



## Technical Report

# Valuation of Forest Ecosystems in Cambodia Lessons Learned

Cambodia, 2014



## Disclaimer

This report was prepared by Ou Rattanak, an independent consultant, and does not necessarily represent the views of the national REDD+ taskforce, the Forestry Administration, the General Department for Administration of Nature Conservation and Protection, the UN-REDD Programme or its participating agencies.

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## ACRONYMS

AUD	Australian dollars
BAUSU	Business as Usual
CLIBO	Climate Beneficial Option
FA	Forestry Administration
FP	Forest Products
GNP	Gross National Product
LEGA	Long-Term Economic Gains
MAFF	Ministry of Agriculture, Forestry and Fisheries
MoE	Ministry of Environment
Mt	Million tonnes
MWTP	Mean Willingness to Pay
NP	National Park
NTFP	Non-timber Forest Products
REDD+	Reducing Emissions from Deforestation and Forest Degradation, and the Role of Conservation, Sustainable Management of Forests and Enhancement of Forest Carbon Stocks in Developing Countries
t/ha	Tonnes/hectare
WS	Wildlife Sanctuary

## INTRODUCTION

### 1.1 Background

Cambodia has one of the highest levels of forest cover in Southeast Asia, with approximately 10.7 million hectares of forest in 2006 or 59% of the land area, as well as a high deforestation rate of approximately 0.8% in the period 2002-2006, making it an international priority for REDD+ action. Cambodia is classified into four environmental regions: Plain, Coastal, Plateau and Mountainous, which consist of twenty-four provinces and four municipalities. In ecological terms, forests help to protect the soil from erosion, stabilize watersheds and regulate water flows and the local weather system. Cambodia is particularly dependent on its forest system due to the unique hydrological system of Mekong River and Tonle Sap Lake. In purely economic terms, the forest is considered as one of the country's most valuable economic assets that provide an important source of revenue<sup>1</sup>. Forests have significant roles in the development of Cambodia's agricultural, environmental and tourism sectors, especially in the subsistence of local communities. Forests also provide a major source of fuel and building materials for the local populations. Cambodian forests contain substantial biological resources, including valuable plant and wildlife species such as birds, reptiles and mammals, which are amongst the richest in biological diversity in the region.

Ecosystem services refer to the range of conditions and processes through which natural ecosystems, and the species that they contain, help sustain and fulfill human life<sup>2</sup>. The forest ecosystem is defined as the community dynamic complex and interaction of living (plants and animals) and nonliving (climate, microclimatic, soil and water), within specific forest areas, that contribute to its role as a functional unit on the planet. Humans with their economic, traditional, cultural and environmental needs are also an integral part of forest ecosystem<sup>3</sup>. Forest ecosystems are being degraded and lost because of rapid population and economic growth that make forest conversion appear more profitable than forest conservation. All ecological services of forests are also economic functions. Many important forest functions have no market, and hence, no apparent financial value. Whereas the use of forestland for other purposes has a clear financial value.

REDD+ can foster global benefits such as biodiversity conservation while providing climate change mitigation. Not accounting for the potential multiple benefits under REDD+ could result in advantageous options being bypassed that ultimately could deliver important additional benefits alongside carbon sequestration and storage. Moreover, demonstrating the economic importance of multiple benefits attainable under REDD+ could provide a more comprehensive perspective for future decision making on land use and land-use change. A recent study of REDD+ co-benefits has already been conducted by UNEP World Conservation Monitoring Centre (UNEP-WCMC) together with Cambodian counterparts: 'Carbon, biodiversity and ecosystem services: Exploring co-benefits' (2010). The study focused on spatial analyses related to co-benefits, specifically biodiversity and carbon content of forest areas under different forms of management. The primary focus of this work under the Cambodia UN-REDD Programme will be an analysis of existing literature on valuation of multiple benefits provided by forests relevant for REDD+ in Cambodia under current management strategies.

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<sup>1</sup> MoE and UNEP (2009) Cambodia Environment Outlook, Phnom Penh, Cambodia

<sup>2</sup> Daily, G.C. (1997), "Introduction: What are Ecosystem Services?" in Daily, G.C., "Nature's Services: Societal Dependence on Natural Ecosystems", Island Press, Washington, D.C.

<sup>3</sup> Forestry Law (2002)

## 1.2 Objective

The objective of this assignment is to report on valuation of multiple benefits provided by standing forests in Cambodia. The findings shall inform an inception workshop to define further work on valuation of the multiple benefits provided by forests.

## 1.3 Methods

The focus of this work is to analysis of existing literature on valuation of multiple benefits provided by standing forests in Cambodia through reviewing the published literature and information, as well as documents and papers from government websites, international journals and projects reports.

# 1. RESULTS

## 2.1 Forest Goods and Services

Forests generate a substantial number of goods and services that benefit human beings. Economics can provide valuable information for decision makers and provide input to the development of strategies and policies. The values can be classified into two, namely: use values and non-use values. Use values include direct use value, indirect use value and option value. Non-use values are existence value and bequest value. Direct use value means extractive, consumptive and non-consumptive uses of the natural resources such as timber and non-timber forest products, and tourism. Indirect use value is defined as services that the environment provides such as protection of watersheds and the storage of carbon. Option value is a value reflecting an aim to conserve the option of making use of the forest even though no current use is made of it. Existence value is a value people derive from the knowledge that something exists, even if they never plan to use it. Bequest value is a value derived from the desire to pass on ecosystems to future generations.

## 2.2 Direct Use Values

### 2.2.1 FOREST PRODUCTS (FPs)

Forest products, mostly commercial timber and round logs, account for approximately 5% of Cambodia's Gross National Product (GNP) and 72% of the workforce is engaged in agriculture and forestry activities<sup>4</sup>. In 1965, forest cover was approximated at 73% of the country and the Forestry Administration has investigated the loss of forestland from 1965 to 2006 (Table 1). The loss of forest cover is consistent with land use and land cover changes associated with demographic growth and economic development, particularly agricultural expansion, legal and illegal logging, a construction boom and increasing demands for land associated with growth in foreign direct investment (FA, 2010). The net annual rate of deforestation estimated as 0.5% during the period 2002-2006 representing a significant decrease compared to earlier estimates. Cambodia's forest cover has declined from over 73% in 1965, with the total of 13,227,100 ha, to 59.09% in 2006, with 10,730,781 ha.

**Table 1: Cambodian Forest Cover Change between 2002-2006**

No.	Year	Forest Cover				Change 2002-2006	
		2002		2006			
		Ha	(%)	Ha	(%)	Ha	(%)
1	Evergreen forest	3,720,493	20.49	3,668,902	20.20	-51,519	-0.28
2	Semi evergreen	1,455,183	8.01	1,362,638	7.50	-92,545	-0.51

<sup>4</sup> FA (Forest Administration) .2010. "Asia-Pacific Forest Sector FA Outlook Study II: Cambodian Forestry Outlook Study," Working Paper No. APFSOS II/ WP/ 2010/ 32, Phnom Penh, Cambodia pp.40-44.

	forest						
3	Deciduous forest	4,833,887	26.62	4,692,098	25.84	-141,789	-0.78
4	Others forest	1,094,728	6.03	1,007,143	5.55	-87,585	-0.48
<b>Total Forest Land</b>		<b>11,104,291</b>	<b>61.15</b>	<b>10,730,781</b>	<b>59.09</b>	<b>-373,510</b>	<b>-2.06</b>
5	Non forest	7,056,383	38.85	7,429,893	40.91	373,510	2.06
<b>Total Area</b>		<b>18,160,674</b>	<b>100</b>	<b>19,160,674</b>	<b>100</b>		

Source: FA forest statistics in 2007

Table 2 indicates the forest classification in Cambodia including evergreen, semi-evergreen and deciduous forest (FA, 2010). Most forestland is dominated by deciduous forest that accounts for 25% of total forestland, followed by evergreen forest (20%) and semi-evergreen forest (almost 8%). From 1996 to 2001, timber production from concession areas amounted to 1.2 million m<sup>3</sup> per year, and the amount processed and exported (round logs, sawn timber, veneer, plywood, etc.) was 920,415 m<sup>3</sup>. About 36% of Cambodia's forest (6% dense evergreen and 30% disturbed evergreen) are commercially attractive, with another 15% of forest areas (mixed and mosaic evergreen) unlikely to be viable for commercial timber production<sup>5</sup>. Forest management in Cambodia has been a challenging task for the Cambodian government from the 1950s to the present.

**Table 2: Cambodian Forest Classification in 2006**

No.	Forest Types	Area	
		Ha	(%)
1	Evergreen forest	3,668,902	20.20
2	Semi evergreen forest	1,362,638	7.50
3	Deciduous forest	4,692,098	25.84
4	Others forest	1,007,143	5.55
<b>Total forest land</b>		<b>10,730,781</b>	<b>59.09</b>
5	Non forest	7,429,893	40.91
<b>Total area</b>		<b>18,160,674</b>	<b>100</b>

Source: FA forest cover statistics in 2006

Four papers have estimated forest products revenues and the survey sites are located in Kandal province (plain), Ream National Park (NP), Preah Sihanouk province (coastal), Central Cardamom (mountainous). Table 3 reveals the value of forest products; these values include total value of forest products, and total value of harvestable forest products or income generation from forest products. The total valuation of ecosystems services in Central Cardamom is around US\$4 billion; which is the highest value<sup>6</sup>. Approximately US\$441 million (US\$1,100 per ha/year) annually of (sustainable) timber and crop values are from Central Cardamom. This annual value is high because the totals of harvestable and non-harvestable timbers are included.

The total value for sustainable harvesting in Cambodia is a US\$111.7 million (US\$10.41 per hectare per year) of annual forest revenues from all forest types in Cambodia using 'business as usual' scenarios. Key data for generating these results include harvested wood, operable logging areas, and forestry taxes<sup>7</sup>; and wood products, sawn wood and veneer wood are the three major forests in Cambodia. The revenues analyzed under three scenarios: 'business as usual' (BAUSU), 'long-term economic gains'

<sup>5</sup> MoE and UNEP (2009) Cambodia Environment Outlook, Phnom Penh, Cambodia

<sup>6</sup> J. Soussan C. Sam (2010) The Values of Land Resources in the Cardamom Mountains of Cambodia, Final Report, in partnership with MAFF, CI and ADB Phnom Penh, Cambodia

<sup>7</sup> Sophanarith Kim, T, Nophe Kim Phatb, c, Masao Koiked, Hiromichi Hayashid (2004) Estimating actual and potential government revenues from timber harvesting in Cambodia

(LEGA), and ‘climate beneficial option’ (CLIBO). Under the BAUSU scenario wood production is estimated at about 1.6 million m<sup>3</sup> per year, of which 0.7 million m<sup>3</sup>, 0.2 million m<sup>3</sup>, and 0.6 million m<sup>3</sup> are from evergreen, mixed, and deciduous forests, respectively.

Many local households rely on Ream NP for mangrove harvesting, agriculture, fisheries and NTFPs collection with an average value of mangrove harvesting of US\$344 per ha per year<sup>8</sup> and the economic value of Ream National Park for local communities is calculated to be in excess of US\$1.24 million per year.

Valuation of flooded forest has been conducted in Kandal province. The average income per year from all products was approximately US\$22/ha<sup>9</sup>. The average of turnover from forestry and logging from 2005 to 2010 is approximately US\$272 million per year (US\$25.41 per ha per year), the total revenue is about US\$128 million per year (US\$11.33 per ha per year)<sup>10</sup>.

**Table 3: Various estimates for values of all forest products**

No.	Category	Total Value/year (US\$)	Total income/ha/year (US\$)	Province	Source
1	Forest Products (including crop values)	441,436,700 (1,100/ha)		Central Cardamom (Pursat, Koh Kong & Kampong Speu)	Soussan, 2010
2	Forest products	111,700,000 (10.41/ha)		Cambodia	Sophanarith et al., 2004
3	Forestry & Logging 2005-2010		271,795,833 (25.41/ha)	Cambodia	NIS, 2011
4	Forestry & Logging 2005-2010		128,250,000 (11.33/ha)	Cambodia	NIS, 2011
5	Mangrove product harvesting		344	Ream NP, Preah Sihanouk	Emerton et al., 2002
6	Flooded forest		22	Kandal province	Navy et al, 2001
<b>Average</b>			<b>82.74</b>		
<b>Range</b>			<b>(22:344)</b>		

### 2.2.2 NON TIMBER FOREST PRODUCTS (NTFPs)

NTFPs are essential for subsistence and economic activities; recently, the importance of NTFPs is receiving increasing recognition by governments and other official agencies. Forests are being valued not simply for their timber, but as intricate systems capable of sustained generation of a great diversity of resources and services. NTFPs are keys to local livelihoods, in maintaining biological diversity, and sustainable economic growth. Firstly, important NTFPs provide basic subsistence with food, medicines and construction materials for shelter, cultural and ritual values as well as cash income for many local communities, especially where these groups have access to forest areas. Most often NTFPs require opportunistic and low-level harvesting, processing and marketing skills, a crucial resort for the poorest groups, and in many cases they are as important as agriculture. Secondly, the important contribution of

<sup>8</sup> Emerton, L. Seilava, R. Pearith, H. (2002) “Field Study: Cambodia: Bokor, Kirirom, Kep and Ream National Park” IUCN, Phnom Penh, Cambodia.

<sup>9</sup> Hap Navy, Thay Somony, and Hav Viseth (2001) Economy and Environment: Case Studies in Cambodia: Valuation of Flooded Forests in Kandal Province, edited by Bruce McKenney, Phnom Penh, Cambodia

<sup>10</sup> National Information Statistic, Ministry of Planning (2011)



NTFPs to food and financial well-being has gained increased recognition. The trading of NTFPs, including resin, rattan and bamboo, minimally contributes to economic development and livelihoods of forest-dependent communities<sup>11</sup>. However, it appears that the statistics do not include formal fees paid to the national treasury, and therefore discounts the contribution to national revenue out of formal fees collection from NTFPs. NTFPs contribute to livelihood development and poverty reduction: in Cambodia 70-90% of households collect and trade forest products / NTFPs<sup>12</sup>, and fuel wood is widely collected throughout for domestic use and is the primary source of energy.

Much research has been conducted throughout Cambodia on the value of non-timber forest product. The results are shown in Table 4.

**Table 4: Various estimates for values of Non-Timber Forest Products**

No.	Category	Total Value/year (US\$)	Total income/ha/year (US\$)	Province	Source
1	NTFPs	441,171,200 (1,099/ha)		Central Cardamom	Soussan, 2010
2	NTFPs	500- 1600 (1050/ha)		Koh Kong province	Bann, 1997
3	NTFPs (malva nut)		100 to160 (130/ha)	Chum District, Ratanakiri province	Sara et al., 2000
4	NTFPs		280 to 345 (312)	Kampong Thom, Pursat, Mondulkiri and Kratie	Kasper and Neth, 2006
5	NTFPs		233 to 316 (274.5)	Ream NP, Preah Sihanouk	De Lopez et al., 2001
6	NTFPs		200	Ratanakiri	Bann, 2003
7	NTFPs		78.9	Phnom Kok CF, Voensai district, Ratanakiri	Sophanarith et al., 2008
8	NTFPs (resin)		229 to 375 (302)	Preah Vihear, Kampong Thom, Mondulkiri & Stung Treng	Prom, 2009
9	NTFPs		15 to 85 (50)	Phnom Aural and Phnom Samkos WS	Grieg et al., 2008
<b>Average</b>			<b>299.74</b>		
<b>Range</b>			<b>(50:1050)</b>		

Some key findings from these data are:

1. The total potential NTFP value in Central Cardamom is approximately US \$400 million annually<sup>13</sup>.
2. The mangroves in Koh Kong province cover an area of 63,700 ha and support a number of households, but are threatened by clearing for intensive shrimp farming, and for commercial and domestic charcoal production. The study presents an economic value of the two key uses of the Koh

<sup>11</sup>FA (Forestry Administration), .2007., "Cambodia: Forestry Statistics 2006"

<sup>12</sup>McKenney, B., C. Yim, T. Prom & T. Evans .2004. "Focusing on Cambodia's High Value Forests" Phnom Penh, CDRI Working Paper No. 15

<sup>13</sup>J. Soussan C. Sam (2010) The Values of Land Resources in the Cardamom Mountains of Cambodia, Final Report, in partnership with MAFF, CI and ADB Phnom Penh, Cambodia

Kong mangrove resource both for local community use and commercial shrimp farming, with the total values of mangrove in the province ranging from US\$500 to US\$1600 per household per year<sup>14</sup>.

3. The Council of Ministers of the Royal Cambodian Government authorized a twenty-five-year timber concession to Hero Taiwan Company, Ltd. to log 60,150 hectares of forest in O Chum, Vonsai, and Taveng districts of Ratanakiri province in 1998, where the Kreung, an indigenous group, have lived for hundreds of years. The Kreung are also deeply linked to the forests for religious reasons. They are making their living in this area, with their limited income coming from selling agricultural products, handicrafts and NTFPs, with average income ranging from US\$100 to US\$160<sup>15</sup> per household per season of malva nut collection.
4. A study in Kratie, Mondulkiri, Pursat, and Kampong Thom found that NTFPs contributed 42% to household income among poor families, ranging from US\$280 to US\$345 per year<sup>16</sup> (and this just for their livelihood improvement).
5. Ream National Park is located in southwestern Cambodia, in the province of Preah Sihanouk province, an area of 21,000 ha of terrestrial and marine habitats. The aim of this study is to determine how the establishment or destruction of the park distributes benefits and costs among different stakeholders, and to formulate strategies for the management of these stakeholders in order to achieve conservation goals. Ream NP is an extremely important economic resource for local communities with a total net value of US\$1.24 million per year. The median family income is only US\$316 per year, and only US\$233 for poor families<sup>17</sup>.
6. The study site, Tapean forest, covers 1,824 hectares and is located in Poey (Chan) Commune, O Chum District, Ratanakiri province. The objective of this study is to assess the value of the forest for traditional purposes and to value NTFP such as fuel wood, rattan and bamboo, malva nuts, house construction materials, and wildlife. The results show that the benefits from traditional sustainable use of forest resources exceed the benefits of commercial timber extraction in the study area by at least US\$200 per hectare over a 90-year period<sup>18</sup>.
7. The study site, the Phnom Kok community forest, is located in the Phnom Kok commune, Voensai district, Ratanakiri province, with a total forest area of 15,959 ha. The annual value of plant-based NTFPs based on the analysis of the 57 resin collectors ranged from US\$5 to US\$270, with an average of US\$58.5. For income generated from animal-based NTFPs, the results based on 62 collectors showed that about 97% of the collectors were able to generate the annual income of up to US\$50 per year. The remainder were able to generate more than US\$50 annually. On average, about US\$20 of income was generated from animal-based NTFPs, which include honey and beeswax. Thus, NTFPs collectors in the Phnom Kok community forest were able to gain income with an average of US\$78.9<sup>19</sup> per year.

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<sup>14</sup>Bann, C. 1997. An Economic Analysis of Alternative Mangrove Management Strategies in Koh Kong Province, Cambodia. Research Report, EEPSEA - Economy and Environment Program for South East Asia, International Development Research Centre: Ottawa

<sup>15</sup>Sara Colm, Srey Marona, and Hou Kalyan (2000) Impacts of the Hero Taiwan Company Concession on Sites of Religious and Cultural Significance in O Chum District, Ratanakiri, Ratanakiri Provincial Environment Department, Ratanakiri Province Cultural Department, CIDSE, UNDP-CARERE, NTFP, ADHIC and Virachey National Park, Ban Lung, Cambodia.

<sup>16</sup>Kasper, K. Hansen, and N. Top, .2006. "Natural Forest Benefits and Economic Analysis of Natural Forest Conversion in Cambodia" Working Paper 33, Cambodia Development Resource Institute. Phnom Penh, Cambodia.

<sup>17</sup>De Lopez, T., Vibol, K., Proeung, S., Dareth, P., Thea, S., Sarina, C., Song, S., Chantha, V., Vandy, N., Bunly, L., and Sinoeun, C. 2001. Policy Options for Cambodia's Ream National Park: A Stakeholder and Economic Analysis. Research Report, EEPSEA - Economy and Environment Program for South East Asia, International Development Research Centre: Ottawa

<sup>18</sup>Bann, C. (2003) An Economic Analysis of Tropical Forest Land Use Options, Ratanakiri Province. Research Report, EEPSEA - Economy and Environment Program for South East Asia, International Development Research Centre: Ottawa

<sup>19</sup>Sophanarith Kim & Nophea Sasaki & Masao Koike (2008), Assessment of non-timber forest products in Phnom Kok community forest, Cambodia, Published online, 6 May 2008 Springer-Verlag

8. Some members of the NTFP working groups are implementing field-based forest management and livelihood programs. They were consulted in order to identify areas known for significant volumes of resin production and high incidences of poverty. The total number of families involved in resin tapping is around 17,800 and they could earn about 86% of the total trade chain with an average of each family tapping earning US\$229-375 per year<sup>20</sup>.
9. A field study was carried out in early of 2007 of five communes around Phnom Aural and Phnom Samkos Wildlife Sanctuary. It found that the local community strongly depends on natural resource extraction, with estimates of the income derived from a wide range of NTFPs at US\$23 per month for low income families, and US\$29 per month for medium income families. These estimates are within the range of gross monthly income reported by villagers for main NTFPs of US\$15-US\$85<sup>21</sup>. These estimates are converted to income per family by multiplying the income per ha by the number of hectares in the sanctuaries in which NTFP collection is permitted. This works out at US\$40 to US\$67 (in 2006 prices) per family per month.

### 2.2.3 BIODIVERSITY

There are a very limited number of studies on biodiversity valuation in Cambodia and only one study has been conducted on the value of forests – the mangrove in Koh Kong province. Mangroves in Koh Kong province cover an area of 63,700 ha, and they are described as ecologically and economically significant to Cambodia, and support a number of households (especially through fishing). The results reveal that the estimation of total value of biodiversity in this area is approximately US\$1.36 billion per year and around US\$511 per ha per year of biodiversity for high quality forest.

### 2.2.4 TOURISM AND RECREATION VALUES

Tourism is one of the fastest growing industries in the world in terms of economic impact. It accounts for many jobs and contributes to over 10% of Gross Domestic Product (GDP) worldwide. In 2012, there were 1 billion tourists globally with the Asia–Pacific region ranking as the highest with more than 7% of international tourists<sup>22</sup>. Ecotourism is the fastest-growing segment of the tourism industry with an annual growth rate of approximately 20%<sup>23</sup>. Through intensive promotion and foreign aid, visitor numbers to Cambodia are currently growing at a rate of 20–30% per year<sup>24</sup>. In 2012, Cambodia received 3.58 million foreign tourists. In 2013, the Ministry of Tourism predicted that the country would receive 4 million foreign tourists<sup>25</sup>. Cambodia contains a number of diverse natural habitats that are important to maintain existing biodiversity, sustain economically and socially valuable natural resources, and provide an overall healthy environment for the people of Cambodia so that they are high potential for livelihood improvement based on ecotourism development and many ecotourism projects established and run by private sector and local community. These community-based ecotourism are the following:

<sup>20</sup> Prom, T. (2009) Beyond Subsistence Trade Chain Analysis of Resin Products in Cambodia, NTFP-EP and NTFP Working Group, Phnom Penh, Cambodia

<sup>21</sup> Grieg-Gran, M., D. de la Harpe, J. McGinley, J. MacGregor, I. Bond (2008), Sustainable financing of protected areas in Cambodia: Phnom Aural and Phnom Samkos Wildlife Sanctuaries, Environmental Economics Programme Discussion Paper 08-01, IIED, London

<sup>22</sup> UNWTO .2013. UNWTO World Tourist Barometer. [WWW document]. [http://mkt.unwto.org/sites/all/files/pdf/unwto\\_pisa\\_2011\\_1.pdf](http://mkt.unwto.org/sites/all/files/pdf/unwto_pisa_2011_1.pdf) (accessed on November 26, 2013).

<sup>23</sup> TIES .2012. Ecotourism Statistical Fact sheet [http://www.ecotourism.org/ecotourism\\_facts](http://www.ecotourism.org/ecotourism_facts) (accessed on November 26,2013) The Echo Traveller. 2013. Ecotravel and Ecotourism Definition. Retrieved November, 2013 from website: <http://www.ecotravellerguide.com/2013/01/eco-travel-and-ecotourism-definition/>.The Ecotourism Society, pp. 155-181.

<sup>24</sup> Ministry of Tourism .2012. Annual Statistics Report, Phnom Penh, Cambodia pp.25-32.

<sup>25</sup> [http://www.wttc.org/site\\_media/uploads/downloads/cambodia2013.pdf](http://www.wttc.org/site_media/uploads/downloads/cambodia2013.pdf)

1. On average, domestic and foreign tourists are willing to pay US\$9-10 per person for a boat ride around Ream, suggesting that there are great opportunities to raise revenues above the current sum of US\$2,500 a year earned from tourism<sup>26</sup>.
2. Tourism in Bokor and Toek Chou has a major economic impact in the province, generating revenue for park and tourism agencies and through the multiplier effects of visitor expenditures. The total values from these areas are approximately US\$691,000 per year. The value from Toek Chou waterfall is estimated to exceed US\$16,000 per year, and from Bokor National Park is estimated approximately US\$675,000 a year<sup>27</sup>. Toek Chou Waterfall is a popular visitor destination in Bokor National Park. Both domestic and foreign tourists visit the waterfall in order to relax, and to enjoy picnics and swimming.
3. Tmatboey is an isolated village located in Kulen Promtep Wildlife Sanctuary in the Northern Plains of Cambodia. The site supports globally important breeding populations of two critically endangered ibis species such as Giant Ibis and White-shouldered Ibis, in the only known nesting site of these species. The underlying Tmatboey business model was therefore based on a minimum of 100 and maximum of 200 relatively high-paying tourists per year. If average local spending during a trip were US\$30 for the village fund and US\$100 per tourist for food, accommodation, guiding, drinks and other services<sup>28</sup> this would net a minimum of US\$3,000 for the fund and US\$10,000 in service fees paid to villagers. Given that the level of Government spending in the Commune is approximately US\$4,000 per year and average annual family incomes are US\$300-450<sup>29</sup>, this would represent a significant level of cash revenue for the village.

**Table 5: Various estimates for values and mapping of ecotourism**

No.	Category	Total income/ year (US\$)	Province	Source
1	Ecotourism	2,500 per year	Ream NP, Preah Sihanouk Province	De Lopez et al., 2001
2	Ecotourism	16,000	Toek Chou, Kampot Province	Emerton et al., 2002
3	Ecotourism	675,000	Bokor NP, Kampot Province	Emerton et al., 2002
4	Ecotourism	37,416.77 (300-450)	Kulen Promtep WS, Preah Vihear Province	Tom et al, 2008
5	Tourism	2,547 million	Cambodia	MoT, 2014

### 2.2.5 CULTURAL AND SPIRITUAL VALUES

Many indigenous ethnic minority groups in Cambodia still strongly believe in spirits, especially forest and mountain spirits. These minority groups include Punong in Mondulkiiri, Kuy in Kampong Thom and Preah Vihear province, and Kreung in Ratanakiri. In Ratanakiri province, Kreung has been classified spirit forests by local people as deep forests with old growth vegetation, large vines, and extraordinary physical features such as large boulders, deep naturally-formed wells, ponds, waterfalls, saltlicks that draw wildlife, and even in one case, stone columns<sup>30</sup>. They have never used these areas but are

<sup>26</sup> De Lopez, T., Vibol, K., Proeung, S., Dareth, P., Thea, S., Sarina, C., Song, S., Chantha, V., Vandy, N., Bunly, L., and Sinoeun, C. 2001. Policy Options for Cambodia's Ream National Park: A Stakeholder and Economic Analysis. Research Report, EEPSEA - Economy and Environment Program for South East Asia, International Development Research Centre: Ottawa

<sup>27</sup> Emerton, L. Seilava, R. Pearith, H. (2002) "Field Study: Cambodia: Bokor, Kirirom, Kep and Ream National Park" IUCN, Phnom Penh, Cambodia.

<sup>28</sup> <http://www.undp.org/content/undp/en/home/ourwork/environmentandenergy/successstories/transforming-ecosystems-in-cambodia.html>

<sup>29</sup> Tom Clements, Ashish John, Karen Nielsen, Chea Vicheka, Ear Sokha and Meas Piseth (2008) Case Study Tmatboey Community-based Ecotourism Project, Cambodia, Ministry of Environment, Cambodia and WCS Cambodia Program

<sup>30</sup> Sara Colm, Srey Marona, and Hou Kalyan (2000) Impacts of the Hero Taiwan Company Concession on Sites of Religious and Cultural Significance in O Chum District, Ratanakiri, Ratanakiri Provincial Environment Department, Ratanakiri Province Cultural Department, CIDSE, UNDP-CARERE, NTFP, ADHIC and Virachey National Park, Ban Lung, Cambodia.

respected from one generation to another. Not many studies have been undertaken which have revealed the value of these people's cultural and spiritual values, and one study attempted to discover this value but could not calculate the total cultural and spiritual value.

The study site, Tapean forest, covers 1,824 hectares and is located in Poey (Chan) Commune, O Chum District, Ratanakiri province. It is used extensively for traditional purposes by at least five villages in the area, acts as an important watershed, is a prime location for malva nuts, has ecotourism potential, and houses trees of commercial value. The area is currently under concession to Macro Panin, but not operation yet, an Indonesian logging company. A forest inventory of half a hectare revealed the area's rich diversity. The area contains close to 200 tree species and over 300 species of ground flora and saplings. The study sought to assess the value of the forest for traditional purposes and to value NTFPs such as fuel wood, rattan and bamboo, malva nuts, house construction materials, and wildlife. The results show that the benefits from traditional sustainable use of forest resources exceed the benefits of commercial timber extraction in the study area by at least US\$200 per hectare. This suggests that local communities might best manage areas of high cultural value and environmental significance<sup>31</sup>.

## 2.3 Indirect Use Value

### 2.3.1 SOIL CONSERVATION

Forests protect soil surfaces from the direct impacts of rain by intercepting rainfall and providing protective litter and humus layers. Like many other forest services, the value of soil erosion control is perhaps best understood when it declines and causes damage locally or downstream in the effected watershed. However, there are no studies that have revealed the soil conservation value in Cambodia. The estimate of actual erosion rates corresponding to each of the possible combinations is based on measurement of plant cover and cropping.

### 2.3.2 CARBON STORAGE AND SEQUESTRATION

Avoided deforestation is not currently included in the flexibility mechanisms of the UNFCCC and Kyoto Protocol. It also points to a possible source of funding in future years, most likely in the next commitment under the Kyoto Convention, if avoided deforestation is incorporated into a carbon trading framework. Carbon storage value may be thought of as the value that is lost if a forest is converted through logging or burning. Carbon sequestration is one of the most important ecosystems services provided by functioning forest ecosystems but has traditionally not been taken into account in the valuation of these resources. Some studies have shown the values of carbon storage and sequestration in Cambodia as follows:

1. Carbon stock values were assigned to the different land cover classes based on published estimates of biomass or carbon stocks in different forest types<sup>32</sup>, where no estimates from Cambodia existed, estimates from similar vegetation types of neighboring countries were used. According to this analysis, the total carbon is stored in the biomass and soils. The majority of carbon is stored in evergreen forest (34%), followed by deciduous forest (30%) and semi-deciduous (11%) (See table 6).

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<sup>31</sup> Bann, C. (2003) An Economic Analysis of Tropical Forest Land Use Options, Ratanakiri Province, Cambodia. Research Report, EEPSEA - Economy and Environment Program for South East Asia, International Development Research Centre: Ottawa

<sup>32</sup> Kapos, V., Ravilious, C., Leng, C., Bertzky, M., Osti, M., Clements, T., Dickson, B. (2010) Carbon, biodiversity and ecosystem services: Exploring co-benefits. Cambodia. UNEP-WCMC, Cambridge, UK.

**Table 6: Total carbon (C) stock (Gt) and total carbon density (t/ha) for different land cover classes in Cambodia**

Land cover	Area [km <sup>2</sup> ] (%)	Total C Stock [Mt] (%)	Biomass Carbon Density (t/ha)	Sources used for estimate
Evergreen forest	37288(20)	1022 (34)	191-211	National
Deciduous forest	47070 (26)	880 (30)	114-126	National
Semi-deciduous forest	13617 (7)	324 (11)	161-178	National
Bamboo and secondary forest	2998 (2)	36 (1)	25-92	National

2. The total of indirect economic benefits into account increases the annual economic value of conserving Ream's mangroves to US\$900,000 a year. Carbon stocks in the forests were estimated from information on the areas of forests of different types in the management zones. Carbon sequestration benefits have been valued at US\$2.2/ha (and mangrove storm protection functions at US\$32/ha) in Koh Kong Province<sup>33</sup>.

3. The forests of the Cardamom Mountains are extremely high in vegetation volume per hectare. The calculation of the value of this carbon sequestration function obviously applies to the whole area, with different values assigned to different categories of forest and land cover. To date, there has been very little direct income to Cambodia from REDD schemes and it is not suggested here that the values calculated for carbon sequestration can be easily turned into monetary income. The result of this valuation estimated of approximately US\$3.7 million per year<sup>34</sup>, one of the highest value ecosystems services that the Central Cardamom provides and global significance.

**Table 7: Various estimates for values of carbon**

No.	Category	Total Value/year (US\$)	Province	Source
1	NPV of carbon over 50-year 10% discount	336 for deciduous, 401 for semi-evergreen, 610 for evergreen (av. 449/ha)	Kampong Thom, Pursat, Mondulhiri and Kratie	Kasper and Neth, 2006
2	Carbon sequestration	3,668,978 (total stock value) (9/ha)	Central Cardamom	Soussan, 2010
3	Carbon sequestration	2.2/ha	Koh Kong	Bann, 1997
<b>Average</b>		<b>153.45</b>		
<b>Range</b>		<b>(2.2-449)</b>		

### 2.3.2 WATERSHED PROTECTION

The maintenance of watershed protection/hydrological services is believed to be an important benefit for protecting against natural disaster and thereby providing significant benefits to local communities. Some publications that reveal the key importance of watershed protection and have valuations within Cambodia are the following:

<sup>33</sup> Bann, C. 1997. An Economic Analysis of Alternative Mangrove Management Strategies in Koh Kong Province, Cambodia. Research Report, EEPSEA - Economy and Environment Program for South East Asia, International Development Research Centre: Ottawa

<sup>34</sup> J. Soussan C. Sam (2010) The Values of Land Resources in the Cardamom Mountains of Cambodia, Final Report, in partnership with MAFF, CI and ADB Phnom Penh, Cambodia

1. The analysis showed that natural forest provides various local, national and global benefits of watershed protection in Cambodia. The results revealed that the forest value (with a 10% discount rate over 50 years) was US\$399/ha/year for deciduous forest, US\$700 for semi-evergreen forests and US\$700 for evergreen forests<sup>35</sup>.
2. The result of this valuation estimate was about US\$3.7 million, and approximately US\$75 million<sup>36</sup> of this estimate is the benefit for watershed protection within these two wildlife sanctuaries.

**Table 8: Various estimates for values of watershed protection**

No.	Category	Total Value/ year (US\$)	Total Value/ ha/year (US\$)	Province	Source
1	NPV of watershed protection (US\$/ha) over 50-years, 10 percent discount	US\$399 for deciduous, US\$700 for semi-evergreen, US\$700 for evergreen	599.67	Kampong Thom, Pursat, Mondulkiri and Kratie	Kasper and Neth, 2006
2	Watershed protection	75,268,095	188	Central Cardamon Mountains	Soussan, 2010
3	Mangrove storm protection functions	176	176	Koh Kong	Bann, 1997
<b>Average</b>			<b>321.07</b>		
<b>Range</b>			<b>(176:599.67)</b>		

### 2.3.3 WATER PURIFICATION

Agriculture accounts for a large proportion of freshwater withdrawals for irrigation systems in Cambodia and relies on rainfall, water flows and water bodies. However, there is a lack of studies to measure freshwater withdrawal, its impacts and the value of forest ecosystem for cleaning drinking water. The total value of water purification in Xishuangbanna Corridors (China) was estimated in two-difference forest types, namely broadleaf and coniferous forest. The total amounts of these areas are approximately US\$185 million, which is about US\$1,123 per hectare per year<sup>37</sup>.

### 2.3.4 NUTRIENT RECYCLING

Nutrient supply in natural systems is derived from the turnover of soil organic matter, which is mediated by soil nutrient cycling organisms. In agricultural settings, this system is disrupted due to the substantial removal of nutrients when the crop is harvested, reduced nutrient release from organic matter, and large additions of readily available nitrogen as organic fertilizer. However, there is no Cambodian study to estimate the value of forest ecosystems for producing nutrient cycling. The total value of nutrient cycling in Xishuangbanna Corridors (China) was estimated in two different forest types, namely broadleaf and coniferous forest. The total amounts of these areas are approximately US\$182 million per year, or about US\$1,102 per hectare per year<sup>38</sup>.

<sup>35</sup> Kasper, K. Hansen, and N. Top, .2006. "Natural Forest Benefits and Economic Analysis of Natural Forest Conversion in Cambodia" Working Paper 33, Cambodia Development Resource Institute, Phnom Penh, Cambodia.

<sup>36</sup> J. Soussan C. Sam (2010) The Values of Land Resources in the Cardamom Mountains of Cambodia, Final Report, in partnership with MAFF, CI and ADB Phnom Penh, Cambodia

<sup>37</sup> <https://lilac.uni-hohenheim.de/en/links/ADBCorridors.pdf>

<sup>38</sup> <https://lilac.uni-hohenheim.de/en/links/ADBCorridors.pdf>

### 2.3.5 POLLINATION

Pollination of crops is an ecosystem services of economic value and many people identify wild bees as the most important pollinator within all kinds of forest types. Forests provide shelter, nest-sites, water, larval food plants and floral resources for an immense number of pollinators ranging from tiny insects to birds and bats. However, there is no Cambodian study to estimate the value of forest ecosystem for supporting pollination yet. The pollination value was estimated for of the wet tropics world heritage area in Queensland, Australia at AUD\$8.07 per ha per year<sup>39</sup>.

### 2.3.6 PEST CONTROL

The loss of plant diversity that accompanies agricultural simplification of a landscape frequently results in less diverse but more abundant pest species and the common solution to this problem is the application of pesticides. However, there is no study to estimate the value of forest ecosystem for supporting pest control in Cambodia yet. A pest control valuation was estimated in Australia. It calculated that the biological control, including pest and disease control, value of the wet tropics world heritage area in Queensland, Australia was AUD\$14.22 per ha per year<sup>40</sup>.

## 2.4 Option Value

Option value is a type of use value of natural resources in that it relates to the future and an individual may value the option to be able to use the resources sometime in the future. Thus there is an additional 'premium' placed on preserving resources and functions for future uses. Option value may be particularly important and it is a high future value in terms of scientific, educational, commercial and other economic uses. In Cambodia, the protected area system covers about 26% of the territory. Some two thirds of those areas are under the authority of the Ministry of Environment (MoE), with the remaining third being under the Ministry of Agriculture, Forestry and Fisheries (MAFF). The establishment of protected areas and other conservation areas is one choice among several possible uses for option value. This option is for long-term benefits of protecting forests and providing environmental functions that are essential to human activities in the future such as watershed protection, climate maintenance and biodiversity.

## 2.5 Non Use Values

Non-use values are existence and bequest values. Existence value derives from the mere existence of a park, an ecosystems and/or wildlife. People may not have current or future use for environmental goods, but may wish to preserve them in their own right. These are values that individuals place on environmental goods and services that they do not personally use. Existence and bequest values are difficult to assess as their estimation involves some assumptions concerning future incomes and preferences, as well as technological change. Thus, no data on the value of non-use values in Cambodia has been carried out so far.

The total existence values of tropical forest range from US\$2 to US\$12 per hectare per year<sup>41</sup>. The existence value in the south-east Pahang peat swap forest, Malaysia, was calculated using the contingent valuation method to estimate the mean of willingness to pay. The results found that the total

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<sup>39</sup> Curtis, I.A. (2004) Valuing ecosystem goods and services: a new approach using a surrogate market and the combination of a multiple criteria analysis and a Delphi Panel to assign weights to the attributes. *Ecological Economics* 50: 163-194.

<sup>40</sup> Curtis, I.A. (2004) Valuing ecosystem goods and services: a new approach using a surrogate market and the combination of a multiple criteria analysis and a Delphi Panel to assign weights to the attributes. *Ecological Economics* 50: 163-194.

<sup>41</sup> <https://www.cbd.int/doc/publications/cbd-ts-04.pdf>



mean willingness to pay (MWTP) for these areas is approximately NZ\$5 million per year with MWTP of NZ\$20.98 per household per year<sup>42</sup>.

## 2. CONCLUSIONS

This review of the ecological and economic literature for the value of forest ecosystem in Cambodia has found the following:

1. Some studies have been done on the value of forest products, which covered some areas representing the key ecological landscapes in Cambodia particularly Central Cardamom mountains. Valuation methods differ, thus these methods should be adopted with more consultation with other stakeholders and submitted to government for their approval before conducting additional studies. The valuation of forest products conducted by Sophanarith et al., 2004 for the whole country, covered all forest types and classification using three different scenarios to estimate the total value of forest products;
2. The valuation results from NTFPs in some areas are very low especially in Ratanakiri, Phnom Samkos and Phnom Aural WS; this may be because of limited access to markets and poor infrastructure. The findings are three times lower than in other areas in Koh Kong, and Kampong Thom province. Most studies only covered income gained and use by the local community and did not estimate the total value of NTFPs before being harvested. Only one study estimated the total value of NTFPs in Central Cardamom, but this study did not reveal the total value of local communities extraction from these areas. Thus, first, some studies to estimate the total NTFPs valuation and NTFPs extracted by local communities should be conducted at the key ecological representative locations. This information can then be used to estimate of the total value of NTFPs and the total of NTFPs exploited by local communities in Cambodia, and even the total value of the sustainable NTFPs harvest;
3. Ecotourism and recreation is the fastest growing sector in Cambodia and many ecotourism areas established recently are managed by both private sectors and local community. The total value of ecotourism and recreation varies from year to year based on tourist numbers and the total value data can be obtained from the annual report of Ministry of Tourism. However, Ministry of Tourism does not record some new ecotourism sites yet and the total value of most ecotourism areas are also not being updated;
4. The total value of both biodiversity and culture are very hard to estimate and no studies have been conducted on the conversion of cultural and spiritual values into monetary term. Thus, conversion methods into monetary term should be considered and identified and then some studies should be conducted at the high priority and ecological representative landscapes. However, according to the study conducted by Bann, in 1997, the value of biodiversity in high quality forest has been estimated;

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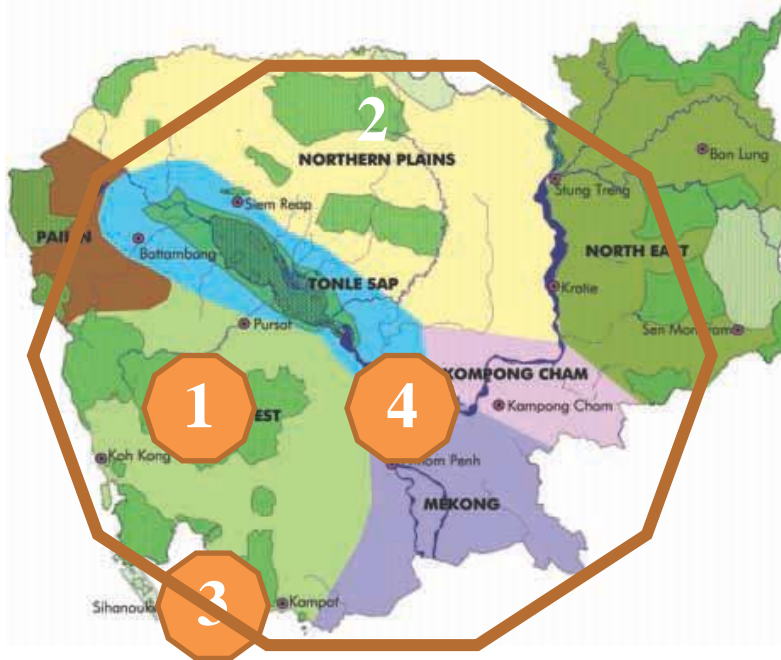
<sup>42</sup> [http://ageconsearch.umn.edu/bitstream/97133/2/2009\\_7\\_%20Peat%20swamp%20value%20Malaysia\\_Azmi%20etal%5b1%5d.pdf](http://ageconsearch.umn.edu/bitstream/97133/2/2009_7_%20Peat%20swamp%20value%20Malaysia_Azmi%20etal%5b1%5d.pdf)

5. Indirect use valuation studies from forest ecosystems are also very limited, especially the estimation of soil conservation, water purification, nutrient cycling, pollination, and pest control. Thus, conversion methods into monetary terms for these sectors should be considered and identified and then some studies should be conducted at the high priority and ecological representative landscapes for these fields.

6. The study conducted by Kasper and Neth, 2006 have already shown the total carbon stock, density for different land cover classes and forest type in Cambodia. Thus, the total value of carbon storage and sequestration can be calculated if the market price of carbon is available. However, the method used to generate this data should be approved and accepted by the government;

7. There is a lack of studies to estimate the option and non-use values, but some studies have already been conducted in neighboring countries, thus some data could be used to estimate these values in Cambodia. However, some studies should be conducted to reveal the option and non-use values in Cambodia.

**Appendix 1: Distribution of value of forest products studies in Cambodia**



No.	Category	Total Value (US\$/ha)	Harvestable Value/ (US\$/ha/y)
1	Forest Products	1,100	
2	Forest products		10.41
3	Forestry & Logging		25.33 (2011)
4	Forestry & Logging		11.95 (2000)
5	Mangrove product harvesting		344
6	Flood forest		22
<b>Average</b>			82.74
<b>Range</b>			(10.41:344)

Source: 1. Soussan, 2010; 2. Sophanarith et al., 2004, 3. NIS, 2011, 4. NIS, 2011 5. Emerton et al., 2002 ; 6. Navy et al., 2001

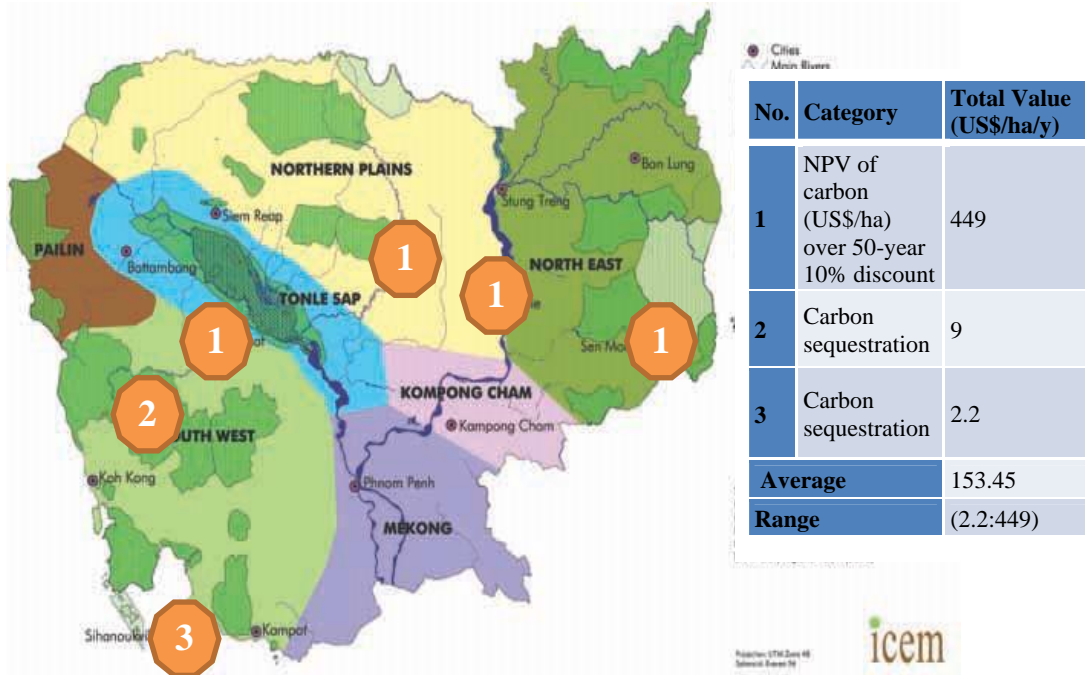
**Appendix 2: Distribution of value of non-timber forest products studies in Cambodia**



No.	Category	Total Value (US\$/ha)	Harvestable Value/Income (US\$/h/y)
1	NTFPs	1,099	
2	NTFPs		1050
3	NTFPs (malva nut)		130
4	NTFPs		312.5
5	NTFPs		274.5
6	NTFPs		200
7	NTFPs		78.9
8	NTFPs (resin)		302
9	NTFPs		50
<b>Average</b>			<b>299.74</b>
<b>Range</b>			<b>(50:1050)</b>

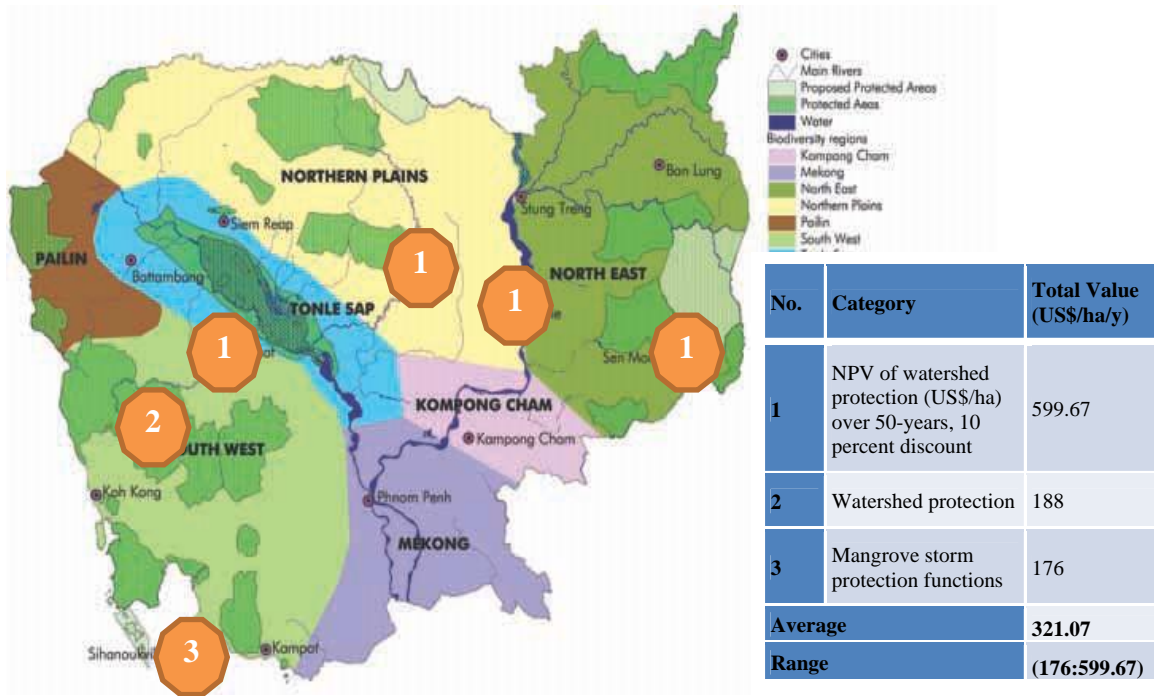
Author: 1. Soussan, 2010; 2. Bann, 1997, 3. Sara et al., 2000; 4. Kasper and Neth, 2006; 5. De Lopex et al, 2001; 6. Bann 2003; 7. Sophanarith et al., 2008; 8. Prom, 2009; 9. Grieg et al., 2008

**Appendix 3: Distribution of value of carbon sequestration studies in Cambodia**



Author: 1. Kasper and Neth, 2006; 2. Soussan, 2010; 3. Bann, 1997

**Appendix 4: Distribution of value of watershed protection studies in Cambodia**



Author: 1. Kasper and Neth, 2006; 2. Soussan, 2010; 3. Bann, 1997

### Appendix 5: Estimates for value of forest ecosystems in Cambodia

Use Value						
Direct Use Value						
Estimates for values of forest products						
No.	Category	Total Value/ income/y (US\$)	Total income/y (US\$)	Province	Source	Method
1	Forest Products (including crop values)	441,436,700 (1,100/ha)		Central Cardamom (Pursat, Koh Kong & Kampong Speu)	Soussan, 2010	<p>There are six stages in the methodology developed under this initiative, with the intention that they can be adapted to different spatial scales for individual studies.</p> <ol style="list-style-type: none"> <li>1. Inception: the identification of the scope, location, spatial scale and strategic focus of the study, based on stakeholder consultation, and the preparation of background materials on the socio-economic and environmental context of the assessment.</li> <li>2. The assessment of the quantity, spatial distribution and ecological characteristics of land cover types, categorized into agro-ecological zones and analyzed using a Geographical Information System (GIS).</li> <li>3. The analysis of ecosystems services stocks and flows, based on the 4-fold MA categorization, for each land cover category.</li> <li>4. The role of the assessed ecosystems services in the livelihoods of communities living in each land cover area and in overall economic development in the study zone.</li> <li>5. The identification of land degradation patterns and pressures on the sustainable management of land resources, including their spatial distribution and the assessment of the factors causing the degradation.</li> <li>6. The assessment of SLM options that have the potential to reduce or remove degradation pressures, including the analysis of their economic viability and the identification of the locations for which they are suitable.</li> </ol>
2	Forest products	111,700,000 (10.41/ha)		Cambodia	Sophanarith et al., 2004	<p>The survey team consisted of five members, including two foresters from cantonment of forestry administration, one forester from the provincial forestry administration, and two local staff members from the community forestry association. The survey team was responsible for interviewing individuals and recording data. The interviews were conducted in late February 2007 in four villages in the Phnom Kok commune: Kokproav,</p>

						Koklaos, Tiem, and Krolaymuy. There are approximately 265 families in these villages, and most people are of the Lao, Braov, Tonpun, or Khmer ethnic groups. The data from the field surveys were entered into a computer for evaluation and were analyzed using Microsoft Excel.
3	Forestry & Logging 2005-2010		271,795,833 (25.41/ha)	Cambodia	NIS, 2011	
4	Forestry & Logging 2005-2010		128,250,000 (11.33/ha)	Cambodia	NIS, 2011	
5	Mangrove product harvesting		344	Ream NP, Preah Sihanouk	Emerton et al., 2002	The field study investigated the contribution of these four protected areas to local and regional economic activities in the towns, villages and communes in Sihanoukville, Kampot and Kompong Speu provinces. The first step in defining the scope and content of the study was assessing and describing the various economic benefits of the South-West Cluster PAs in terms of their development connections and beneficiary groups. Selected benefits were then chosen for detailed analysis.
6	Flood forest		22	Kandal province	Navy et al, 2001	The two flooded forest areas selected for this study are located in four communes of Muk Kompul and Ponhear Leu Districts, Kandal Province. These study sites were chosen for their close proximity to Phnom Penh, the associated land and fuel wood collection pressures, and the presence of commercial fishing lots. Further, these sites were chosen for their differences in the quantity and quality of the flooded forests. Survey interviews were conducted with 49 households in two communes. All the household interviews were randomly selected. The 107 households surveyed represented about 2% of the total households in the four communes.
<b>Average</b>			<b>82.74</b>			
<b>Range</b>			<b>(22:344)</b>			
<b>Estimates for values of Non-Timber Forest Products</b>						
1	NTFPs	441,171,200 (1,099/ha)		Central Cardamom	Soussan, 2010	There are six stages in the methodology developed under this initiative, with the intention that they can be adapted to different spatial scales for individual studies. 1. Inception: the identification of the scope, location, spatial scale and strategic focus of the study, based on stakeholder consultation, and the

						<p>preparation of background materials on the socio-economic and environmental context of the assessment.</p> <p>2. The assessment of the quantity, spatial distribution and ecological characteristics of land cover types, categorized into agro-ecological zones and analyzed using a Geographical Information System (GIS).</p> <p>3. The analysis of ecosystems services stocks and flows, based on the 4-fold MA categorization, for each land cover category.</p> <p>4. The role of the assessed ecosystems services in the livelihoods of communities living in each land cover area and in overall economic development in the study zone.</p> <p>5. The identification of land degradation patterns and pressures on the sustainable management of land resources, including their spatial distribution and the assessment of the factors causing the degradation.</p> <p>6. The assessment of SLM options that have the potential to reduce or remove degradation pressures, including the analysis of their economic viability and the identification of the locations for which they are suitable.</p>
2	NTFPs		500- 1600 (1,050)	Koh Kong province	Bann, 1997	The direct use values of mangrove resources and services are relatively straightforward to measure, usually involving the market value of production gains. The indirect use value of an environmental function is related to the change in the value of production or consumption of the activity or property that it is protecting or supporting.
3	NTFPs (malva nut)		100 to160 (130)	Chum District, Ratanakiri province	Sara et al., 2000	<p>The study followed a modified Rural Appraisal methodology, including the following:</p> <ul style="list-style-type: none"> <li>• Conduct participatory community mapping exercises in the villages</li> <li>• Compile and analyze information and data collected.</li> <li>• Present preliminary results to representatives of villages.</li> </ul>
4	NTFPs		280 to 345 (312.5)	Kampong Thom, Pursat, Mondulakiri and Kratie	Kasper and Neth, 2006	This value, however, does not reflect the true value of forest resources to society, since it excludes products collected for subsistence use, as well as externalities and non-tangible products. Natural forests have many positive externalities and non-tangible products such as animal habitat, watershed protection and carbon sequestration.
5	NTFPs		233 to 316 (274.5)	Ream NP, Preah Sihanouk	De Lopez et al., 2001	Cost benefit analysis compares alternative policies and projects according to their monetized valued costs and benefits. When there are several possible choices, the management option with the highest net benefits to society should be undertaken. Standard cost-benefit studies tend to report only the net aggregate economic values of proposed projects. However, under different management scenarios, those who pay the

						costs and those who receive the benefits will not be the same. The costs and benefits of land use options are distributed unevenly among groups with different social characteristics. The assumption can have a number of important implications: (1) disadvantaged stakeholders such as the poor or minorities may bear a disproportionate share of the costs (2) stakeholders with wealth and influence may oppose the implementation of options that would not maximise their economic benefits. The first shortcoming raises the issue of equity or fairness of the distribution of costs and benefits among stakeholders. If a particular set of individuals bears the costs, and another set reaps the benefits, this may seem unfair not only to those individuals, but also to society at large. The second issue of concern is the practical implementation of a land use option. The establishment of Ream National Park creates conflicts over the management of natural resources.
6	NTFPs		200	Ratanakiri	Bann, 2003	The survey work focused on five key categories of NTFP: fuelwood, rattan and bamboo, medicine, wildlife, and malva nuts. These products were selected following a review of existing survey work and discussions with agencies working in the villages. A rapid rural appraisal (RRA) approach was used during interview. More in-depth future research could be based on results from it. The survey covered general socio-economic issues, as well as information necessary for valuation purposes. The researchers worked in pairs, each responsible for one of the five categories of NTFP under investigation. They had planned to start with a meeting with the key people in the village, followed by individual meetings and finally a communal meeting in evening. These informal meetings proved to be very animated and fruitful. A market survey was also undertaken in Ban Lung Market to determine the market prices of marketed forest products and of the potential substitutes for non-marketed forest products.
7	NTFPs		78.9	Phnom Kok CF, Voensai district, Ratanakiri	Sophanarith et al., 2008	The survey team consisted of five members, including two foresters from cantonment of forestry administration, one forester from the provincial forestry administration, and two local staff members from the community forestry association. The survey team was responsible for interviewing individuals and recording data. The interviews were conducted in late February 2007 in four villages in the Phnom Kok commune: Kokproav, Koklaos, Tiem, and Krolaymuy. There are approximately 265 families in these villages, and most people are of the Lao, Braov, Tonpun, or Khmer ethnic groups. The data from the field surveys were entered into a computer for evaluation and were analyzed using Microsoft Excel.



8	NTFPs (resin)		229 to 375 (302)	Preah Vihear, Kampong Thom, Mondulkiri & Stung Treng	Prom, 2009	<p>NTFP-EP carried out field research on resin trade by making five trips to the study areas between May and June, 2008. Using prepared questionnaires, 41 semi-structured interviews were conducted with traders, wholesalers, local resin processors, transporters, exporters, and domestic retailers/distributors. Focus group discussions (FGD) were also conducted with more than 50 resin tappers, and representatives of 5 resin associations and 2 NTFP associations in the 5 provinces during this period. In addition, NTFP-EP conducted, with funding support from Oxfam GB and The Asia Foundation, 2 value chain workshops in Kratie in September 2008 and Kg. Thom in October 2008, which was participated by up to 70 resin collectors, local NGO staff and members of resin and NTFP community based associations in the 5 provinces. The workshop was both for capacity building of participants in NTFP value chain analysis as well as to validate the field data of the resin study. The FGDs and the value chain workshops strengthened the available data on collection volume, trade bottlenecks and opportunities and organizational management issues and capacity building needs of collectors groups and assisting local NGOs. Based on the wide interview coverage, including five main trade routes of resin production and also by cross-checking with stakeholders working on forest products and livelihoods, and utilizing other data validation methods, it is suggested that this study is expected to be fairly representative of resin production and market and trade across the country.</p>
9	NTFPs		15 to 85 (50)	Phnom Aural and Phnom Samkos WS	Grieg et al., 2008	<p>The ecological services valuation is based around two scenarios:</p> <ol style="list-style-type: none"> <li>1. Protection scenario: the value of ecosystem services provided by the sanctuaries taking into account the provisions of the management plans.</li> <li>2. Non-protection scenario: the value of ecosystem services provided by the sanctuaries if controls on land and resource use are lifted. The study estimates the value associated with timber harvesting, collection of non-timber forest products (including fuel wood and building materials for local use, agriculture, and carbon storage under the two scenarios. The scenarios are considered over 25 years, and a discount rate of 10% is used to convert returns from land uses (such as agriculture and exploitation of NTFPs) that yield a stream of returns over time to a common year. This makes it possible to compare their value with that of unsustainable timber harvesting which yields benefits only in a short time span. All prices and cost data have been expressed as 2006 US\$ using the GDP deflator (BEA).</li> </ol>

		<b>Average</b>	<b>299.74</b>			
		<b>Range</b>	<b>(50:1050)</b>			
<b>Estimates for values of biodiversity</b>						
1	Biodiversity	1.36 billion (511/ha)		Koh Kong	Bann, 1997	The direct use values of mangrove resources and services are relatively straightforward to measure, usually involving the market value of production gains. The indirect use value of an environmental function is related to the change in the value of production or consumption of the activity or property that it is protecting or supporting. The first step to valuation is deciding whether the service supports economic productivity or is protecting economic activities and property.
<b>Estimates for values and mapping of ecotourism</b>						
1	Ecotourism		2,500 per year	Ream NP, Preah Sihanouk Province	De Lopez et al., 2001	The costs and benefits of land use options are distributed unevenly among groups with different social characteristics. The assumption can have a number of important implications: (1) disadvantaged stakeholders such as the poor or minorities may bear a disproportionate share of the costs (2) stakeholders with wealth and influence may oppose the implementation of options that would not maximise their economic benefits.
2	Ecotourism		16,000	Toeuk Chou, Kampot Province	Emerton et al., 2002	This value, however, does not reflect the true value of forest resources to society, since it excludes products collected for subsistence use, as well as externalities and non-tangible products. Natural forests have many positive externalities and non-tangible products such as animal habitat, watershed protection and carbon sequestration.
3	Ecotourism		675,000	Bokor NP, Kampot Province	Emerton et al., 2002	This value, however, does not reflect the true value of forest resources to society, since it excludes products collected for subsistence use, as well as externalities and non-tangible products. Natural forests have many positive externalities and non-tangible products such as animal habitat, watershed protection and carbon sequestration.
4	Ecotourism		37,416.77 (300-450)	Kulen Promtep WS, Preah Vihear Province	Tom et al., 2008	

5	Tourism		2,547,000,000	Cambodia	MoT, 2014	
<b>Estimates for value of cultural and spiritual values</b>						
No Data						
<b>Indirect Use Value</b>						
<b>Estimates for values of soil conservation</b>						
No Data						
<b>Estimates for values of carbon</b>						
1	NPV of carbon (US\$/ha) over 50-year 10% discount	336 for deciduous, 401 for semi-evergreen, 610 for evergreen (449/ha)		Kampong Thom, Pursat, Mondulkiri and Kratie	Kasper and Neth, 2006	This value, however, does not reflect the true value of forest resources to society, since it excludes products collected for subsistence use, as well as externalities and non-tangible products. Natural forests have many positive externalities and non-tangible products such as animal habitat, watershed protection and carbon sequestration.
2	Carbon sequestration	3,668,978 per year (9/ha)		Central Cardamom	Soussan, 2010	<p>There are six stages in the methodology developed under this initiative, with the intention that they can be adapted to different spatial scales for individual studies.</p> <ol style="list-style-type: none"> <li>1. Inception: the identification of the scope, location, spatial scale and strategic focus of the study, based on stakeholder consultation, and the preparation of background materials on the socio-economic and environmental context of the assessment.</li> <li>2. The assessment of the quantity, spatial distribution and ecological characteristics of land cover types, categorized into agro-ecological zones and analyzed using a Geographical Information System (GIS).</li> <li>3. The analysis of ecosystems services stocks and flows, based on the 4-fold MA categorization, for each land cover category.</li> <li>4. The role of the assessed ecosystems services in the livelihoods of communities living in each land cover area and in overall economic development in the study zone.</li> <li>5. The identification of land degradation patterns and pressures on the sustainable management of land resources, including their spatial distribution and the assessment of the factors causing the degradation.</li> <li>6. The assessment of SLM options that have the potential to reduce or remove degradation pressures, including the analysis of their economic</li> </ol>

						viability and the identification of the locations for which they are suitable.
3	Carbon sequestration	2.2/ha		Koh Kong	Bann, 1997	The direct use values of mangrove resources and services are relatively straightforward to measure, usually involving the market value of production gains. The indirect use value of an environmental function is related to the change in the value of production or consumption of the activity or property that it is protecting or supporting. The first step to valuation is deciding whether the service supports economic productivity or is protecting economic activities and property.
		<b>Average</b>	<b>153.45</b>			
		<b>Range</b>	<b>(2.2-449)</b>			
<b>Estimates for values of watershed protection</b>						
1	NPV of watershed protection (US\$/ha) over 50-years, 10 percent discount	US\$399 for deciduous, US\$700 for semi-evergreen, US\$700 for evergreen (599.67/ha)		Kampong Thom, Pursat, Mondulkiri and Kratie	Kasper and Neth, 2006	This value, however, does not reflect the true value of forest resources to society, since it excludes products collected for subsistence use, as well as externalities and non-tangible products. Natural forests have many positive externalities and non-tangible products such as animal habitat, watershed protection and carbon sequestration.
2	Watershed protection	US\$75,268,095 per year (188/ha)		Central Cardamon Mountains	Soussan, 2010	<p>There are six stages in the methodology developed under this initiative, with the intention that they can be adapted to different spatial scales for individual studies.</p> <ol style="list-style-type: none"> <li>1. Inception: the identification of the scope, location, spatial scale and strategic focus of the study, based on stakeholder consultation, and the preparation of background materials on the socio-economic and environmental context of the assessment.</li> <li>2. The assessment of the quantity, spatial distribution and ecological characteristics of land cover types, categorized into agro-ecological zones and analyzed using a Geographical Information System (GIS).</li> <li>3. The analysis of ecosystems services stocks and flows, based on the 4-fold MA categorization, for each land cover category.</li> <li>4. The role of the assessed ecosystems services in the livelihoods of communities living in each land cover area and in overall economic development in the study zone.</li> <li>5. The identification of land degradation patterns and pressures on the sustainable management of land resources, including their spatial</li> </ol>

						distribution and the assessment of the factors causing the degradation. 6. The assessment of SLM options that have the potential to reduce or remove degradation pressures, including the analysis of their economic viability and the identification of the locations for which they are suitable.
3	Mangrove storm protection functions	US\$176/ha/year		Koh Kong	Bann, 1997	The direct use values of mangrove resources and services are relatively straightforward to measure, usually involving the market value of production gains. The indirect use value of an environmental function is related to the change in the value of production or consumption of the activity or property that it is protecting or supporting. The first step to valuation is deciding whether the service supports economic productivity or is protecting economic activities and property.
		<b>Average</b>	<b>321.07</b>			
		<b>Range</b>	<b>(176:599.67)</b>			
<b>Estimates for values of water purification</b>						
No Data						
<b>Estimates for values of nutrient cycling</b>						
No Data						
<b>Estimates for values of pollination</b>						
No Data						
<b>Estimates for values of pest control</b>						
No Data						
<b>Option value</b>						
No Data						
<b>Non Use Value</b>						
<b>Estimates for values of existence and bequest</b>						
No Data						



**REDD+ Taskforce Secretariat Office**

#40, Preah Norodom Blvd., Sangkat Psar Kanal,

Phnom Penh, Cambodia

Tel: (+855) 23 224 251

Email: [redd.secretariat@cambodia-redd.org](mailto:red.secretariat@cambodia-redd.org)

Website: [www.cambodia-redd.org](http://www.cambodia-redd.org)