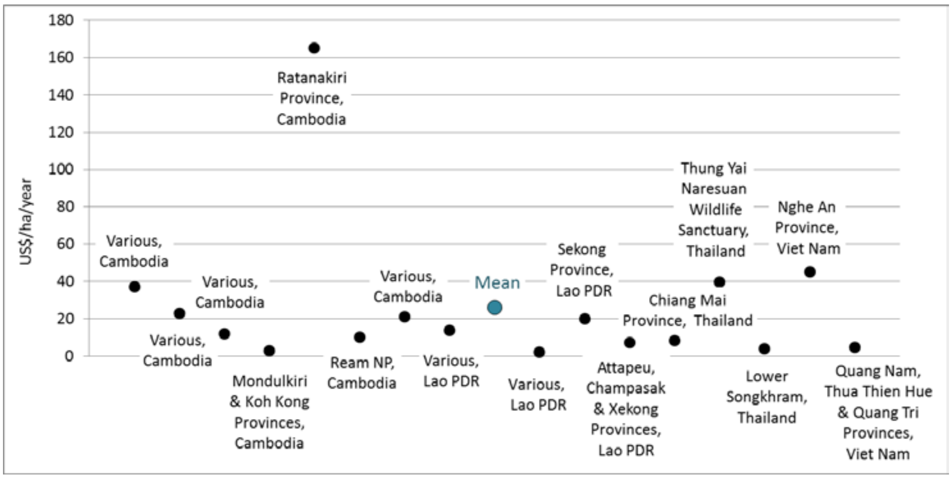


Figure 5: variation in estimates of the value of forest watershed protection

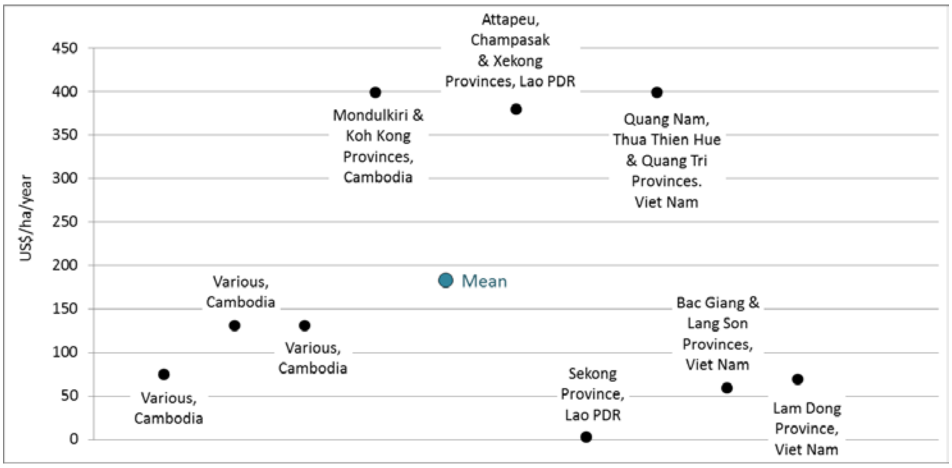
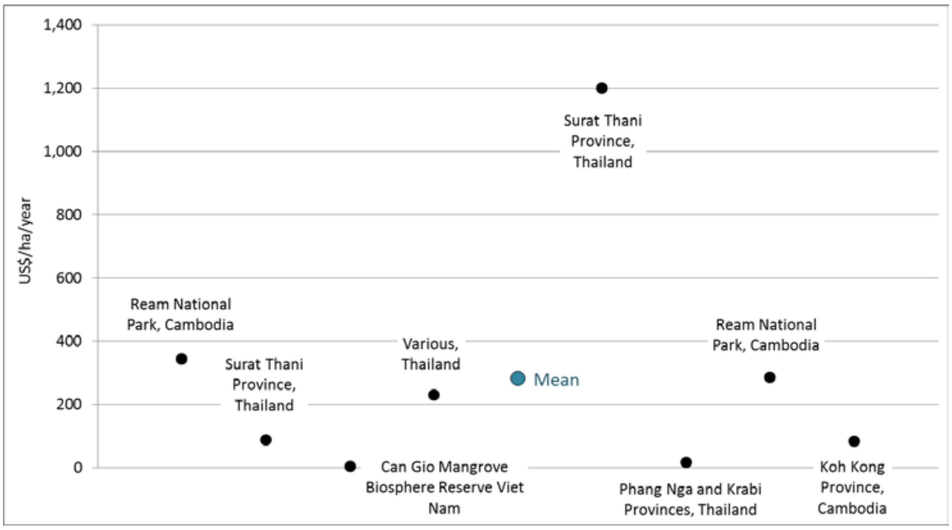


Figure 6: variation in estimates of the value of mangrove products



2. 'Real-world' valuation: To what extent are these values being captured as payments for ecosystem services?

However great the value of ecosystem services is demonstrated to be in theory, this information has little impact unless it translates into both real economic gains on the ground, and sufficient investment in maintaining the ecosystems that generate these services and the groups that provide them. Over recent years there has been a growth in the use of market-based and other mechanisms which attempt to capture the economically important values described in the previous chapter. These are being used to supplement more conventional sources of conservation financing (e.g. central government budgets, limited user fees and international donor assistance). This chapter summarises the ways in which ecosystem values are being captured as payments for conservation, and identifies ecosystem services that are currently not being effectively captured in payment streams.

Payments for ecosystem services

A large number of current funding efforts in the Lower Mekong region are termed "payments for ecosystem services" (PES), probably reflecting the current popularity of the term and approach among conservation planners and donors. It is less certain that all can, strictly, be considered to be PES: many are, in reality, just new ways of communicating and packaging traditional donor and international NGO project interventions, or providing subsidies to communities who live in or around high conservation value landscapes.

However, if we are looking at capturing ecosystem values, it is important to distinguish financing mechanisms which are based on directly charging the users or beneficiaries of valuable ecosystem services, and directly compensating or rewarding the providers of those same ecosystem services – in other words, those that make a clear link between the value of a given ecosystem service, and the costs incurred in maintaining it. The paragraphs below therefore focus mainly on market-based schemes which fit most closely with the definition of PES as "voluntary agreements to enter into a legally binding contract under which one or more buyers purchase a well-defined ecosystem service by providing financial or other incentives to one or more sellers who undertake to carry out a particular land use on a continuous basis, which will generate the agreed ecosystem service at specified levels" (IUCN 2008).

Cambodia

There have been recent questions about the political acceptability of PES in Cambodia, even though (as described in the following paragraphs) the reality is that several PES efforts are already under way or are being planned. After the topic was raised at a workshop in mid-2010, the prime minister responded firmly that he did not consider PES to be feasible or desirable, because of the risk of payments acting as disincentives to investment (particularly in hydropower, water supply and irrigation sectors), and the possibility of the poor being penalized due to additional costs being passed on to consumers through increased water, energy and food prices (Emerton 2010). The future broad acceptance of PES by the Cambodian government will depend on high-level decision-makers being persuaded that these fears are unfounded.

In Cambodia there has, however, been wide use of the terms ecosystem services and PES in public planning and in operational projects for ecosystem conservation for some time (Chervier et al. 2010). PES or "PES-type" mechanisms are being tested in several priority ecosystems. Many of these are associated with pre-existing biodiversity conservation or protected area projects, and most are driven by large international conservation NGOs. Without detracting from their undoubted successes in ecosystem conservation and local livelihood terms, it should however be noted that the majority might be more aptly seen as "conservation subsidies" from the international community or as integrated conservation and development activities than as market-driven PES.

One exception is the Cambodia Payment for Ecosystem Services Project being developed by Fauna and Flora International (FFI). This focuses on establishing market-based PES schemes at two hydroelectricity sites located within protected areas of the Cardamom Mountains landscape. The Wildlife Conservation Society (WCS) also refers to a series of direct conservation payment schemes instituted around two protected areas in the Northern Plains landscape (Kulen Promtep Wildlife Sanctuary and Preah Vihear Protected Forest) as PES (Clements 2010). These involve agri-environment payments, the development of wildlife-friendly products, and the provision of direct contracts for bird nest protection to local communities. Conservation International's "conservation agreements[16]" are also frequently referred to as PES in the organization's promotional materials. One example, in Cambodia, is the agreements entered into with six communities living around the Cardamom Forest. The communities have agreed to cease slash-and-burn practices, stop hunting and setting snares for wildlife, and instead engage in patrolling and protection activities to conserve the nesting sites of the Siamese crocodile.

Laos

In Laos, payments for environmental services remain at an early stage of design and development. There are currently no functioning schemes when PES is defined in the strict sense (revenue-sharing arrangements with the hydropower sector are considered separately, and discussed below), and no enabling policy or legal framework. A clear interest from government decision-makers, however, suggests that PES may soon be tested on a pilot basis, and further formalized. The two newly established River Basin Funds are, for example, attempting to operationalize PES in relation to watershed protection services (Emerton and Douangchan 2011), and both the Lao Environment Protection Fund and the Forest Development Fund have expressed their wish to integrate PES funding.

Various research and academic studies have been carried out looking at the feasibility of instituting PES in Laos, although the conclusions are mixed. There seems to be a general consensus that economic, institutional and legal constraints mean that there is still a considerable amount of work to be done on creating the broader enabling conditions for any kind of a PES scheme to function at the national level. It is also not certain that, outside the hydropower and urban water sectors, there exists a sufficient market for PES buyers.

Detailed work has, for example, been carried out in Houay Xon watershed on the feasibility of PES (George et al. 2009, Mousquès et al. 2008). This finds that, in princinple, downstream ecosystem service beneficiaries would be willing to pay enough to compensate upland farmers for implementing new land management practices which would abate some of the negative impacts of soil erosion on water quality; however, the absence of a critical mass of buyers would hinder the development of a more comprehensive PES scheme.

Thailand

PES appear to be least developed in Thailand, although there are clear indications of a growing interest to develop and pilot such schemes. A recent UNDP-sponsored workshop looked into the potential and constraints of applying a PES system in Thailand,[17] and three government of Thailand/UNDP-GEF projects have been developed or are in the process of development which aim to pilot PES. These relate to protected areas, the development of sustainable harvesting and supply chains for biodiversity-based products, and integrated catchment management systems.

Vietnam

PES have been institutionalized at the national level in Vietnam. Box 2 describes Vietnam's experiences in payments for forest environmental services. This pilot scheme (which focused on payments for watershed and tourism ecosystem services in two provinces) has just been extended, via Decree No. 99 /2010/ND-CP, to the entire country. Decree 99 is confined to forest environmental services, comprising watershed protection, carbon sequestration, tourism and "spawning grounds, sources of feeds, and natural seeds, use of water from forest for aquaculture". Those eligible to receive payments include forest owners, local households and communities, economic organizations and the management boards of protection forests and special use forests.

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[16] Under these schemes, land owners or local communities are directly or indirectly compensated with international funding for protecting specific habitats or species, on the understanding that they enter into formal agreements not to carry out certain land and resource uses which are considered incompatible with conservation, or directly engage in biodiversity conservation activities.

[17] "Payments for Ecosystem Services in Thailand: why and how?", UNDP Thailand News and Events, 15 December 2009.

Box 2: payments for forest environmental services in Lam Dong and Son La provinces, Vietnam

The idea of payments for environmental services began to take hold in Vietnam in 2005. In 2008, the government issued Decision No. 380/QD-TTg on piloting payments for forest environmental services in Lam Dong and Son La provinces. These two schemes have both been developed collaboratively between the Ministry of Agriculture and Rural Development and external donors: USAID/Winrock International in Lam Dong, and GTZ in Son La.

Similar systems operate in both provinces. Cash payments are received from key water users (hydropower, water bottling companies and other urban and industrial consumers). These payments are calculated at VND20/kWh (US$0.001/kWh) of commercial electricity, and VND40/m^3 (US$0.002/ m^3) of clean commercial water. The revenues collected are retained in separate bank accounts as part of provincial forest protection and development funds. Between 10 and 20 per cent is retained by government, and the remainder paid out to environmental service providers. Local households in watershed areas are eligible to receive payments, calculated on a per-hectare basis.

The Son La pilot scheme covers an area of 395,000 hectares of forest in nine districts, and involves just over 4,500 forest owners. The scheme is funded from two water supply companies and two hydropower plants. Payments will be made at a rate of between VND70,000 and VND140,000 per hectare per year. As yet, no funds have actually been released, but payments are expected to start soon.

The Lam Dong pilot scheme covers just under 550,000 hectares in four districts, and involves around 3,000 households and forest owners. The scheme is funded by two hydropower plants, two water supply companies and one tourism company. Payments have been made at the rate of between VND270,000 and VND290,000 per hectare per year. Decision 380 was subsequently extended to an additional 15 provinces (those with major watersheds and hydropower plants). A decree was passed in September 2010 which scaled payments for forest environmental services up to the national level, extending the scope of environmental services for which payment could be made (most notably including carbon sequestration), and updated the recommended payment levels.

Carbon finance

Carbon finance can also be considered to be a form of PES (it is based on capturing ecosystem carbon sequestration service values), but is considered separately in this chapter due to its rather specific institutional and funding characteristics. Three main carbon finance mechanisms are considered below, and can be found in the region: Clean Development Mechanism (CDM)[18], reducing emissions from deforestation and forest degradation (REDD)[19], and voluntary carbon markets.

Although CDM projects can in theory provide funding for afforestation and reforestation activities, the requirements for project preparation and verification are extremely complex. It is maybe for this reason that there seems to be very little focus in Lower Mekong countries on CDM as a mechanism for funding forest ecosystem restoration. Although two CDM projects have been registered in Cambodia, one in Laos, 54 in Thailand and 46 in Vietnam, all except one concern energy efficiency. The only forestry and land use CDM project is a relatively small one in Vietnam, the Cao Phong Reforestation Project.

REDD/REDD+ and voluntary carbon market projects are generally seen as more appropriate sources of funding for ecosystem conservation in the region. Several pilot REDD projects are already underway, and many more are being planned by conservation agencies active in the four countries.

For example, in Cambodia, Community Forestry International and Pact are supporting a REDD pilot project in Oddar Meanchey province (see Box 3), and WCS has developed REDD activities in Seima Mondulkiri. In Laos, GIZ, working with KfW, is supporting the testing of REDD in Nam Et-Phou Loei and Nam Phui NPAs; WCS is undertaking a REDD

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[18] The Clean Development Mechanism (CDM), defined in Article 12 of the Protocol, allows a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol (Annex B Party) to implement an emission-reduction project in developing countries. Such projects can earn saleable certified emission reduction (CER) credits, each equivalent to one tonne of CO2, which can be counted towards meeting Kyoto targets. See http://unfccc.int/kyoto_protocol/mechanisms/clean_development_mechanism/items/2718.php

[19] REDD is a mechanism to create an incentive for developing countries to protect, better manage and wisely use their forest resources, contributing to the global fight against climate change. REDD strategies aim to make forests more valuable standing than they would be cut down, by creating a financial value for the carbon stored in trees. Once this carbon is assessed and quantified, the final phase of REDD involves developed countries paying developing countries carbon offsets for their standing forests. See http://www.un-redd.org/FAQs/tabid/586/Default.aspx

feasibility study for sites in Nam Et-Phou Loei NPA, Nam Kading NPA and Bolikhamxay province; and JICA, under the PAREDD project, is working on REDD at four sites in Luang Prabang province.

In Thailand, the Tenasserim Biodiversity Corridor and Western/Kaeng Krachan forest complexes has been identified as a pilot REDD site. The Department of National Parks, Asian Development Bank and a private company have prepared a proposal to secure funding. In Vietnam, Lam Dong province has been identified as a pilot site under the UN-REDD programme, with Son La and Can Tho provinces also highlighted as priority areas for REDD development and piloting.

Box 3: pilot REDD activities in Oddar Meanchey province, Cambodia[20]

In December 2007, the Forestry Administration introduced the Oddar Meanchey REDD project, working with a variety of international and national NGOs and forest communities. The project seeks to retain and increase carbon stocks, enhance the hydrology in the upland watersheds of the Tonle Sap basin, and conserve endangered biodiversity. Its intention is to generate 8.5 million verified emission reductions over 30 years, which will be sold on voluntary carbon markets. The project was submitted for validation to the Climate Community Biodiversity Alliance and Voluntary Carbon Standard in 2009 but has yet to bring credits to the voluntary market.

The pilot project covers 60,000 hectares and involves 13 forestry groups in 55 villages. Project sites include larger tracts of community-managed forests with healthy closed canopy forests, as well as degraded forests suitable for restoration. The project provides regeneration contracts to all participating community forest management committees (CFMCs) to restore their degraded forests. Restoration contracts are based on CFMC management plans, providing employment opportunities, materials, and funding CFMC operations. Carbon financing is used to support rural communities to develop a range of livelihood activities including non-timber forest product industries, community-based ecotourism infrastructure, and water resource development. The project is also working with the Forestry Administration and commune, district and provincial government to assist planners to formulate long term plans for sustainable natural resource management that can foster economic growth.

REDD is, however, in the early stages of development, and may only come on track as a mainstream source of ecosystem funding in several years' time. In the meantime, a number of uncertainties remain about exactly how it will operate in Lower Mekong countries. National benefit sharing systems are in the process of being designed, and REDD roadmaps and readiness plans are being formulated, with the assistance of UN-REDD and the World Bank's Forest Carbon Partnership Facility.

Several other new funding opportunities associated with climate change, carbon and REDD have also recently emerged which may offer financial resources for ecosystem conservation. In Cambodia UNDP has stated its intention to set up a new small grant facility concerned with REDD and climate, and two donor-funded climate adaptation funds have recently been developed. A multi-donor fund of just under US$9 million has been established through the Climate Change Alliance and is being administered through Cambodia's Forestry Administration. Although a final decision has not yet been taken on exactly how these funds will be used, it seems likely that grants will be made available for organizations and agencies to engage in climate change adaptation activities.

A second adaptation fund for Cambodia is in the design stage, to be financed from the World Bank, DFID, JICA, EU, France and other donors. This will also be used for adaptation activities, but at the level of policy development and mainstreaming rather than for on-the-ground activities. It is planned that funds will be provided as general budget support, and allocated according to priorities decided by the central government – possibly for mainstreaming climate change adaptation into agriculture, rural infrastructure, irrigation and other priority development sectors.

Biodiversity offsets

Biodiversity offsets cannot be considered as payments for ecosystem services, because they serve to compensate (or offset) negative biodiversity and habitat impacts by investing in conservation efforts elsewhere. Broadly speaking, however, they are predicated on a recognition of the value of ecosystem services, and the need to offset the costs of

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[20] *See:* red-monitor.org, 'Oddar Meanchey REDD project runs into problems selling carbon credits, as the Cambodian government misses deal signing deadline' 21 June 2013. *http://www.redd-monitor.org/2013/06/21/oddar-meanchey-redd-project-runs-into-problems-selling-carbon-credits-as-the-cambodian-government-misses-deal-signing-deadline/*

ecosystem service degradation or loss through the restoration or maintenance of equivalent services elsewhere. They are therefore dealt with briefly below.

Biodiversity offsets are not widespread in the region, but are in the early stages of development in all of the Lower Mekong countries. Experiences with the cement industry in Thailand and with hydropower in Laos probably represent the closest approximation (voluntary contributions by the corporate sector are dealt with separately, below). As illustrated in Box 4, in Thailand the Siam Cement Group is engaged in the restoration and reforestation of exhausted quarry areas, and in Laos there are now several examples of individual hydropower schemes providing environmental funding in order to offset or compensate for damages caused on-site.

In Vietnam, a national programme on biodiversity offsets is under development, and it is envisaged that a policy on biodiversity offsets will be developed.[21] The Ministry of Environment and Natural Resources has recently submitted a draft policy on environmental compensation to the government, and the legal framework on biodiversity offsets also draws on Article 75 of the Biodiversity Law No. 20/2008/QH12.[22] Work on developing a national biodiversity offset programme is being supported by Forests Trends' Business and Biodiversity Offsets Programme.

Box 4: biodiversity offsets by Siam Cement Group in Thailand and the hydropower sector in Laos

In Thailand, the Siam Cement Group is engaged in an active corporate environmental and social responsibility programme which includes biodiversity offsets. These operate mainly through the rehabilitation and revegetation (using local species) of limestone quarries. Check dams have been constructed to increase soil moisture, and biodiversity surveys and monitoring are carried out. The project runs in collaboration with the Ministry of Forestry, Department of Fundamental Industry and Mining and Faculty of Forestry at Kasetsart University.

In Laos, both the Nam Theun 2 and Theun-Hinboun Expansion hydropower projects are piloting mechanisms for sharing revenues or investing funds in environmental management. The World Bank-funded Lao Environment and Social (LEnS) project was designed as a complementary activity to the Nam Theun 2 project, including social and environmental activities to address the cumulative impacts of river basin development in the Nam Theun-Nam Kading river basin. In addition, the Theun 2 project has undertaken to provide direct funding for the Nakai-Nam Theun Watershed Management and Protection Authority of US$1 million a year for the duration of the concession period (31 years), including funds for management of Nakai Nam Theun NPA and two corridor areas.

Under a slightly different structure (and working through an international NGO, WCS), funding is being made available from the Theun-Hinboun Expansion project for the development and implementation of a catchment biodiversity development and protection plan in Nam Gnouang watershed.

Based on these models, several other new hydropower projects are also discussing methods for contributing funds towards land and resource conservation in the catchments in which they operate.

Other corporate funding

Aside from PES which are designed to recompense directly for the benefits of ecosystem services and offset the costs of ecosystem services loss, various other corporate funding sources are being voluntarily invested in biodiversity and ecosystem conservation. As this funding is being provided at least partially in recognition of the high value of ecosystem services, it is included in this chapter.

In Cambodia and Laos, for example, WWF has a partnership with the Swedish home furnishings company IKEA to promote responsible forestry. This is providing funding for research on rattan production, harvest, use and trade, as well as determining the potential to develop a sustainable rattan harvesting model at the community level. In Laos, WCS has managed to access funds for biodiversity and species conservation from the mining company MMG, which operates the Sepon copper and gold mine in Savannakhet province. In Thailand, the government is working with the ASEAN Centre for Biodiversity to support a forum to encourage companies to include biodiversity conservation in their corporate social responsibility initiatives. In Vietnam, the international cement company Holcim is providing ongoing funding to the Kien Giang Provincial People's Committee and other organizations for the conservation of karst landscapes (see Box 5).

[21] Vietnam News Agency, 24 April 2010, "Vietnam considers biodiversity offset scheme."

[22] "Organizations or individuals that infringe upon conservation areas or biodiversity conservation facilities… shall pay damages in accordance with law" and "damage caused to biodiversity due to environmental pollution or degradation shall be compensated in accordance with law."

Box 5: corporate funding to karst ecosystem conservation in Kien Giang province, Vietnam
Holcim Ltd., a global company specialising in the manufacture and distribution of cement and aggregates, has committed to provide around US$1 million to preserve and restore the ecological system of Kien Giang province and Kien Luong district, part of a UNESCO Biosphere Reserve. Activities include protection of important karst landscapes and conservation of endangered species, namely the silver langur and sarus crane. A framework agreement with the Kien Giang Provincial People's Committee and the Kien Giang Union of Friendship Organizations has also been established, to provide a platform to engage the local authorities in the Kien Giang province, where Holcim's Hon Chong plant is located. Training programmes have been developed to raise awareness of the importance of environmental protection among the local community and Holcim staff. As part of the agreement, Holcim and its local partners are determining the feasibility of eco-tourism in the Mo So caves area as a means for protecting biodiversity.

Conclusions: the extent to which values are being captured as payments for ecosystem services

Are values being captured as payments? As the experiences and case studies presented above show, all forms of payments for ecosystem services are very much at an incipient stage in the Lower Mekong countries – which suggests that they are not capturing the full value being delivered by the region's ecosystems. The exceptions to this are of course (a) the government and donor funding which is (presumably) being provided in recognition of the important public benefits that are generated by biodiversity and ecosystems, and the responsibility of the state and the international community to maintain them; and (b) the various charges, fees and taxes that are levied on the physical products and facilities that are associated with ecosystems. Both of these mechanisms, which are not dealt with in this report, have long formed sources of conservation financing, and continue to do so.

Why is leakage a potential issue? One important lesson learned from conventional ecosystem and biodiversity-related revenue-generating mechanisms, as they have been applied in the region to date, is that simply instituting PES mechanisms is not by itself sufficient to ensure increased investment in conservation. Beneficiaries of many of the direct values or provisioning services associated with ecosystems are already charged for their use (for example through forest royalties, fishing concession fees, hunting permits, tourist entry charges or environmental taxes). But in many if not most instances, the revenues raised are not reinvested in the management of ecosystems – and may not even be retained by the agency or at the site that generated them. They tend to be treated as general budget funds, and are remitted to the parent ministry or central treasury. The danger of this type of leakage remains a potential issue to be dealt with, as other payments for ecosystem services emerge.

What stage have payments for ecosystem services reached? Pilot PES schemes exist, or are emerging, in all of the Lower Mekong countries. It is only in Vietnam that PES have been institutionalized, and are specifically covered by law. In Cambodia, Laos and Thailand it is however clear that there is a great deal of interest (among both government and the NGO community) in scaling up site-specific PES efforts, and establishing some kind of national institutional, legal and funding framework that could guide the further development of PES across the country. This process is being expedited by the emergence of REDD/REDD+ across the region, which is demanding that these issues are addressed – although the extent to which carbon finance can, or will, be "bundled" with payments for other ecosystem services is not yet clear. All four countries are still in the process of finalizing REDD/REDD+ structures and arrangements.

> While it is clear that PES (including REDD/REDD+ and other forms of carbon finance) provide a potentially important source of ecosystem funding, they should not be seen as the sole solution. Despite the high economic value of the region's ecosystem services, there is at present only a limited market and relatively small amount of buyers. Much of the region's population and many of its businesses currently remain economically unable, or unwilling, to voluntarily pay for the ecosystem services that they benefit from.

Who are the beneficiaries of payments for ecosystem services? Unlike more conventional ways of capturing ecosystem values, such as user fees which accrue as budgetary revenues for the government, PES provide an opportunity to mobilize funding for all the different groups that incur a cost from ecosystem conservation. The development to date of PES in the region has focused on establishing mechanisms which do not just generate revenues for government, but also provide funding to the landholders, resource users and local communities which are involved in providing key ecosystem services. This is an important point, as PES are not only being used as a tool to better capture (and reinvest in) ecosystem values, but also to cover more equitably the costs of ecosystem service provision.

Which ecosystem services are currently not being effectively captured in payment streams? The review of experiences from the region underlines the fact that almost all of the current PES efforts focus on forest ecosystems, primarily on watershed[23] and biodiversity[24] services. There remains a significant gap in PES relating to freshwater wetlands, marine and coastal ecosystems, despite the economically important (and potentially marketable) services these provide. In this sense the Lower Mekong region varies little from the rest of the world, where forest ecosystem services – and particularly forest watershed services – have long dominated PES systems.

[23] Including erosion control, water flow regulation and water quality maintenance.
[24] Including landscape, tourism and species habitat.

PART III: MODELLING THE FUTURE OF ECOSYSTEM SERVICES CHANGE IN THE LOWER MEKONG

1. What are the likely future ecosystem management and use scenarios?

Ecosystem service values are not static. It is self-evident that they depend both on the types, extent and quality of ecosystems, and on the level of reliance of the region's human population on ecosystem services for their economic well-being. This chapter outlines two possible future scenarios for ecosystem management and use in the region, and the implications of different levels of management for the delivery of ecosystem services. It goes on to assess the economic implications of each scenario, and provides details about the key trends, assumptions and parameters associated with them.

What the scenarios are based on

Each scenario presents a (very simplified and generalized) model of how the use of land and resources, and the area and quality of ecosystems, might change over the next 25 years in the Lower Mekong countries of Cambodia, Laos, Thailand and Vietnam.

It should be noted that there are several other possible ways to construct scenarios of the future economic value of ecosystem services. It would be possible, for example, to use a more anthropocentric basis for projections, such as population growth and resource demand. It would also be possible to use changing policies as the basis for projections. This study, however, takes a land use/ecosystem area-based approach. It sets a baseline for the physical coverage of forest, freshwater, mangroves and coral reefs in 2010 – and then describes scenarios for the change in that coverage with the implications for the change in value of services being delivered by those ecosystems by 2035.

This is for three main reasons. First, an ecosystem value scenario-modelling exercise has already been conducted for the WWF-Greater Mekong priority landscapes (Campbell, 2010), which takes this approach. Because this data is included in the current study, it was necessary to generate country and regional data which could be directly compared and combined with the figures calculated in the earlier exercise. Second, it is consistent with the TEV-MA framework presented in the introduction to this report. The scenarios essentially relate changes in ecosystem assets or natural capital (ecosystem extent and quality) to changes in the flow of ecosystem services and, in turn, changes in economic values and well-being. Third, it reflects WWF's concern with ecosystem conservation and improved investment in ecosystems.

Extrapolating current ecosystem values into the future is both imprecise and risky. As already noted, the relationship between changes in ecosystem areas and quality, the provision of ecosystem services, and the generation of economic values is not a linear one. However, the time and data constraints faced by the current study mean that some degree of linearity has to be assumed in the calculations. Future changes in land use and ecosystem status are almost impossible to predict, and there are high degrees of uncertainty involved.

Other parameters, such as the degree of human dependence on ecosystem services, the real value of these services over time, and changes in population, demography, income levels and societal preferences all affect ecosystem values; however, these cannot be predicted with any certainty. Partly for this reason, and also because of the limited time and information base available to this study, the modelling exercise holds many of these factors constant between the different scenarios – even though, in reality, one would expect them to vary significantly, depending on future conservation and development pathways.

Many assumptions are required to take all of these factors into account, and are applied in the current study. In terms of basic parameters for land use, ecosystem area and quality, the scenario modelling draws on the underlying data and assumptions provided in many sources. The key baseline parameters are summarised in the next section, and the further assumptions used in the scenario modelling are elaborated.

Key baseline parameters

Table 3: scenario analysis – key baseline parameters

		Cambodia	Laos	Thailand	Vietnam	Source
Per capita GDP	Current US$	667	940	3,893	1,032	World Bank 2011
Population	Million persons	14.81	6.32	67.76	87.28	World Bank 2011
Population (rural)	Million persons	11.83	4.22	44.32	60.75	UNDP 2010
Land area	km^2 '000	176.52	230.80	510.89	310.07	World Bank 2011
Agricultural area	km^2 '000	54.55	21.29	197.50	100.72	World Bank 2011
Terrestrial PAs	km^2 '000	43.40	37.55	104.45	18.59	World Bank 2011
Marine PAs	km^2 '000	0.69	n/a	19.87	4.52	World Bank 2011
Natural forest	km^2 '000	100.25	155.27	149.87	102.85	FAO 2010
Other wooded areas	km^2 '000	1.33	48.34	-	11.24	FAO 2010
Designated production forest	km^2 '000	33.31	36.23	26.56	64.85	FAO 2010
Designated watershed forest	km^2 '000	5.05	91.36	13.28	51.05	FAO 2010
Designated biodiversity conservation forest	km^2 '000	39.37	29.93	89.17	22.08	FAO 2010
Freshwater swamps, marshes and rice fields	km^2 '000	7.60	9.45	9.90	6.10	Various*
Inland waters	km^2 '000	4.52	6.00	2.23	19.24	FAO 2010
Mangroves	km^2	69	n/a	250	150	FAO 2007
Coral reefs	km^2	50	n/a	2,130	1,270	Spalding et al. 2001

**Excludes large rivers, streams and open water bodies. For Cambodia, includes flooded forest, flooded grasslands, receding/floating rice fields, and swamps (from MOE 2010); for Laos includes swamps, marshes and receding/floating rice fields (from Emerton et al. 2002b); for Thailand includes swamps, marshes and receding/floating rice fields within 50km of the main Mekong channel (from Choowaew 2003); for Vietnam includes small ponds, small lakes, marshes, swamps and receding/floating rice fields (from Do, T.N. and Bennett, J. 2007.).*

Business As Usual (BAU)

The "Business As Usual" scenario depicts what will happen if current trends continue. In practical terms, this means that even though the region's protected area system will be maintained at its current size, coverage and management categories, the area of well-managed natural ecosystems contained in the system will be progressively degraded, converted and lost. Conversion and degradation of natural ecosystems outside protected areas will continue.

A dominant development paradigm which emphasizes short-term economic gains at the expense of longer-term sustainable development will prevail. Even though policies supporting the conservation and sustainable use of ecosystems will remain in force, they will not always be implemented or enforced effectively. No significant new conservation or environmental policy measures will be put in place. In many cases, economic policies and instruments which aim to stimulate production and consumption in other sectors (such as subsidies, price support or inducements for investment) will act as perverse incentives in conservation terms, encouraging people to carry out activities that harm biodiversity and ecosystems.

As population increases in the region, there will be a rising demand for food, timber and other products, many of which will be sourced unsustainably. Stocks of biological resources will become exhausted in certain places, and some species may become locally extinct. Resource demands will also be driven by the growth of an increasingly affluent urban population, and the progressive integration of Lower Mekong countries into wider regional and global markets. Meanwhile, the incidence of poverty, although declining, will remain high. A large proportion of the region's rural population will continue to rely on wild products and species for their day-to-day livelihoods and survival.

Under the BAU scenario, farming and land-based production systems will be intensified, and there will continue to be wide-scale conversion of natural habitats to agriculture, industrial plantations and urban settlements. Rapid infrastructure development in the roads and hydropower sectors, as well as an upscaling of the activities of extractive industries, will also leave its mark on many currently pristine terrestrial and coastal/marine landscapes. There will be problems associated with the introduction and spread of alien invasive species, to the cost of native fauna and flora. Ongoing climate variability and climate change will compound these impacts, as human and natural systems become less resilient, and more vulnerable to stresses and shocks.

While biodiversity will be conserved to some extent within most PAs, there will be intensifying problems of encroachment – particularly in those PAs which are located close to human settlements or in high-potential agricultural lands. Public funding to PAs and ecosystems will remain steady in real terms, and there will be a modest increase in new conservation finance, particularly that sourced from self-generated revenues, the private sector, PES, carbon finance and voluntary contributions. The amount of funding will, however, be insufficient to ensure that PAs are managed effectively or that ecosystems outside PAs are adequately conserved.

Green Economic Growth (GEG)

The "Green Economic Growth" scenario depicts what will happen if the region's PA system is expanded and recategorized to include a more representative range of critical ecosystems and management systems, and if renewed efforts are made to better fund and conserve ecosystems and biodiversity outside PAs. This is in line with the green growth strategies and policies currently being elaborated by Lower Mekong countries. A defining characteristic of this approach is that it attempts to stimulate public and private involvement in the sustainable use of biodiversity and ecosystems, so as to capture ecosystem values both as real economic and livelihood gains, and as financing for conservation.

In practical terms, this means that the region's protected area system will be extended, and in places rezoned and/or recategorized. A more progressive and realistic approach to conservation which is based on maximizing sustainable use opportunities and devolving responsibility for key functions and facilities will be introduced. Existing PAs will be managed more effectively, rates of ecosystem loss outside PAs will decline, and key landscapes will be rehabilitated and restored.

National development policy will continue to be focused firmly on economic growth and poverty reduction, and on the expansion of trade, industry and investment. A more proactive and progressive on-the-ground approach to ecosystem conservation will, however, be reflected in greater success in mainstreaming conservation goals into the strategies, policies and plans of other sectors. New conservation management and funding approaches will be backed up by a series of new policies and instruments, and improved implementation and enforcement of existing ones. Although the policies and instruments of other sectors will continue to present some level of perverse incentives as regards ecosystem conservation, new financing mechanisms for conservation will go some way towards balancing the market and price distortions that have long acted as disincentives to sustainable ecosystem management.

Urbanization and market integration will increase, and there will be an upsurge in industrial and commercial activities across the region. The focus on more environmentally sustainable development by government and overseas donors, combined with more effective enforcement of environmental laws, will however mitigate many of the negative effects that economic growth implies in terms of land-use change and resource demands. Investments will be made in promoting cleaner production, alternative energy sources, greener technologies and sustainable sourcing of products. Meanwhile, both the corporate sector and civil society will become more involved in sustainable use activities, and better able to benefit from the economic opportunities they afford. The effects of climate variability and climate change will continue to pose a threat both to people's economic well-being and to the status of natural ecosystems, but human and natural systems will be more resilient, and less vulnerable to these stresses and shocks.

Development will not be achieved without some impact on biodiversity and ecosystems. Some areas of formerly pristine ecosystems will see an increased level of human presence and economic activities, and there will be some level of habitat degradation, conversion and modification. These trade-offs will, however, gradually be balanced by more effective conservation in other locations.

Central budget allocations to PAs will see a small and steady increase, and there will be substantial growth in new sources of conservation finance, particularly those sourced from other sectors, self-generated revenues, the private sector, PES, carbon finance and voluntary contributions. Ecosystem conservation will become more financially sustainable and cost-effective.

2. What are the impacts of ecosystem change on economic values in the Lower Mekong region?

Each future ecosystem management and use scenario has different implications for the economy, and for people's economic well-being. This chapter integrates the information on ecosystem values presented in Part II with the scenario models developed in Chapter 1, Part III and the methodology described in Part !. It presents estimates of the monetary values associated with achieving each scenario, and describes how costs and benefits will be distributed between different stakeholder groups. It finishes by outlining the potential economic gains from the collaborative management of ecosystems and the maintenance of key ecosystem services.

Net present benefits and costs of Business As Usual and Green Economic Growth

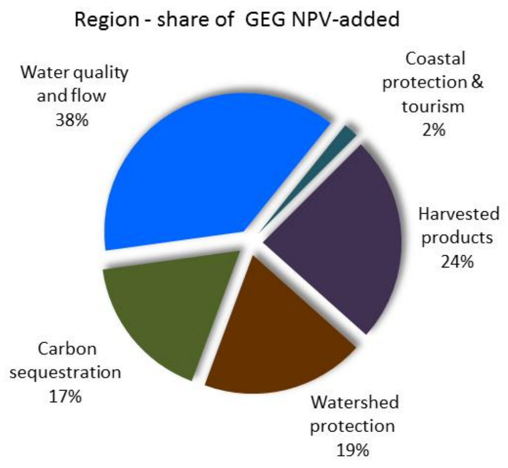
The scenario analysis makes it clear that there are considerable gains to the region from GEG over and above a continuation of BAU. At the regional level, the net present value added from pursuing such a strategy is estimated at almost US$10.5 billion (Table 4; see Table 5 for country-level figures). As ecosystems are maintained and improved, all ecosystem services increase in value over the 25-year period modelled. Although the value added to extractive uses and harvested production is not insignificant, with a NPV of more than US$2.5 billion, regulating and supporting services contribute by far the greatest proportion – around three-quarters – of this value (Figure 7).

Table 4: annual regional ecosystem services values under BAU and GEG (Net Present Value, US$ billion)

	BAU	GEG	Value added
Natural forests	64.19	69.87	5.68
Freshwater wetlands	45.82	50.41	4.59
Mangroves	1.10	1.19	0.10
Coral reefs	0.63	0.71	0.08
Total	**111.74**	**122.19**	**10.45**

	BAU	GEG	Value added
Harvested products	26.39	28.91	2.52
Watershed protection	25.34	27.33	1.99
Carbon sequestration	19.14	20.94	1.79
Water quality and flow	39.38	43.35	3.96
Coastal protection	1.32	1.48	0.16
Coastal tourism	0.17	0.19	0.02
Total	**111.74**	**122.19**	**10.45**

Figure 7: regional Net Present Value by GEG by ecosystem service type



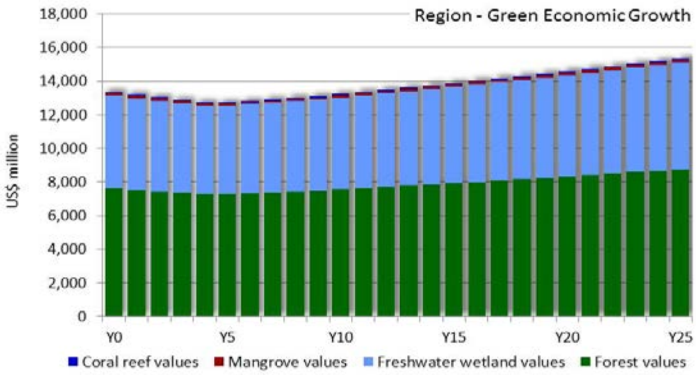
Change in ecosystem values over time

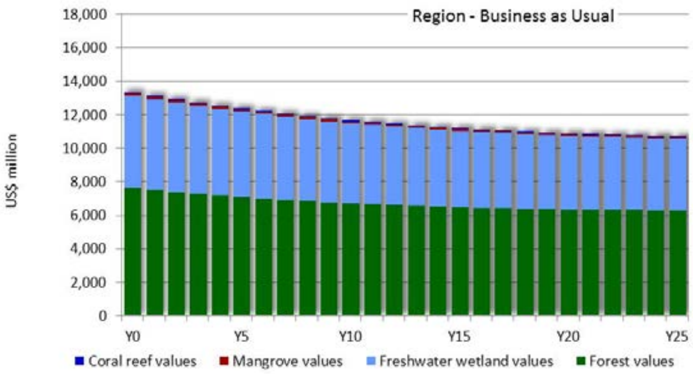
As is to be expected, and has already been described above, the implementation of GEG will initially result in a decline in ecosystem service values[25] (Figure 8; see Figure 11 for country-level figures). It will take time to shift to more sustainable and reduced-impact land and resource activities and initiate improved ecosystem management and investment. As a result, there will be a delay before the current downward trends in ecosystem status are reversed and the impacts on

[25] This is in addition to increased ecosystem conservation and management costs, which are not included in the analysis.

service provision become apparent. However, over time the value of ecosystem services will recover, and continue to grow. In contrast, under BAU, it is possible to discern a steady downward trend in values, as ecosystems are degraded, become unable to support the demands for extractive use that are placed on them, and yield a progressively declining quality and quantity of services.

Figure 8: annual regional annual ecosystem values under BAU and GEG

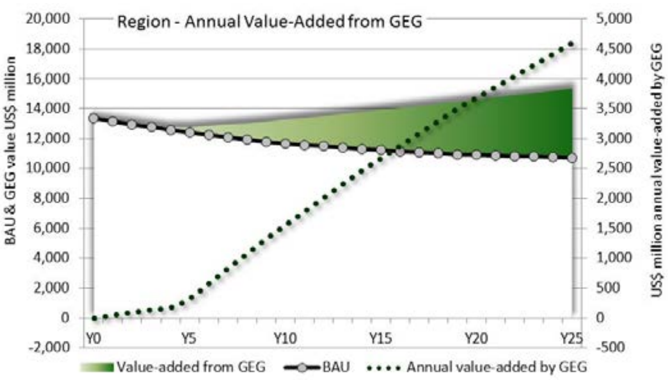




Value added from GEG

As described above, the NPV from GEG over and above that which would be generated under BAU is estimated at almost US$10.5 billion. The value added by GEG will steadily increase over time. By 2035 (the end of the time period analysed), GEG will be generating an annual value added of more than US$4.6 billion as compared to the benefits that would have been gained under BAU (Figure 9; see Figure 12 for country-level figures). Cumulatively, almost US$55 billion value will have been added to the region's economy by GEG over and above BAU (see Figure 13 for country-level figures). These values can also be thought of as the costs of policy inaction over the next 25 years: the losses that will accrue as a consequence of failing to take steps to reverse the current trends of ecosystem degradation and underinvestment.

Figure 9: annual regional annual and cumulative value added from GEG over BAU



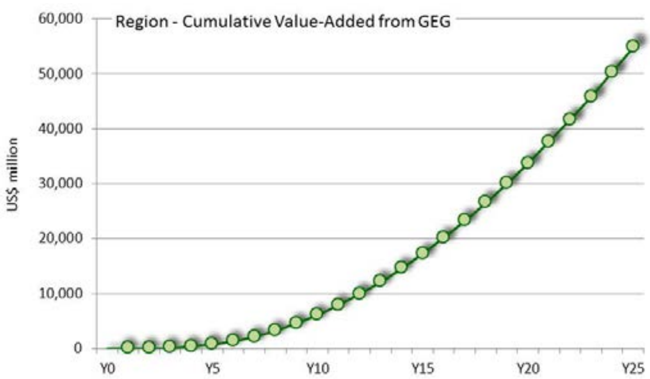
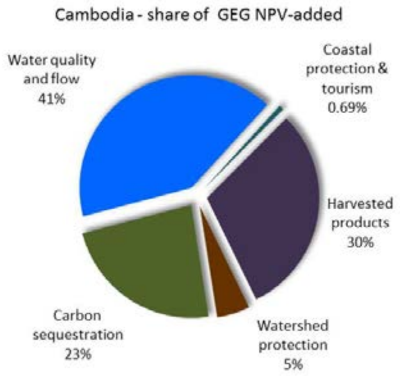


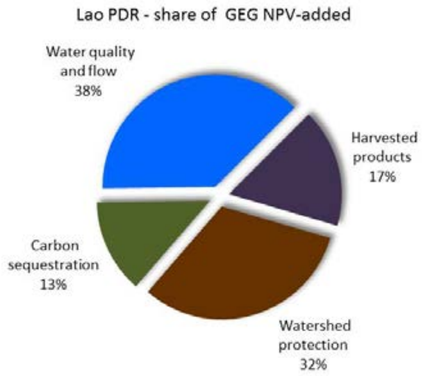
Table 5: annual ecosystem services values under BAU and GEG for Cambodia, Laos, Thailand and Vietnam (Net Present Value, US$ billion)

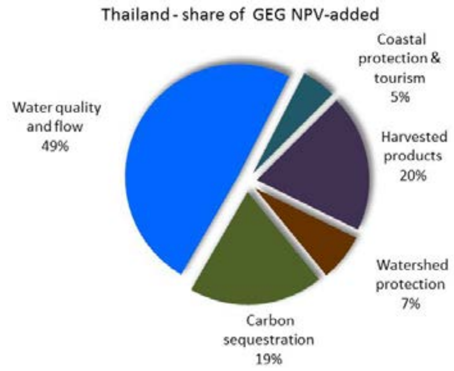
	Cambodia			Laos			Thailand			Vietnam		
	BAU	GEG	Value added	BAU	GEG	Value added	BAU	GEG	Value added	BAU	GEG	Value added
Natural forests	6.78	8.18	1.40	26.34	28.23	1.89	12.81	13.66	0.84	18.26	19.80	1.54
Freshwater wetlands	9.92	11.13	1.22	12.54	13.96	1.42	13.34	14.46	1.12	10.03	10.87	0.84
Mangroves	0.16	0.18	0.01	-	-	-	0.58	0.64	0.05	0.35	0.38	0.03
Coral reefs	0.01	0.01	0.00	-	-	-	0.39	0.44	0.05	0.23	0.26	0.03
Total	**16.87**	**19.50**	**2.64**	**38.88**	**42.19**	**3.31**	**27.13**	**29.19**	**2.06**	**28.87**	**31.31**	**2.44**

	Cambodia			Laos			Thailand			Vietnam		
	BAU	GEG	Value added	BAU	GEG	Value added	BAU	GEG	Value added	BAU	GEG	Value added
Harvested products	4.36	5.16	0.80	6.98	7.54	0.56	6.03	6.44	0.41	9.02	9.77	0.75
Watershed protection	0.61	0.73	0.13	14.68	15.73	1.05	2.14	2.28	0.14	7.92	8.59	0.67
Carbon sequestration	2.99	3.61	0.62	6.18	6.63	0.44	6.00	6.40	0.40	3.97	4.30	0.34
Water quality and flow	8.76	9.84	1.08	11.05	12.29	1.25	12.11	13.13	1.01	7.46	8.09	0.63
Coastal protection	0.13	0.15	0.02	-	-	-	0.74	0.83	0.09	0.44	0.50	0.05
Coastal tourism	0.02	0.02	0.00	-	-	-	0.10	0.11	0.01	0.06	0.06	0.01
Total	**16.87**	**19.50**	**2.64**	**38.88**	**42.19**	**3.31**	**27.13**	**29.19**	**2.06**	**28.87**	**31.31**	**2.44**

Figure 10: net present value added by GEG by ecosystem service type for Cambodia, Laos, Thailand and Vietnam







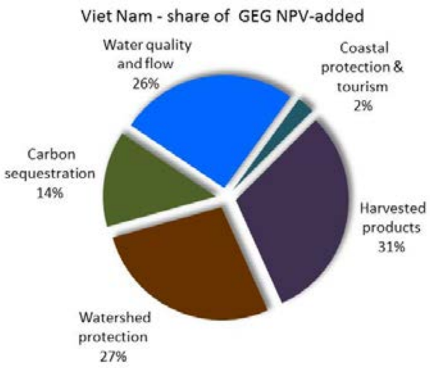
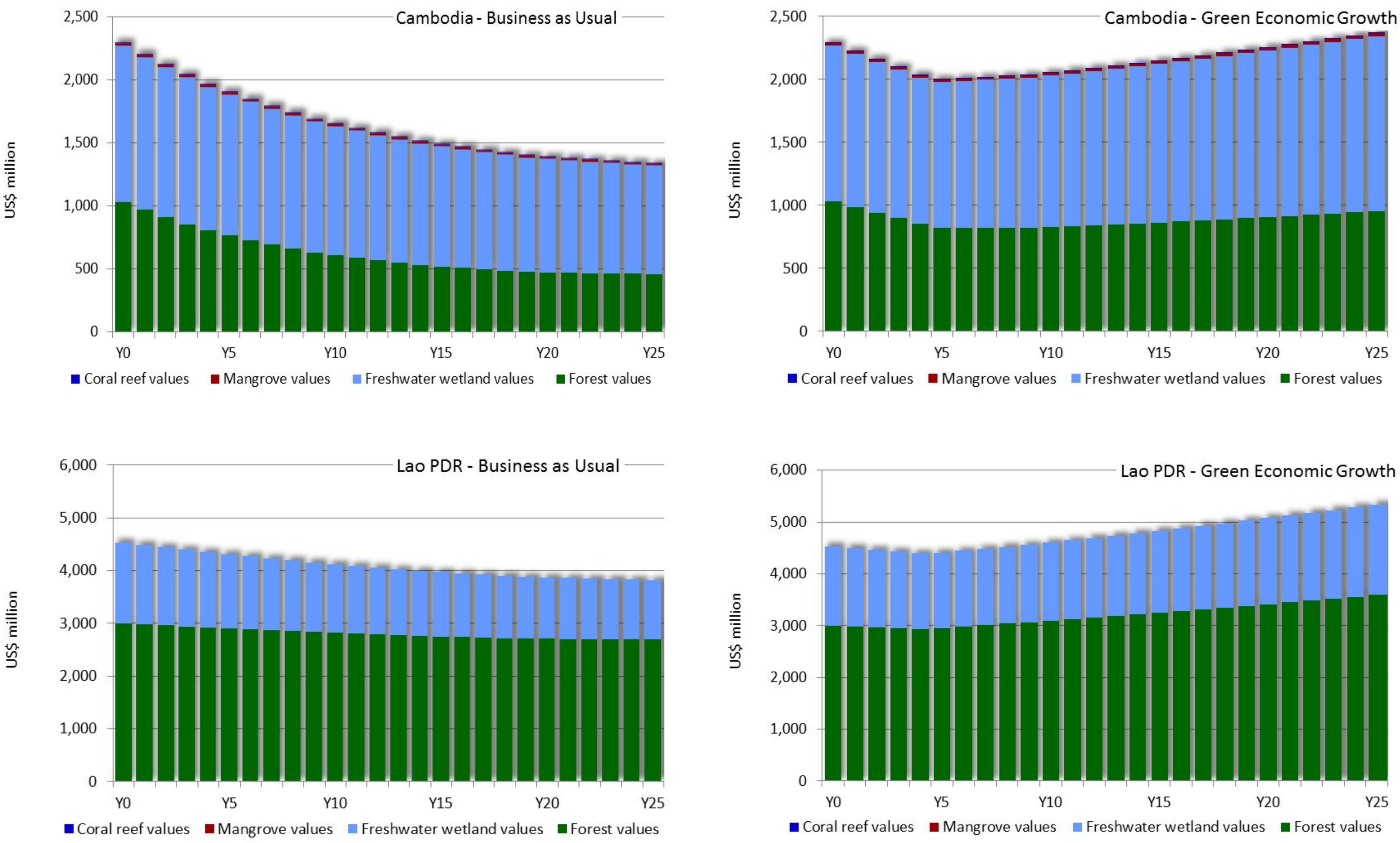
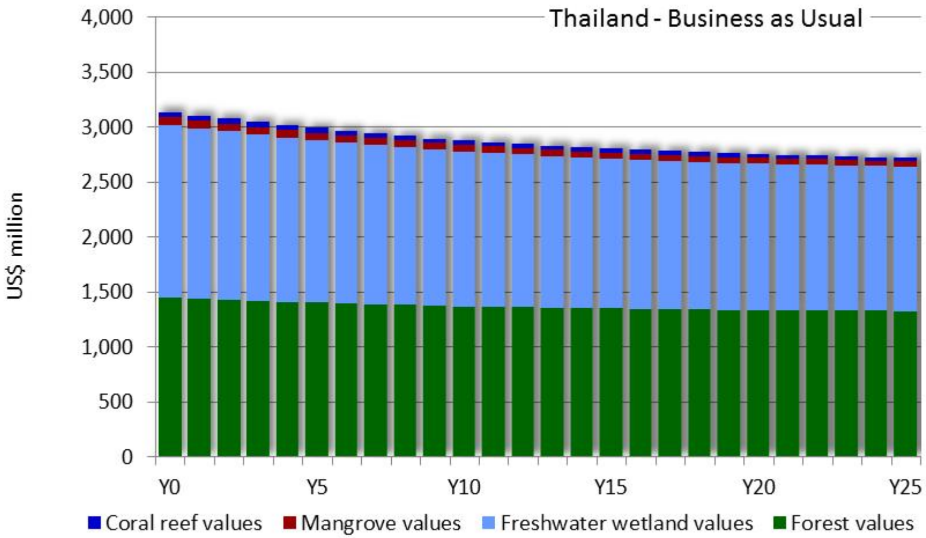
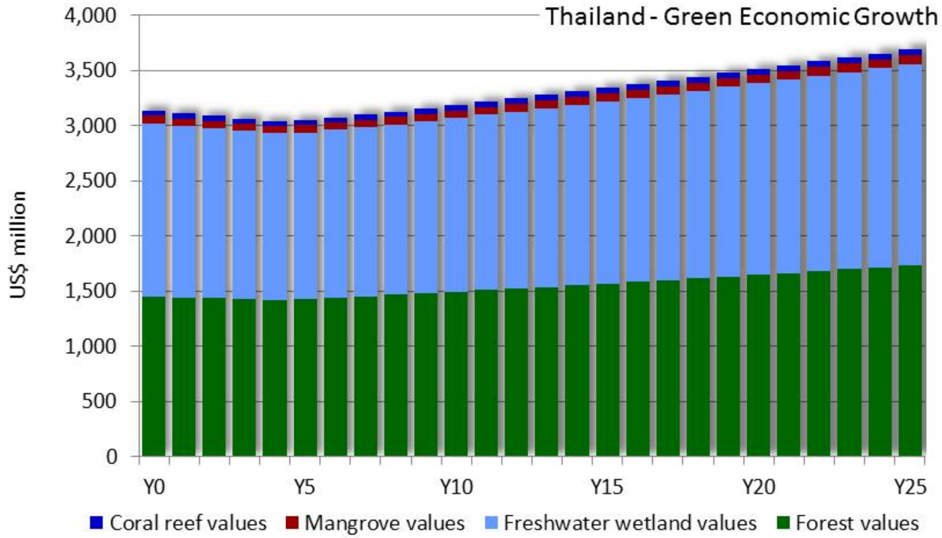
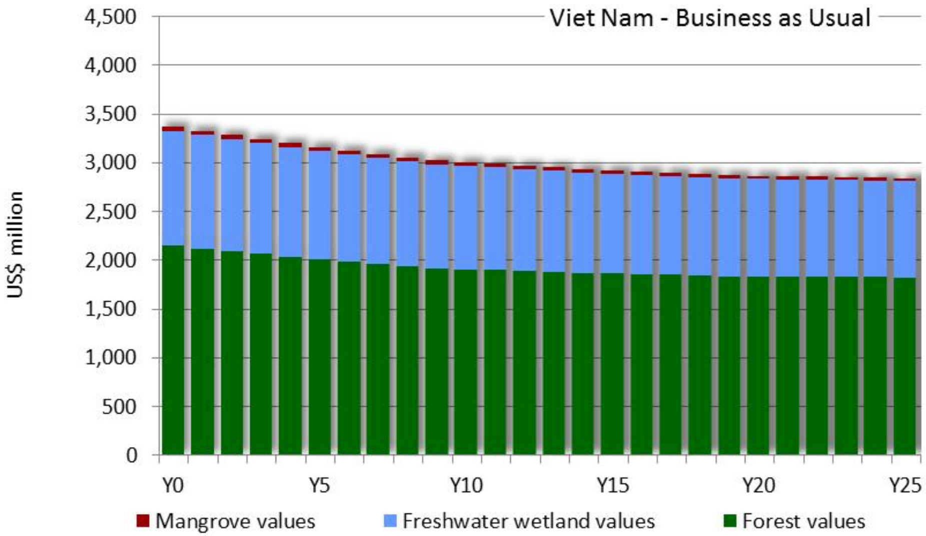


Figure 11: annual ecosystem values under BAU and GEG for Cambodia, Laos, Thailand and Vietnam




Thailand - Business as Usual
US$ million
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Y0
Y5
Y10
Y15
Y20
Y25
Coral reef values
Mangrove values
Freshwater wetland values
Forest values


Thailand - Green Economic Growth
US$ million
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Y0
Y5
Y10
Y15
Y20
Y25
Coral reef values
Mangrove values
Freshwater wetland values
Forest values


Viet Nam - Business as Usual
US$ million
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
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Y0
Y5
Y10
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Y20
Y25
Mangrove values
Freshwater wetland values
Forest values

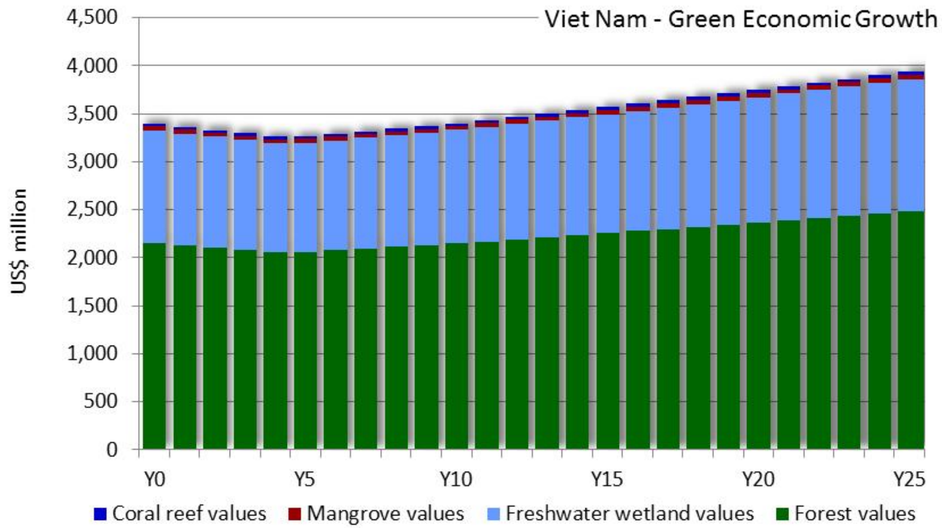

Viet Nam - Green Economic Growth
US$ million
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Y0
Y5
Y10
Y15
Y20
Y25
Coral reef values
Mangrove values
Freshwater wetland values
Forest values

Figure 12: annual value added from GEG over BAU for Cambodia, Laos, Thailand and Vietnam

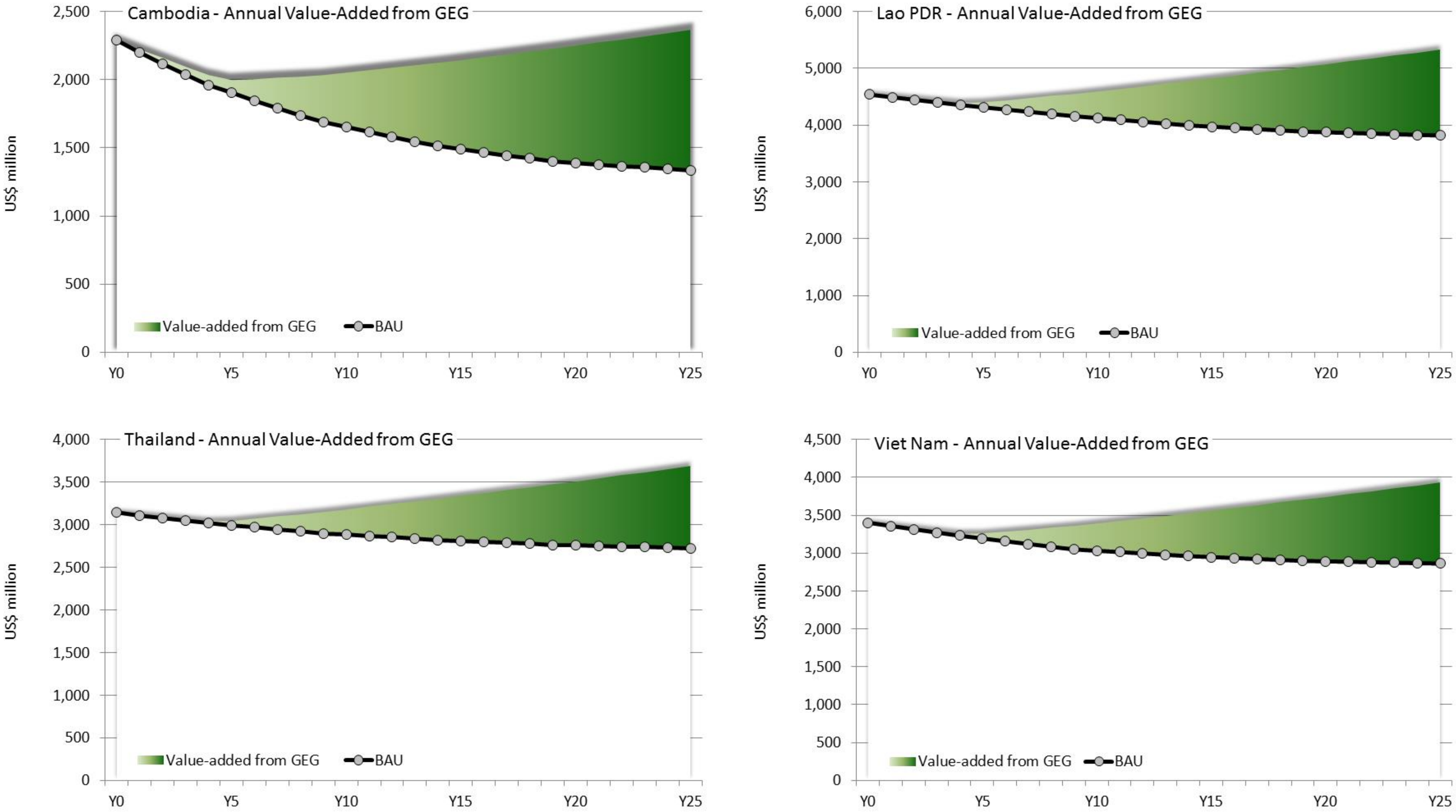
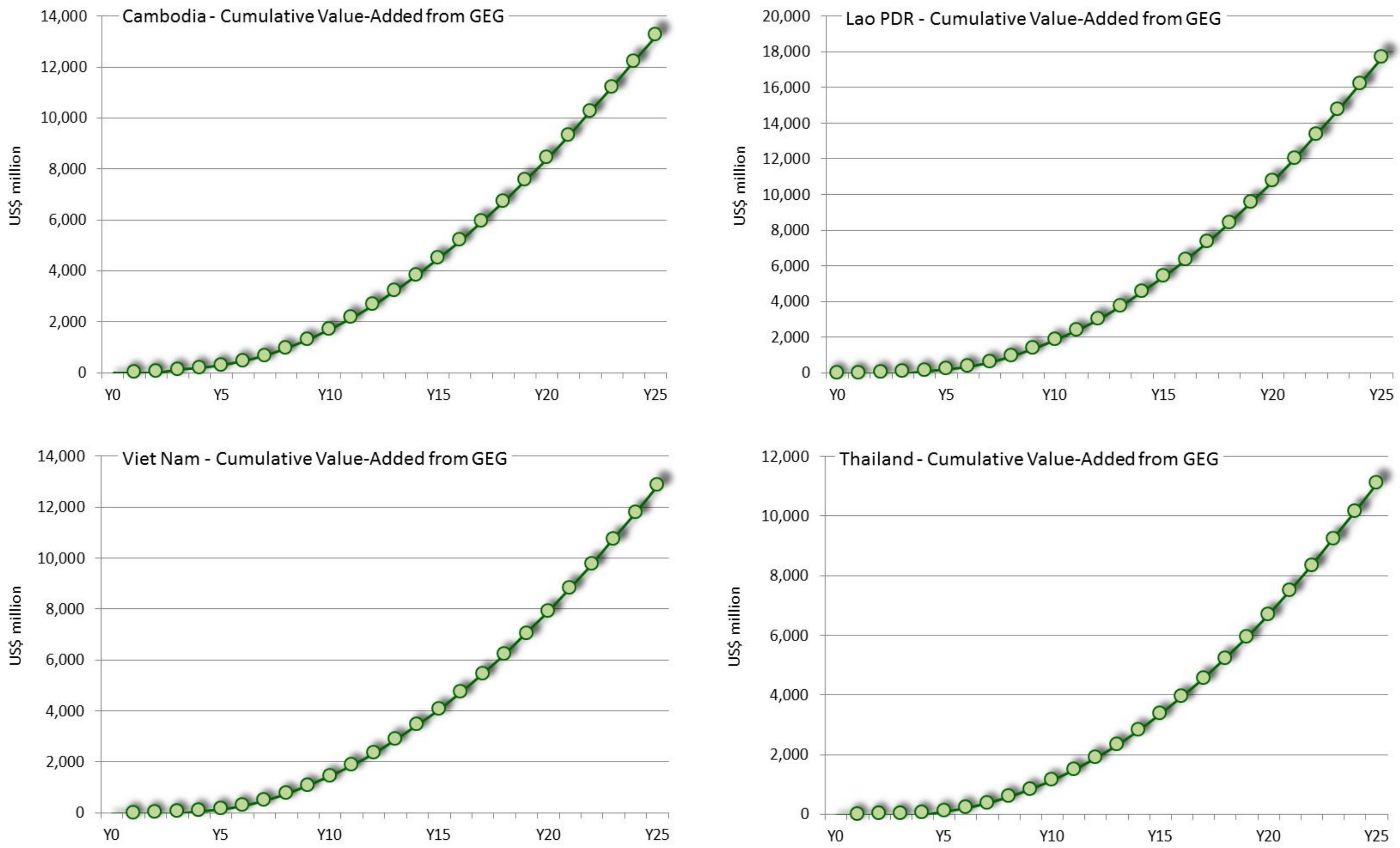


Figure 13: cumulative value added from GEG over BAU for Cambodia, Laos, Thailand and Vietnam



PART IV: ADVANCING ECOSYSTEM VALUATION

1. Towards improved valuation of the region's ecosystem services

On the basis of the foregoing analysis, this chapter reflects on the needs to advance ecosystem valuation in the Lower Mekong, and on the steps that are necessary to do this. It identifies critical information gaps and data needs, and reviews available ecosystem techniques and tools as to their suitability for application in the region. The chapter ends by proposing a series of broad recommendations which relate to the core elements of a future project or programme that might be undertaken to further this work.

What are the information needs and gaps?

One gap is clearly in estimates of the value of ecosystem services. There is a lack of information on almost all ecosystem values in the region, including most ecosystem types and categories of ecosystem services. Although almost 100 ecosystem valuation studies from the region were discovered as part of the current study, of which around 60 per cent were broadly useable, only a handful deal with each category of ecosystem and ecosystem service. The exception to this is estimates on the economic value of non-timber forest products, for which there is a large body of information. Even among those studies that were considered useable, serious questions arise about the accuracy and credibility of some ecosystem service value estimates. Particularly critical gaps concern supporting and provisioning services, particularly for freshwater wetlands and coral reefs.

The resulting estimates of ecosystem values vary so widely between different studies that it is of paramount importance to generate an additional body of information, based on credible assumptions and data, to widen the sample from which value estimates can be obtained. **We recommend that at the very least, efforts are made to generate new primary data on the key values, particularly supporting and provisioning services, for representative ecosystems in the region.** Without such information, it will be difficult to advance ecosystem valuation.

The information gap is, however, far wider than just a dearth of credible economic estimates of ecosystem values. Most ecosystem valuation estimates have a very weak scientific basis, and the assumptions they make about the links between ecosystem status and the provision of given ecosystem services are largely under-researched. A basic lack of information about the underlying scientific and biophysical parameters relating to the region's ecosystems both prevents more accurate valuation, and acts as a constraint to credible scenario-based modelling. Examples include detailed GIS and other figures on ecosystem status and change, and on the links between ecosystem status and the provision of given ecosystem services. While **some of this scientific and biophysical data may exist, or may even already be readily accessible, it needs to be identified, extracted and made available in a form that can be integrated into economic modelling and datasets**.

Although primary data and figures are obviously needed, filling these information gaps requires more than just the generation and extraction of numbers. To carry out **a credible scenario modelling exercise and associated economic analysis also demands a much broader-based dialogue with key stakeholders and experts in the region**. Only through this wider consultation and input can realistic scenarios of future development, conservation and ecosystem trends be built up.

An associated issue, and major gap in the current study, is **linking ecosystem and economic scenario modelling to a thorough analysis of the drivers of ecosystem change in the region**. Future changes in ecosystem services will result from the interactive and cumulative effects of a large number of social, economic and other drivers. Further information is needed on the pressures and threats that are currently occurring, and are likely to persist in the future, in order to predict future ecosystem values with any degree of certainty.

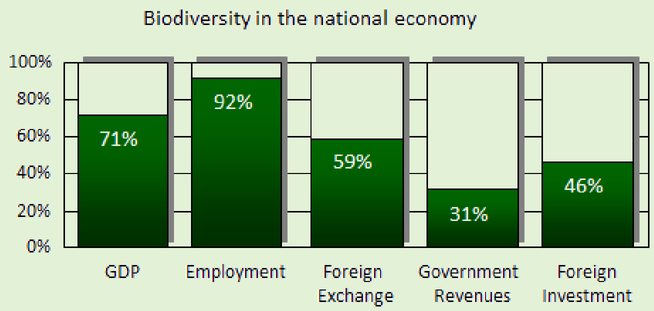
Last, but not least, is the issue of communications. However good the data and "science" of ecosystem valuation and scenario modelling are, the **resulting information has little relevance if it is not being communicated effectively to decision-makers. It needs to be communicated in a form that is practical, policy-relevant and credible to them, and which leads to real changes in both development and conservation policy and practice**. Economic and monetary measures can be especially convincing to planners and policy-makers, but simply generating such figures is not enough. Values have little meaning unless they actually tell a story, and relate directly to the development and economic indicators in the region that matter to decision-makers. Box 6 provides one example of how information on ecosystem values was specifically articulated in terms of measures and arguments that mattered to decision-makers – in this case financial and economic planners in government and development donor agencies in Laos.

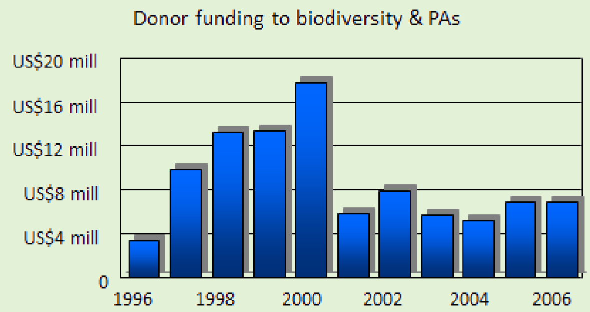
Box 6: demonstrating the value of biodiversity to Laos' economy to public decision-makers

With the major aims of ensuring that adequate investment in biodiversity and protected areas could be justified to economic planners and decision-makers in government and the donor community, an economic assessment was carried out as part of Laos's National Biodiversity Strategy and Action Plan. The results underlined the importance of biodiversity to the country's key development goals as articulated in the Five Year Socio-Economic Development Plan and National Development Vision. They showed that biodiversity contributes almost three-quarters of per capita GDP, more than 90 per cent of employment, just under 60 per cent of exports and foreign exchange, a third of government revenues and nearly half of foreign investment.

Yet both donor and government budgets to biodiversity have fallen drastically in recent years. There has been a major change in development policy and funding priorities – finance has been realigned towards economic growth, poverty alleviation and the Millennium Development Goals. Budgets were shifted away from conservation. Today, funding to PAs is less than 40 per cent of what it was in 2000, and continues to decline sharply.

The figures presented questioned the wisdom of these decisions. As natural ecosystems make such a demonstrably important contribution to the national economy, failing to allocate adequate funds to their conservation may in fact undermine the main goals that government and donor assistance aim to achieve: sustainable and equitable development for all (from Emerton et al. 2002b).





What valuation frameworks and tools could be used?

Techniques to assess the value of ecosystem services

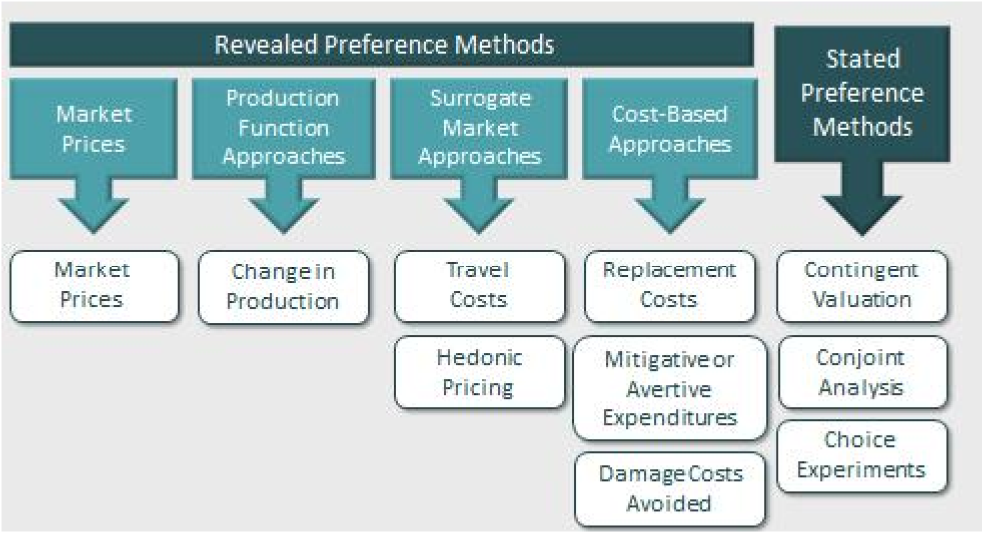
Today, a wide range of ecosystem valuation techniques is in common usage. These address the fact that ecosystem services tend to be left out of conventional economic calculations and analyses, because they so often do not have a market or a price. It is beyond the scope of this document to describe these valuation techniques in detail (although further details on each of the main techniques listed in terms of the requirements and steps in their application to valuing ecosystem services are provided in Annex Chapter 2). **We give no specific recommendations on individual ecosystem valuation techniques, as each is suitable for different situations, and it is generally considered best practice to deploy as broad a range of techniques as possible.**

As summarised below in Figure 14 and Table 6, the main toolbox of ecosystem valuation techniques used by economists and suitable for further development in the region includes:

- **Production function approaches:** These attempt to relate changes in the output of a marketed good or service to a measurable change in the quality or quantity of ecosystem goods and services by establishing a biophysical or dose-response relationship between ecosystem quality, the provision of particular services, and related production.
- **Surrogate market approaches:** These look at the ways in which the value of ecosystem goods and services is reflected indirectly in people's expenditures, or in the prices of other market goods and services.
- **Cost-based approaches:** These look at the market trade-offs or avoided costs from maintaining ecosystems for their goods and services.

- **Stated-preference approaches:** Rather than looking at the way in which people reveal their preferences for ecosystem goods and services through market production and consumption, these methods ask consumers to state their preference directly.

Figure 14: commonly used techniques for ecosystem valuation



(from Emerton and Bos 2004)

Table 6: how ecosystem valuation techniques can be applied

Valuation techniques		How they are applied, and for what
Revealed preference approaches	Market prices	How much it costs to buy an ecosystem good or service, or what it is worth to sell – e.g., the price of timber or minerals
	Effect on production	Changes in the output of a marketed good or service related to a measurable change in ecosystem services – e.g., the reduction in lifespan of a hydropower dam due to siltation resulting from deforestation
	Travel costs	The amount of time and money people spend visiting an ecosystem for recreation or leisure purposes – e.g., the transport and accommodation costs, entry fees and time spent to visit a National Park
	Hedonic pricing	The difference in property prices or wage rates that can be ascribed to the different ecosystem qualities or values – e.g., the difference in house prices between those overlooking an area of natural beauty and those without a view of the landscape
Cost-based approaches	Replacement costs	The cost of replacing an ecosystem good or service with artificial or man-made products, infrastructure or technologies, in terms of expenditures saved – e.g., the costs of flood protection infrastructure after the loss of catchment protection forest
	Mitigative or avertive expenditures	The expenditures required to mitigate or avert the negative effects of the loss of ecosystem services, in terms of expenditures saved – e.g., additional purification infrastructure required to maintain water quality standards after the loss of natural wetlands
	Damage costs avoided	The costs incurred to property, infrastructure and production when ecosystem services which protect economically valuable assets are lost, in terms of expenditures saved – e.g., the damage to roads, bridges, farms and property resulting from increased flooding after the loss of catchment protection forest
Stated preference approaches	Contingent valuation	Ecosystem values inferred by asking people directly what is their willingness to pay (WTP) for them or their willingness to accept (WTA) compensation for their loss – e.g., how much would you be willing to contribute towards a fund to clean up and conserve a river?
	Conjoint analysis	Information elicted on preferences where the respondent would have to choose between scenarios involving ecosystem services, at different prices or costs saved – e.g., the relative value of wildlife, landscape and water quality attributes of a river under different scenarios
	Choice experiments	A series of alternative resource or ecosystem use options, each defined by various attributes including price; respondents are asked to evaluate these "sets", which each contain different bundles of ecosystem services – e.g., respondents' preferences for conservation, recreational facilities and educational attributes of natural woodlands

(from Emerton 2009b)

Guidance on conducting ecosystem valuation

A vast amount of guidance has been produced on how to go about valuing ecosystems, using the techniques summarized in the previous section. A wide variety of ecosystem valuation manuals and guidelines are listed in Table 7, which represent the main state of knowledge on this topic. Several guidance documents and toolkits have also been produced aiming to equip the staff of environmental agencies with the economic valuation methods and arguments to advocate for their sector. The focus of these efforts has primarily been directed at the public sector, to enable government conservation planners to target their arguments to central finance ministries and treasuries, and donor development agencies. Recent examples include a "primer" on making the economic case for mainstreaming environment into national development planning that has been produced by the UNDP-UNEP Poverty and Environment Initiative (Emerton 2008), and The Nature Conservancy's recent guide to valuing nature for protected area managers (Pabon-Zamora et al. 2008). **Most of these toolkits provide useful guidance which could, potentially, be applied in a future programme of ecosystem valuation in the region.**

In addition, there are now a number of websites dedicated specifically to summarising and listing global references on ecosystem valuation. Some of these are searchable by ecosystem, type of service or country. The most widely used online valuation databases are summarised in Table 8. As data on key ecosystem service values has been identified as a major information gap above, these might seem to be valuable resources for any future work on ecosystem valuation in the Lower Mekong region. Certainly, they provide a cheap, quick and easy method for accessing data on ecosystem values.

Extreme caution must, however, always be deployed in transposing estimates from one country or site to others. This has already been highlighted as a major issue in the current study, in terms of transferring data from one part of Southeast Asia to another, where ecological and socio-economic conditions are relatively homogeneous. The risks and hazards inherent in a "benefit-transfer[26]" approach which takes data from other parts of the world and attempts to apply it universally, or in very different countries or locations, are obvious – and cannot be considered best practice. Unfortunately, this is exactly the method that has been used in several of the more well-known and widely publicized ecosystem valuation studies (for example in the now-infamous *Nature* article by Costanza et al. (1997), or in the 2008 TEEB studies). **The use of benefit-transfer techniques which are based on applying figures generated in other parts of the world is not recommended for use in any further ecosystem valuation work in the Lower Mekong region without i) strict assessment of the validity of the use of such estimates and/or ii) additional manipulation of the estimates to be transferred to match more closely with local conditions.**[27] Such valuation references and databases have a use in the Lower Mekong context, but this is primarily for cross-checking, comparison and triangulation purposes, not as the source of estimates of ecosystem values.

[26] Benefit transfer involves applying values estimated from studies elsewhere to the study site in question, making adjustments as appropriate. It must be applied carefully and transparently to avoid significant errors.
[27] See the following references for further information on benefit transfer methods: EEA. 2010 and Brander et al. (2012).

Table 7: ecosystem valuation guidelines

Title	Author/published	Date	Coverage
Guidelines for biodiversity valuation			
An Exploration of Tools and Methodologies for Valuation of Biodiversity and Biodiversity Resources and Functions	Convention on Biological Diversity	2007	Global
Making Economic Valuation Work for Biodiversity Conservation	Department of Environment and Heritage, Land & Water Australia	2005	Australia
Handbook of Biodiversity Valuation: A Guide for Policy Makers	Organisation for Economic Co-operation & Development (OECD)	2002	OECD countries
Valuation of Biodiversity	Organisation for Economic Co-operation & Development (OECD)	2001	OECD countries
The Valuation of Biological Diversity for National Biodiversity Action Plans and Strategies: A Guide for Trainers	United Nations Environment Programme (UNEP)	2000	Global
Economic Valuation of Biological Diversity	Convention on Biological Diversity	1996	Global
The Economic Value of Biodiversity	International Union for Conservation of Nature (IUCN)	1994	Global
Economic Value of Ecosystems: 3 - Biological Diversity	International Institute for Environment & Development (IIED)	1991	Global
Guidelines for ecosystem services & environmental valuation			
An introductory guide to valuing ecosystem services	UK Department for Environment, Food & Rural Affairs (DEFRA)	2007	United Kingdom
Valuation for Environmental Policy: Ecological Benefits	US Environmental Protection Agency	2007	United States
The Economic, Social and Ecological Value of Ecosystem Services	UK Department for Environment, Food & Rural Affairs (DEFRA)	2005	United Kingdom
Estimating the Cost of Environmental Degradation: A Training Manual in English, French and Arabic	World Bank	2005	Global
Valuing Ecosystem Benefits: Readings and Case Studies on the Value of Conservation	World Bank, International Union for Conservation of Nature (IUCN), and The Nature Conservancy (TNC)	2005	Global
How Much is an Ecosystem Worth ? Assessing the Economic Value of Conservation	International Union for Conservation of Nature (IUCN), The Nature Conservancy (TNC) and the World Bank	2004	Global
Assessing the Economic Value of Ecosystem Conservation	World Bank and International Union for Conservation of Nature (IUCN)	2004	Global
Environmental Valuation: A Worldwide Compendium of Case Studies	United Nations Environment Programme (UNEP)	2000	Global
Environment and Economics in Project Preparation	Asian Development Bank	1999	Asia
Economic Analysis and Environmental Assessment Sourcebook Update No. 23, 1998	World Bank	1998	Global
A Review of Economic Appraisal of Environmental Goods and Services: With a Focus on Developing Countries	International Institute for Environment & Development (IIED)	1996	Developing countries
Monetary Measurement of Environmental Goods and Services: Framework and Summary of Techniques for Corps Planners	US Army Corps of Engineers	1996	United States
Review of Monetary and Non-Monetary Valuation of Environmental Investments	US Army Corps of Engineers	1995	United States
Economic Values and the Environment	United Nations Environment Programme (UNEP)	1994	Global
The Measurement of Environmental and Resource Values: Theory and Methods.	Resources for the Future (RFF)	1993	Global
Economic Valuation and the Natural World	World Bank	1992	Global
Policy Appraisal and the Environment	UK Department of the Environment	1991	United

Title	Author/published	Date	Coverage
			Kingdom
Values for the Environment	UK Overseas Development Administration (ODA)	1991	Global
Economic Analysis of the Environmental Impacts of Development Projects	Asian Development Bank	1986	Asia
Guidelines for Preparing Economic Analyses	US Environmental Protection Agency	2008	United States
Guidelines for forest valuation			
Using Economic Valuation to Promote Forest Biodiversity Conservation: A Toolkit	International Union for Conservation of Nature (IUCN)	2004	Eastern and Southern Africa
Valuing Forests: A Review of Methods and Applications in Developing Countries	International Institute for Environment and Development (IIED)	2003	Developing countries
Herramientas para la valoración y manejo forestal sostenible de los bosques sudamericanos	International Union for Conservation of Nature (IUCN)	2003	South America
Economic Valuation of Forests and Nature: A support tool for effective decision-making	Wageningen University	2002	Global
The Value of Forest Ecosystems	Convention on Biological Diversity	2001	Global
Forest Valuation for Decision Making	Food & Agriculture Organization of the United Nations (FAO)	1997	Global
Valuing the Hidden Harvest: Methodological approaches for local-level economic analysis of wild resources	International Institute for Environment & Development (IIED)	1997	Developing countries
Economic Value of Ecosystems: 2 - Tropical Forests	International Institute for Environment & Development (IIED)	1991	Global
Guidelines for marine & coastal valuation			
Valuing the Environment in Small Islands	UK Overseas Territories Environment Programme (OTEP) and the UK Joint Nature Conservation Committee (JNCC)	2007	Global
Economic Valuation of Natural Resources: A Guidebook for Coastal Resources Policymakers	National Oceanic and Atmospheric Administration (NOAA)	1995	United States
Economic Value of Ecosystems: 4 - Coral Reefs	International Institute for Environment & Development (IIED)	1992	Global
Guidelines for protected areas valuation			
Valuing Nature: Assessing Protected Area Benefits	The Nature Conservancy (TNC) and Convention on Biological Diversity	2008	Global
The Use of Economic Valuation for Protected Area Management: A Review of Experiences and Lessons Learned	International Union for Conservation of Nature (IUCN)	2001	Global
Economic Values of Protected Areas: Guidelines for Protected Area Managers	International Union for Conservation of Nature (IUCN)	1998	Global
Guidelines for watershed & wetland valuation			
Watershed Valuation as a Tool for Biodiversity Conservation	The Nature Conservancy (TNC)	2007	Latin America
Valuing wetlands: Guidance for valuing the benefits derived from wetland ecosystem services	Ramsar Convention and Convention on Biological Diversity	2006	Global
Tools for Wetland Valuation	International Union for Conservation of Nature (IUCN)	2005	Southern Africa
Value: Counting Ecosystems as an Economic Part of Water Infrastructure	International Union for Conservation of Nature (IUCN)	2004	Global
Economic Value of Ecosystems: 1 - Tropical Wetlands	International Institute for Environment & Development (IIED)	1989	Global

(from Emerton 2009b)

Table 8: online databases of ecosystem valuation references

Database	Publisher	Web
Biodiversity valuation library	The **Ecosystem Marketplace**, a project of Forest Trends.	http://www.ecosystemmarketplace.com/
Coastal environmental economics extension network	National Oceanic and Atmospheric Administration (NOAA) & Sea Grant	http://www.mdsg.umd.edu/topics/extension/our-services
Conservation value map	Conservation International (CI)	http://www.iarn-ar.org/
Ecosystem Valuation	Dennis M. King & Marisa Mazzotta	www.ecosystemvaluation.org
Envalue	New South Wales Department of Environment and Climate Change	www.environment.nsw.gov.au/envalue
Environmental valuation and cost benefit website	The Cost-Benefit Group	www.costbenefitanalysis.org
Environmental Valuation Reference Inventory	Environment Canada	www.evri.ca
New Zealand Non Market Valuation Database	Lincoln University	http://www.lincoln.ac.nz/research-themes/ecosystem-services/Research-Projects-and-Websites/Ecosystem-Services-Valuation-Database/
ValueBase^{SWE}	Beijier Institute	www.beijer.kva.se/valuebase.htm

(Adapted from Emerton 2009b)

Analytical tools

More recent initiatives in ecosystem valuation being carried out by conservation NGOs and universities have resulted in a series of quite sophisticated and innovative web-based tools, data models and Geographic Information System (GIS) based approaches and software models. Most of these are currently still under development, and deal with incorporating ecosystem values into spatial planning and decision-making. Four of the more prominent are summarised in Table 9.

Although such tools are undoubtedly useful, the use of "off-the-shelf" ecosystem valuation analytical tools is not currently recommended for future work in the Lower Mekong region. Most involve the user inputting key data on the specific site, ecosystem service or sector that they are concerned with, and combine this information to generate valuation results. Many use aggregated or averaged information on ecosystem values taken from other sites and contexts, or are based on applying national, regional or global estimates of the value of key ecosystem services. As such, they should be treated with great caution: most are still in a development stage, depend on doubtful data, and are often cumbersome and inflexible to use (WBCSD, forthcoming).

The vast majority of ecosystem valuation exercises use simple, tailor-made spreadsheet models. By their very nature, such tools are highly flexible, readily aligning with both conservation and development objectives and processes. They can be easily linked to valuation databases and other tools such as GIS. **Simple, tailor-made spreadsheet models may be most appropriate for future work on ecosystem valuation in the region**.

Table 9: web-based tools and software models for ecosystem valuation

Valuation techniques		How they are applied, and for what
ARIES	Assessment and Research Infrastructure for Ecosystem Services - ecoinformatics.uvm.edu/projects/aries.html	Developed by the Gund Institute for Ecological Economics at the University of Vermont, in collaboration with the Ecoinformatics Collaboratory, Earth Economics and Conservation International, this web-based tool aims to facilitate rapid ecosystem service assessment and valuation in a given site, so as to make decision-making easier and more effective. Its output is an environmental asset portfolio that describes in depth the spatial distribution of ecosystems and ecosystem services in the selected site, their potential and realised economic values, likely trends for future values, and the causal relationships that link the values to each other and to actual or potential policies. A map and summary statistics of economic value for the area can also be built. ARIES can also be used to search for previously published data for the study site, as well as retrieving data from other comparable locations.
EcoValue	http://www.ecovalue.co.nz/	Based out of the University of Vermont, the project is developing a web-based, interactive decision support system for assessing and reporting the economic value of ecosystem services. This combines peer-reviewed valuation literature, GIS and regional database technology to provide interactive maps, graphs and statistics. The project is currently working in New Zealand and the US, but aims for eventual global coverage.
InVEST	Integrated Valuation of Ecosystem Services and Tradeoffs - naturalcapitalproject.org	The Natural Capital Project is a joint venture between TNC, WWF and the Woods Institute for the Environment at Stanford University. The project has developed a software tool, InVEST, which models and maps the delivery, distribution, and economic value of ecosystem services and biodiversity across the world. It assists users to visualize the impacts of land-use choices by identifying trade-offs and compatibilities between environmental, economic and social benefits.
MIMES	Multiscale Integrated Models of Ecosystem Services - http://www.ebmtools.org/mimes.html	The Gund Institute for Ecological Economics at the University of Vermont developed a suite of dynamic ecological economic computer models that quantifies the effects of varying environmental conditions derived from land-use change. MIMES evaluates land-use changes and subsequent effects on ecosystem services on global, regional and local levels. MIMES sub-models are organized into five different spheres – Atmosphere, Lithosphere, Hydrosphere, Biosphere and Anthroposphere – that are synthesized and interrelated. MIMES uses input data to develop relationships among the spheres to demonstrate how development, management and land-use decisions will affect natural, human and built capital. MIMES also intends to develop and apply new valuation techniques for ecosystem services that can be integrated with the models.

(from Emerton 2009b)

ANNEXES

1. Data tables

Table 10: summary of ecosystem service value estimates for Cambodia, Laos, Thailand and Vietnam

Country	Ecosystem/site	Type of value(s)	Value (US$ /year)	Source
Direct values / provisioning services				
Cambodia	Deciduous forest (various)	Non-timber forest products	37/ha	Hansen and Top 2006
Cambodia	Semi-evergreen forest (various)	Non-timber forest products	23/ha	
Cambodia		Sustainable timber	37/ha	
Cambodia	Evergreen forest (various)	Non-timber forest products	12/ha	
Cambodia		Sustainable timber	171/ha	
Cambodia	Forests (various)	Local non-timber forest products	280-345/hhold	
Cambodia	Evergreen forest (Mondulkiri and Koh Kong provinces)	Non-timber forest products	2.7/ha	ADB 2010
Cambodia	Evergreen forest (Tapean forest, Ratanakiri province)	Local non-timber forest products	165/ha	Bann 1997a
Cambodia	Evergreen, semi-evergreen and deciduous forests (Phnom Aural and Phnom Samkos Wildlife Sanctuaries)	Local non-timber forest products	15-85/hhold	Grieg-Gran et al. 2008
Cambodia	Lowland evergreen forest (Preah Sihanouk (Ream) National Park)	Local non-timber forest products	10/ha	Emerton et al. 2002a
Cambodia	Forest (various)	Local non-timber forest products	276-348/hhold	Heov et al. 2006
Cambodia	Forest (various)	Local non-timber forest products (fuelwood, charcoal, resin)	16-26/ha	Boscolo 2004
Cambodia			480-804/hhold	
Cambodia	Freshwater wetlands (Stoeng Treng province)	Local livelihood products (fish, aquatic animals, waterbirds, building materials)	658/ha	Chong 2005
Cambodia	Mangroves (Preah Sihanouk (Ream) National Park)	Local subsistence products (excluding fish)	344/ha	Emerton et al. 2002a
Cambodia		Local fisheries	286/ha	
Cambodia	Mangroves (Koh Kong Province)	Local fisheries	84/ha	Bann 1997b
Cambodia		Local firewood	3.5/ha	
Cambodia		Local sustainable charcoal	413/ha	
Laos	Forests (various)	Local non-timber forest products	14/ha	Emerton et al. 2002b
Laos		Local non-timber forest products subsistence use	223/hhold	
Laos		Local non-timber forest products cash income	2.2/ha	
Laos		Local non-timber forest products cash income	36/hhold	
Laos		Commercial non-timber forest products	1.3/ha	
Laos		Non-timber forest product exports	2.7/ha	
Laos		Local woodfuel	0.3/ha	
Laos		Local woodfuel	40/hhold	
Laos		Commercial woodfuel	0.07/ha	
Laos		Legal commercial timber	4.6/ha	

Country	Ecosystem/site	Type of value(s)	Value (US$ /year)	Source
Laos		Local timber	1.5/ha	
Laos	Forest (Sekong province)	Local non-timber forest products	17-23/ha	Rosales et al. 2003
Laos		Local non-timber forest products	398-525/ha	
Laos	Evergreen forest (Attapeu, Champasak and Xekong provinces)	Local non-timber forest products	7.1/ha	ADB 2010
Laos	Freshwater wetlands (various)	Local fish and aquatic animals	106/ha	Emerton et al. 2002b
Thailand	Forest (Chiang Mai province)	Local non-timber forest products cash income	8.3/ha	Hindui et al. 2008
Thailand	Forest (Thung Yai Naresuan Wildlife Sanctuary)	Local use of non-marketed wild edible plants	30-302/hhold	Delang 2005
Thailand		Local use of non-marketed wild edible plants	7.3-72/ha	
Thailand	Forest (Lower Songkhram)	Local non-timber forest products (wild vegetable plants, edible mushrooms, bamboo shoots, firewood, fodder, edible insects and ant eggs)	4.1/ha	Khonchantet 2007
Thailand		Local fisheries	3.6/ha	
Thailand	Freshwater wetlands (Udon Thani province)	Local use	270/hhold	Pagdee et al. 2007
Thailand		Local use	24/ha	
Thailand	Mangroves (Surat Thani province)	Local use (fish, shrimp, crab, molluscs, honey, wood)	88/ha	Sathirathai and Barbier 2001
Thailand		Local use	1,200/ha	Sathirathai 1998
Thailand	Mangroves (various)	Local use	230/ha	Christensen 1982
Thailand	Mangroves (Phang Nga Bay, Phang Nga and Krabi provinces)	Local use	17/ha	Seenprachawong 2002
Thailand		Tourism and recreation	504/ha	
Thailand	Coral reefs (Phi Phi Islands)	Tourism and recreation	82/ha	Seenprachawong 2003
Vietnam	Forest (Nghe An province)	Local non-timber forest products	20-70/ha	Phuong and Duong 2007
Vietnam	Evergreen forest (Quang Nam, Thua Thien Hue and Quang Tri provinces)	Local non-timber forest products	4.7/ha	ADB 2010
Vietnam	Coral reef (Nha Trang Bay Marine Protected Area)	Recreation	332/ha	Nama 2005
Vietnam		Fisheries	155/ha	
Vietnam	Mangroves (Can Gio Mangrove Biosphere Reserve)	Wood produce	48/ha	Tri 2000
Vietnam		Local aquatic produce use (fish, crabs, indigenous shrimps and shellfish)	2.5/ha	
Vietnam		Local aquatic produce trade (fish, crabs, indigenous shrimps and shellfish)	1.4/ha	
Vietnam		Local use of nipa palm for thatch	0.2/ha	
Indirect values / supporting and regulating services				
Cambodia	Deciduous forest (various)	Carbon sequestration	34/ha	Hansen and Top 2006
Cambodia		Soil and water protection	75/ha	
Cambodia	Semi-evergreen forest (various)	Carbon sequestration	40/ha	
Cambodia		Soil and water protection	131/ha	
Cambodia	Evergreen forest (various)	Carbon sequestration	62/ha	
Cambodia		Soil and water protection	131/ha	
Cambodia	Evergreen forest (Tapean forest, Ratanakiri province)	Forest environmental services	35/ha	Bann 1997a
Cambodia	Evergreen forest (Mondulkiri	Carbon storage	1,743/ha	ADB 2010

Country	Ecosystem/site	Type of value(s)	Value (US$ /year)	Source
Cambodia	and Koh Kong provinces)	Watershed protection	652/ha	
Cambodia		Water quality regulation	1,018/ha	
Cambodia		Soil erosion control	399/ha	
Laos	Forest (Sekong province)	Watershed protection	2.9/ha	Rosales et al. 2003
Laos		Flood control	92/ha	
Laos	Forest (Phou Dean Din BCA)	Forest ecosystem services	24/ha	Aymui and Chanhda 2009
Laos	Evergreen forest (Attapeu, Champasak and Xekong provinces)	Carbon storage	1,846/ha	ADB 2010
Laos		Watershed protection	681/ha	
Laos		Water quality regulation	718/ha	
Laos		Soil erosion control	380/ha	
Laos	Freshwater wetlands (That Luang Marsh)	Flood protection and wastewater treatment	1,436/ha	Gerrard 2004
Thailand	Mangroves (Surat Thani province)	Coastline protection	3,000/ha	Sathirathai 1998
Thailand		Carbon sequestration	100/ha	
Thailand		Offshore fisheries	21-69/ha	Sathirathai and Barbier 2001
Thailand		Shoreline stabilization and coastal protection	3,679/ha	
Thailand	Mangroves (Phang Nga Bay, Phang Nga and Krabi provinces)	Ecological functions	23/ha	Seenprachawong 2002
Vietnam	Forest (Lam Dong province)	Water regulation for downstream hydropower	15/ha	MARD 2008
Vietnam		Retention of sediment	54/ha	
Vietnam	Evergreen forest (Quang Nam, Thua Thien Hue and Quang Tri provinces)	Carbon storage	2,085/ha	ADB 2010
Vietnam		Watershed protection	1,417/ha	
Vietnam		Water quality regulation	1,131/ha	
Vietnam		Soil erosion control	399/ha	
Vietnam	Forest (Bac GIang and Lang Son provinces)	Watershed services to paddy	1.6-62/ha	Kuchelmeister 2003
Vietnam		Watershed services to micro-irrigation	23/ha	
Vietnam		Watershed services to fisheries	4.3/ha	
Vietnam	Mangroves (southern Vietnam)	Protection against extreme weather events	50/ha	Tri et al. 1998
Indonesia	Coral reefs (Wakatobi National Park)	Coastal protection	4.7/ha	Hargreaves-Allen 2004
Indonesia	Coral reefs (various)	Coastal protection in sparsely populated areas	8.3/ha	Cesar 1996
Indonesia		Coastal protection in higher-populated areas	500/ha	
Indonesia		Coastal protection in tourist areas	10,000/ha	
Non-use values / cultural services				
Thailand	Mangroves (Phang Nga Bay, Phang Nga and Krabi provinces)	Non-use values	7.5/ha	Seenprachawong 2002
Thailand	Coral reefs (Phi Phi Islands)	Domestic option/existence value	15,075/ha	Seenprachawong 2003
Vietnam	Freshwater wetlands (Tram Chim National Park)	Non-use values	433/ha	Do and Bennett 2007
Vietnam	Coral reef (Nha Trang Bay Marine Protected Area)	International and domestic option/existence value	19/ha	Nama 2005

2. Application of ecosystem valuation techniques: data needs, data analysis and suitability[28]

Change in production techniques

Change in production techniques look at the way in which changes in the quantity or quality of ecosystem services affect the production of other outputs or income flows. Downstream hydropower and irrigation schemes, for example, depend on upper catchment protection services, fisheries depend on wetland habitats for breeding and nursery areas, and many industries use natural products as raw materials.

They are particularly useful for valuing ecosystem goods and services that clearly form a part of other, marketed, sources of production – such as insect pollination, as illustrated in Example 1. Their main weakness or difficulty in application is that it is often difficult to collect sufficient data to accurately predict the biophysical impact and relationships between a change in ecosystem status and off-site production processes.

Example 1: Using change in production to value insect pollination services (Gallai et al., 2007)
Effect on production techniques were used to value the vulnerability of world agriculture to insect pollinator decline, considering the 100 crops used directly for human food worldwide as listed by FAO. The study measured the economic impact of pollinators on agricultural output via the use of dependence ratios quantifying the impact of a lack of insect pollinators on crop production value. It calculated the vulnerability of each crop, and of the agricultural industry in a given region when faced with pollinator decline. The study found that the total economic value of insect pollination worldwide amounted to €153 billion, which represented 9.4 per cent of the value of world agricultural production used for human food in 2005.

Summary of data collection and analysis requirements

There are three main steps to collect and analyse the data required for change in production techniques to value ecosystem goods and services:

1. Determine the contribution of ecosystem goods and services to the related source of production, and specify the relationship between changes in the quality or quantity of a particular ecosystem good or service and output.
2. Relate a specified change in the provision of the ecosystem good or service to a physical change in the output or availability of the related product.
3. Estimate the market value of the change in production.

Change in production techniques rely on a simple logic, and it is relatively easy to collect and analyse the market information that is required to value changes in production of ecosystem-dependent products (see market price techniques, below). The most difficult aspect of this method is determining and quantifying the biophysical or dose-response relationship that links changes in the supply or quality of ecosystem goods and services with other sources of production. For example, detailed data is required to relate catchment deforestation to a particular rate of soil erosion, consequent siltation of a hydropower dam and reduced power outputs, or to assess exactly the impacts of the loss of wetland habitat and water purification services on local fisheries production. To be able to specify these kinds of relationships with confidence usually involves wide consultation with other experts, and may require situation-specific laboratory or field research, controlled experiments, detailed modelling and statistical regression.

Travel cost techniques

Travel cost techniques look at how much money people spend to visit an ecosystem or to enjoy its facilities, including entry fees, time spent, food, accommodation, fuel and other costs of the visit. This information is used to construct a demand curve relating the number of visits to the costs of travel, to model visitation rates to different prices, and to calculate visitor "consumer surplus" (the benefit over and above what is actually paid to enter and use the ecosystem).

They are particularly useful for valuing the recreational attributes of ecosystems, especially if these are not priced, and for setting entry fees and user charges – as illustrated in Example 2. Their main weakness or difficulty in application is that they require extensive visitor surveys, large data sets, and quite complex analysis.

[28] The description and examples of ecosystem valuation are from Emerton (2010)

Example 2: Using travel costs to value PA recreation and tourism in Costa Rica (Tobias and Mendelsohn, 1991)

The Monteverde Cloud Forest Biological Reserve in Costa Rica is an important recreational destination for both foreign tourists and domestic visitors. A study was carried out to estimate the domestic recreational value of Monteverde, using travel cost techniques. Survey questionnaires were prepared and distributed to visitors, and collected at the reserve headquarters. These obtained a variety of information about the costs of visiting Monteverde, and the socio-economic characteristics of the respondent. The opportunity to win wildlife photographs was offered as an incentive for visitors to fill in the survey forms. Travel costs per kilometre were calculated to include out-of-pocket expenses, a proportion of fixed costs, and travel time. A linear demand function was then constructed relating visitation rates to these travel costs, yielding an annual consumer surplus of between $2.4 million and $2.9 million, or about $35 per domestic visit.

Summary of data collection and analysis requirements

There are six main steps involved in collecting and analysing the data required to use travel cost techniques to value ecosystem goods and services:

1. Ascertain the total area from which recreational visitors come to visit an ecosystem, and divide this into zones within which travel costs are approximately equal.
2. Within each zone, sample visitors to collect information about the costs incurred in visiting the ecosystem, motives for the trip, frequency of visits, site attributes and socio-economic variables (such as the visitor's place of origin, income, age, education and so on).
3. Obtain the visitation rates for each zone, and use this information to estimate the total number of visitor days per head of the local population.
4. Estimate travel costs, including both direct expenses (such as fuel and fares, food, equipment, accommodation) and time spent on the trip.
5. Carry out a statistical regression to test the relationship between visitation rates and other explanatory factors such as travel cost and socio-economic variables.
6. Construct a demand curve relating number of visits to travel cost, model visitation rates at different prices, and calculate visitor consumer surplus.

Travel cost techniques depend on a relatively large data set. Quite complex statistical analysis and modelling are required in order to construct visitor demand curves. Basic data is usually collected via visitor interviews and questionnaires, which make special efforts to cover different seasons or times of the year, and to ensure that various types of visitors from different locations are represented.

Hedonic pricing techniques

Hedonic pricing techniques look at the difference in prices of property or wage rates that can be ascribed to good environmental quality and the existence of ecosystem services.

They are particularly useful for valuing the landscape and aesthetic attributes of ecosystems – such as wetland landscape services, as illustrated in Example 3. Their main weakness or difficulty in application is that they require a large amount of data to be collected on property prices or wage rates under different conditions, and that it is often very difficult to isolate environmental or ecosystem affects from other determinants of property prices or wage rates.

Example 3: Using hedonic pricing to value wetland landscape services in the USA (Mahan, 1997)

Hedonic pricing techniques were used to calculate urban residents' willingness to pay to live close to wetlands in Portland metropolitan region, Oregon. The study used a data set of almost 15,000 observations, with each observation representing a residential home sale. For each sale information was obtained about the property price and a variety of structural, neighbourhood and environmental characteristics associated with the property, as well as socio-economic characteristics associated with the buyer. Wetlands were classified into four types: open water, emergent vegetation, forested and scrub-shrub, and their area and distance from the property were recorded. Results showed that wetland proximity and size exerted a significant influence on property values, especially for open water and larger wetlands.

Summary of data collection and analysis requirements

There are five main steps involved in collecting and analysing the data required to use hedonic pricing techniques to value ecosystem goods and services:

1. Decide on the indicator to be used to measure the quality or quantity of an ecosystem good or service associated with a particular job or property.
2. Specify the functional relationship between wages or property prices and all of the relevant attributes that are

associated with them, including ecosystem goods and services.

3. Collect data on wages or property prices in different situations and areas which have varying quality and quantity of ecosystem goods and services.
4. Use multiple regression analysis to obtain a correlation between wages or property prices and the ecosystem good or service.
5. Derive a demand curve for the ecosystem good or service.

Hedonic pricing techniques require the collection of a large amount of data, which must be subject to detailed and complex analysis. Data is usually gathered through market observation, questionnaires and interviews, which aim to represent a wide variety of situations and time periods.

Replacement cost techniques

Replacement cost techniques look at the costs of replacing or replicating a particular ecosystem good or service with artificial or man-made technologies or infrastructure. For example, constructed reservoirs can replace natural lakes, gas can replace fuelwood, or sewage treatment plants can replace wetland wastewater purification functions.

They are particularly useful for valuing ecosystem indirect values – such as wastewater treatment services, as illustrated in Example 4 – and are relatively simply to apply and analyse. Their main weakness or difficulty in application is that it is usually impossible to find perfect replacements or substitutes for ecosystem goods and services that would provide an equivalent level of benefits to the same beneficiary population.

Example 4: Using replacement costs to value wastewater treatment services in Uganda (Emerton et al. 1999)

Replacement cost techniques were used to value the wastewater treatment services provided by Nakivubo Swamp, Uganda. Covering an area of some 550ha and a catchment of over 4000ha, the wetland runs from the central industrial district of Kampala, Uganda's capital city, passing through dense residential settlements before entering Lake Victoria at Murchison Bay. The study looked at the cost of replacing wetland wastewater processing services with artificial technologies. Replacement costs included two components: connecting Nakivubo channel to an upgraded sewage treatment plant which could cope with additional wastewater loads, and constructing elevated pit latrines to process sewage from nearby slum settlements. The study found that the infrastructure required to achieve a similar level of wastewater treatment to that provided by the wetland would incur costs of up to US$2 million a year in terms of extending sewerage and treatment facilities.

Summary of data collection and analysis requirements

There are three main steps involved in collecting and analysing the data required to use replacement cost techniques to value ecosystem goods and services:

1. Ascertain the benefits that are associated with a given ecosystem good or service, how it is used and by whom, and the magnitude and extent of these benefits.
2. Identify the most likely alternative source of product, infrastructure or technology that would provide an equivalent level of benefits to an equivalent population.
3. Calculate the costs of introducing and distributing, or installing and running, the replacement to the ecosystem good or service.

Data collection is relatively straightforward, and usually relies on secondary information about the benefits associated with a particular ecosystem good or service and alternatives that are available to replace it. In most cases this can be ascertained through expert consultation and professional estimates, supplemented with direct observation.

Mitigative or avertive expenditures techniques

Mitigative or avertive expenditures techniques look at the costs of dealing with the effects of the loss of an ecosystem good or service, in terms of what has to be spent to mitigate or avert any negative impacts. For example the loss of upper catchment protection can make it necessary to desilt reservoirs, or the loss of flood control services may require the construction of flood barriers.

They are particularly useful for valuing ecosystem indirect values – such as nitrogen abatement services, as illustrated in Example 5 – and are relatively simply to apply and analyse. Their main weakness or difficulty in application is that the response measures that are employed when an ecosystem service is lost do not always provide an equivalent level of benefits. Also, in many cases it is questionable whether in fact such expenditures would be made or would be seen as worth making.

Example 5: Using mitigative expenditure to value nitrogen abatement in Sweden (Gren, 1995)

Poor quality drinking water supply is a major problem in Gotland, Sweden, and is related to the high levels of nitrates in water, which are about double the WHO-recommended safe concentrations. This study aimed to value the services that natural wetlands provide in terms of reducing nitrate levels in water, using mitigative expenditure techniques which looked at the different measures that can be employed for nitrogen abatement. In addition to wetland restoration, it considered reducing farmers' applications of chemical fertilizers and manure, and increasing the capacity of domestic and industrial sewage treatment plants. This enabled the total value of investments in wetlands for nitrogen abatement to be calculated, and compared with the costs of upgrading sewage treatment facilities and reducing fertilizer use. The study found that the total value of investing in wetland restoration and management is at least twice as high as the costs of implementing mitigative or avertive measures.

Summary of data collection and analysis requirements

There are four main steps involved in collecting and analysing the data required to use mitigative or avertive expenditure techniques to value ecosystem goods and services:

1. Identify the negative effects or hazards that would arise from the loss of a particular ecosystem good or service.
2. Locate the area and population which would be affected by the loss of the ecosystem good and service, and determine a cut-off point beyond which the effect will not be analysed.
3. Obtain information on people's responses, and measures taken to mitigate or avert the negative effects of the loss of the ecosystem good or service.
4. Cost the mitigative or avertive expenditures.

Data collection and analysis is relatively straightforward, and usually relies on a combination of interviews, surveys, direct observation and expert consultation.

Damage costs avoided techniques

Damage costs avoided techniques look at the costs and losses that occur when the loss of ecosystem services leads to disasters or damage to property and economic activities. Examples include floods, food shortages, destruction of infrastructure and disease.

They are particularly useful for valuing indirect ecosystem values that protect human settlements and economic processes – such as flood control services, as illustrated in Example 6 – and are relatively simple to apply and analyse. Their main weakness or difficulty in application is that in most cases the estimates of damages avoided remain hypothetical, and thus may not be accurate – they are based on predicting what might occur, usually under considerable uncertainty.

Example 6: Using damage costs avoided to flood control services in Malawi and Zambia (Turpie, 1999)

The damage costs avoided approach was used to calculate the value of wetland flood control services in the Zambezi basin, in southern Africa. Because they store water, and release it slowly, many wetlands in the region play an appreciable role in minimizing downstream flooding during times of high rainfall. The study found that the Lower Shire wetlands in Malawi help to avoid average damage costs with an NPV of US$13.3 million; this covers expenditures on coping with the displacement of local populations in flood-prone areas, and damage to road and rail infrastructure. Meanwhile the marshes and swamps of the Barotse floodplain save farmers in both Zambia and neighbouring Namibia damages to farms and livestock facilities, roads, houses and other buildings, with an NPV of around US$1.5 million.

Summary of data collection and analysis requirements

There are four main steps involved in collecting and analysing the data required to use damage cost avoided techniques to value ecosystem goods and services:

1. Identify the protective services of the ecosystem, in terms of the degree of protection afforded and the on- and offsite damages that would occur as a result of loss of this protection.
2. For the specific change in ecosystem service provision that is being considered, locate the infrastructure, output or human population that would be affected by this damage, and determine a cut-off point beyond which effects will not be analysed.
3. Obtain information on the likelihood and frequency of damaging events occurring under different scenarios of ecosystem loss, the spread of their impacts and the magnitude of damage caused.
4. Cost these damages and ascribe the contribution of the ecosystem service towards minimizing or avoiding them.

Data collection is for the most part straightforward, usually relying on a combination of analysis of historical records, direct observation, interviews and professional estimates. Predicting and quantifying the likelihood and impacts of damage events under different ecosystem scenarios is, however, usually a more complex exercise, and may require detailed data and modelling.

Contingent valuation techniques

Contingent valuation techniques ask people directly how much they would be willing to pay for ecosystem goods and services, or accept in compensation for their loss. They might, for example, ask how much people would be willing to contribute to a fund for the conservation of a beautiful landscape or rare species, how much they would be willing to see their water bills increase in order to conserve watershed forests, or to what extent they would be willing to share in the costs of maintaining a nearby protected area.

They are particularly useful for valuing ecosystem goods and services that have no market price, close substitutes or clear effects on other production processes – such as wildlife and national parks, as illustrated in Example 7. Their main weakness or difficulty in application is that they rely on extremely complex survey and data analysis techniques, and typically require high budgets and specialized expertise to carry out.

Example 7: Using contingent valuation to value wildlife and national parks in Kenya (Moran, 1994)

A contingent valuation study was carried out to determine the value to foreign tourists of Kenya's national parks and the wildlife they contain. This was done via a questionnaire administered to a sample of tourists at several protected areas, and at the airport. The questionnaires began by asking general questions about the respondents' interests in wildlife and nature. Next, country of origin and component travel cost information was gathered, plus questions on days spent in parks, parks visited, length of safari and other destinations visited in Kenya. Respondents were then asked to consider the costs of park management and the problems facing conservation, and given the option of higher entrance fees as a possible solution to wildlife loss. Finally, the questionnaire asked for basic socio-economic information: income, age, sex, member of conservation group, education, as well as information on how respondents thought higher fees should be charged. The survey showed a consumer surplus attached to protected areas by foreign visitors at some US$450 million per annum. The estimate is additional to current financial returns from tourism.

Summary of data collection and analysis requirements

There are five main steps involved in collecting and analysing the data required to use contingent valuation techniques to value ecosystem goods and services:

1. Ask respondents their willingness-to-pay (WTP) or willingness-to-accept compensation (WTA) for a particular ecosystem good or service.
2. Draw up a frequency distribution relating the size of different WTP/WTA statements to the number of people making them.
3. Cross-tabulate WTP/WTA responses with respondents' socio-economic characteristics and other relevant factors.
4. Use multivariate statistical techniques to correlate responses with respondents' socio-economic attributes.
5. Gross up sample results to obtain the value likely to be placed on the ecosystem good or service by the whole population, or the entire group of users.

This valuation technique requires complex data collection and sophisticated statistical analysis and modelling, which are described in detail elsewhere. Most contingent valuation studies are conducted via interviews or postal surveys with individuals, but sometimes interviews are conducted with groups. A variety of methods are used in order to elicit people's statement or bids of their WTP/WTA for particular ecosystem goods or services in relation to specified changes in their quantity or quality. The two main variants of contingent valuation are: dichotomous choice surveys, which present an upper and lower estimate between which respondents have to choose; and open-ended surveys, which let respondents determine their own bids. More sophisticated techniques are also sometimes used, such as engaging in trade-off games or using take-it-or-leave it experiments. The Delphi technique uses expert opinion rather than approaching consumers directly.

Conjoint analysis techniques

Conjoint analysis techniques ask people to consider the status quo, and alternative states of biodiversity conservation or ecosystem services. They describe specific scenarios for the future, including various ecosystem goods and services, between which people have to make a choice. Respondents give information about their own preferences between various ecosystem and biodiversity alternatives, at different prices or costs to them.

They are particularly useful for valuing ecosystem goods and services that have no market price, close substitutes or clear effects on other production processes – such as water quality, as illustrated in Example 8. Their main weakness or difficulty in application is that they rely on extremely complex survey and data analysis techniques, and typically require high budgets and specialized expertise to carry out.

Example 8: Using conjoint analysis to value water quality in South Africa (Turpie, 2001)
The conjoint analysis sought to ascertain the tourism value of rivers in the Crocodile Catchment in terms of revenues to Kruger National Park, South Africa. A combination of a representative range of relevant river attributes (the number of crocodiles and hippos, number of waterbird species, diversity of the riverscape, and density of riparian trees) were presented, and four levels were defined for each depending on ecological catchment management practices. Two contingent valuation-style questions provided values for the "ideal" and "worst" scenarios relative to the status quo: (1) If all of the rivers in the Kruger National Park dried up completely, so that there were no crocodiles, hippos or waterbirds present, there were no riverine trees, but everything else in the park were the same, would you spend less time in the park? Please estimate how much. (2) Consider the fact that the rivers in the park are used upstream, and are presently not in their original state. If, hypothetically, the rivers were to be restored to their original state – that is, they contained high numbers of crocodiles, hippos, waterbirds, etc., diverse habitats, including lots of riverine trees, do you think that you would spend more time in the park? The study estimated that the current value of Kruger National Park tourism is about US$17 million in terms of on-site expenditure, US$33 million in terms of economic impact, and US$125 million in terms of consumer surplus. It was found that about 30 per cent of tourism business would be lost if rivers were totally degraded.

Summary of data collection and analysis requirements
Conjoint analysis is a complex technique to apply so the steps are not summarised here. A useful reference is Alriksson S, and Oberg T. (2008). Conjoint analysis for environmental evaluation--a review of methods and applications. *Environmental Science and Pollution Research International* 2008 May 15(3):244-57.

Choice experiments techniques

Choice experiments techniques give the respondent a series of alternative resource or ecosystem use options, each of which are defined by various attributes (such as species mix, ecosystem status, landscape, size of area) including price or cost. These attributes are varied across the alternatives, and respondents are asked to choose their preferred alternative.

They are particularly useful for valuing ecosystem goods and services that have no market price, close substitutes or clear effects on other production processes – such as woodland recreation, as illustrated in Example 9. Their main weakness or difficulty in application is that they rely on extremely complex survey and data analysis techniques, and typically require high budgets and specialized expertise to carry out.

Example 9: Using choice experiments to value woodlands in the UK (Manukyants, 2005)
A choice experiment study, administered via a postal survey, was used to ascertain conservation and recreational values for Forestry Commission woodlands in south-east England. The aim was to get a better understanding of people's preferences and values of forests. Three major dimensions of forest management were investigated in the valuation study: nature conservation (wildlife preservation and ecological functions), provision for public access (recreational activities) and experience of nature (appreciation of woodlands for the opportunity of having direct contact with nature). A fourth dimension was also added: distance, which reflected the location of the woodland relative to the place of residence. The findings of the study revealed strongly expressed preferences towards higher levels of woodland conservation and lower levels of provision for public access in the form of recreational facilities.

Summary of data collection and analysis requirements
Choice experiments is a complex technique to apply so the steps are not summarised here. A useful reference is Hoyos, D. The state of the art of environmental valuation with discrete choice experiments, Ecological Economics, Volume 69, Issue 8, 15 June 2010: 1595-1603, available at: http://www.sciencedirect.com/science/article/pii/S0921800910001540#

3. Terms of reference for the study

Background and rationale

The WWF Greater Mekong Programme, in partnership with regional stakeholders, is implementing a coordinated conservation strategy focusing on shared ecosystems and key conservation landscapes in the Lower Mekong region. A key priority of this strategy is to build climate change resilience through integrated conservation and economic development planning and implementation, supporting the collaborative management of shared ecosystems, emphasizing the considerable benefits that collaboration can confer to regional resilience to climate change.

Other elements of WWF's conservation strategy include:

- advocacy for a regional climate change agreement amongst the lower Mekong country governments;
- landscape-scale biodiversity and forest conservation targets;
- the maintenance of landscape integrity through integrated spatial planning and payment for ecosystem services mechanisms;
- improved protected area management;
- activities to keep the Mekong river and key tributaries free flowing; and
- the accelerated development of mechanisms to ensure sustainable financing for conservation in the region, perhaps catalyzed via funding from GEF5 for a regional program.

Achieving the objectives set in WWF's conservation plan will require better valuation of the region's ecosystem services (ES). Improved articulation of the value of ecosystems and the services they provide should help ensure that these values are better integrated into policy decisions and economic development indicators. This integration should allow the national governments of the region to understand the value of and recognize the urgent need to protect one of their greatest assets. In addition, maintaining these ES provides a cost-effective way to increase resilience to the impacts of climate change. It is therefore a priority for ES to be effectively protected and for this to happen, their economic values must be better recognized and better factored into multi-sectoral planning and decision-making.

In order to support this broad strategy, WWF is sponsoring a review of existing ES information, the development of effective communication products to capture and convey their key messages, and further, more detailed work on ecosystem services valuation (ESV). This ToR will help lay the foundations for future, more detailed work, with specific workplans and ToRs for other aspects to be developed as the work progresses. This initial work is crucial to possibly raise funds for future more detailed work in this area.

Objectives

Produce a synthesis of the value of the region's main ES (including quantitative estimates at landscape, national, and regional scales), which can be used to persuade decision-makers to support integrated conservation and development strategies.

Scope

Major ecosystem services provided by the region's key conservation landscapes expressed for each of four countries (Cambodia, Laos, Thailand and Vietnam) and at the regional scale.

Activities

1) Compile, review and synthesize key statistics, messages, and insights of existing data and reports on the economic value of ES provided by the region's ecosystems (especially including WWF's priority biodiversity conservation landscapes). The review should answer the following questions:
   a) What kinds of economic values are associated with ecosystem services in the Lower Mekong, and local, national and regional scales?
   b) What mechanisms exist to capture these values as payments for ecosystem services, and which ecosystem services are currently not being effectively captured in payment streams?
   c) What kinds of economic values might accrue to each Lower Mekong country if they implemented a regional climate change agreement, which includes collaborative management of shared ecosystems and the services they provide?
2) Develop at least 3 scenarios (business as usual, strong conservation emphasis, etc.) that capture the range of plausible development pathways for the region. Provide comparative narratives that include, at minimum the following as they relate to each scenario:
   - Assumptions about global, regional, and national economic trends;
   - Assumptions about the evolution/development of natural resource management and payment for ecosystem services policies (or lack thereof);

- Assumptions about land use and land tenure policies especially at the country level.
- Assumptions about climate change impacts if such impacts are anticipated within the time horizon evaluated (see below).

3) Describe and contrast in general quantitative terms the following for each scenario over a 15-40 year time horizon (at the discretion of the consultant). Estimates can involve any number of realistic simplifying and qualifying assumptions (see, for example, discussion of simplifying assumptions and procedures used in various TEEB analyses and comparisons):
    a) Rough indicative costs of achieving the scenario (e.g. protected area management costs, enforcement of zoning, increased planning expenditures, substitution costs of lost ecosystem services over time due to degradation, etc.)
    b) Rough indicative value of realising this scenario in comparison with a uniform base value (perhaps business as usual or a highly extractive scenario)
4) Describe and contrast in general qualitative terms the following for each scenario developed:
    a) Distribution of costs and benefits by broad representative stakeholder groups (e.g. various sectors, socio-economic groups, etc.);
    b) How these costs and benefits would likely be distributed over time under the various scenarios;
    c) How these costs and benefits would be distributed geographically under the various scenarios (e.g. will costs be borne by local communities or central government; will benefits remain in the landscape or be exported to more distant regions or countries)
5) Identify and summarise key information needs (e.g. a gap analysis), which if filled would help develop a more persuasive economic argument about the need to maintain ES
6) Evaluate and compare the range of existing ES valuation frameworks, models, and tools (and required data needs for each)
7) Produce a report that summarises the analyses listed above and recommends next steps to further improve valuation of ecosystem services in the region, in a clear format and with accessible language so that the analytical methods are transparent and the results can be used for policy advocacy and as the basis of developing a proposal for future work.
8) Based on the report's key findings, produce a PowerPoint presentation that could be used to persuade decision-makers to support integrated conservation and development strategies.
9) Based on your experience and expertise in this field and interactions with key stakeholder groups (especially government officials in the region), anticipate and articulate questions that people are most likely to ask in relation to ES economic valuation methods and findings in the region. Also anticipate questions that are likely to arise from the various communications deliverables developed for this consultancy. Develop concise answers to these questions.

Deliverables

Deliverable One

Summary report roughly organized as follows:

1) Review and synthesis of current information on the value of the region's ecosystem services, including
    a) An assessment of the estimate of key ecosystem services at the landscape, national, and regional scales; and
    b) An assessment of key ecosystem services which are currently not being effectively captured in payment streams.
2) Scenarios and Associated Costs and Benefits (to include, at minimum, the points stipulated in the "activities" section above.
    a) Scenarios and associated assumptions
    b) Indicative quantitative summary figures for each scenario as described above
    c) Indicative qualitative comparisons for each scenario as described above
3) Identification of key information needs (e.g. a gap analysis).
4) Potential benefits of a regional climate change agreement for each Lower Mekong country resulting from improved conservation of shared ecosystems and thus maintenance of key ecosystem services
5) Comparative evaluation of ecosystem frameworks/models and tools and the corresponding data needs of each.
6) Recommendations to advance the improved valuation of ES in the region.

Deliverable Two

1) A Powerpoint presentation, based on the outputs of Deliverable One. The Powerpoint presentation (in the English language) are to be appropriate for stakeholders who do not have English as a mother tongue.
2) A set of questions (and associated concise answers) that stakeholders (primarily government officials in the region) are most likely to ask in relation to ES economic valuation methods and findings in the region.

The output from Deliverable Two will be used in meetings with a range of stakeholders-including governments-to demonstrate the benefits of ecosystem services in their country and under a collaborative regional approach and what actions they can take to fully realise these benefits.

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Greater Mekong green economy

WWF · ECONOMIC VALUE OF ECOSYSTEM SERVICES IN THE MEKONG BASIN

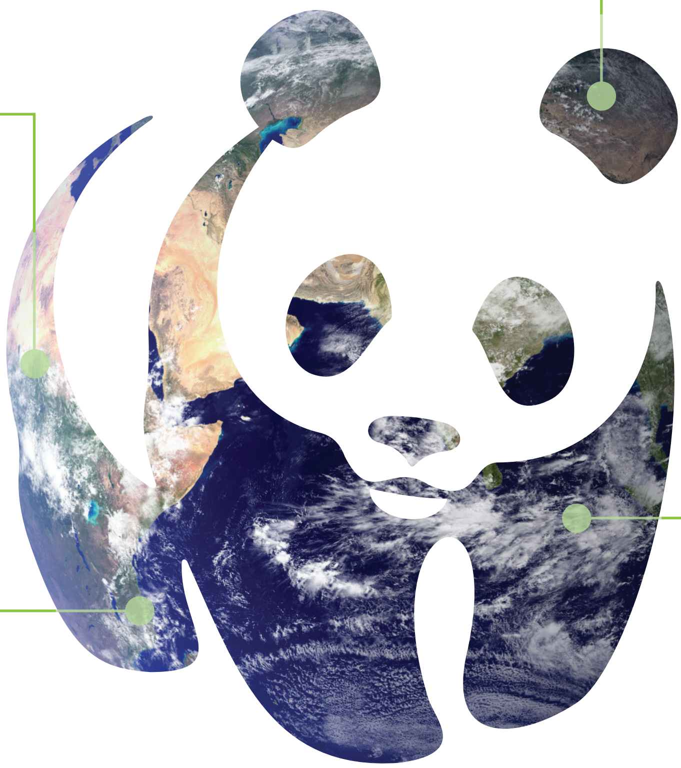
100% RECYCLED

US$4 BILLION

Retail value of Mekong River fisheries estimated at more than US$4 billion annually

60 M

The Lower Mekong River provides the main source of food for 60 million people



+US$55 BILLION

The value that could be added cumulatively to the combined economies of Cambodia, Laos, Thailand and Vietnam by 2035 through implementing green economic growth policies that maintain natural capital over and above the value added by 'Business as Usual' economic development

80%

The Greater Mekong's natural capital directly supports 80 per cent of the region's population by providing vital ecosystem services

WWF

Why we are here
To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

panda.org

The Greater Mekong region is one of the biologically richest places on the planet; its varied natural resources support the livelihoods and well-being of millions of people in mainland Southeast Asia. WWF-Greater Mekong – on the ground in Cambodia, Laos, Myanmar, Thailand and Vietnam – is working to conserve the region's biodiversity and build a secure and sustainable future for people and wildlife.

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