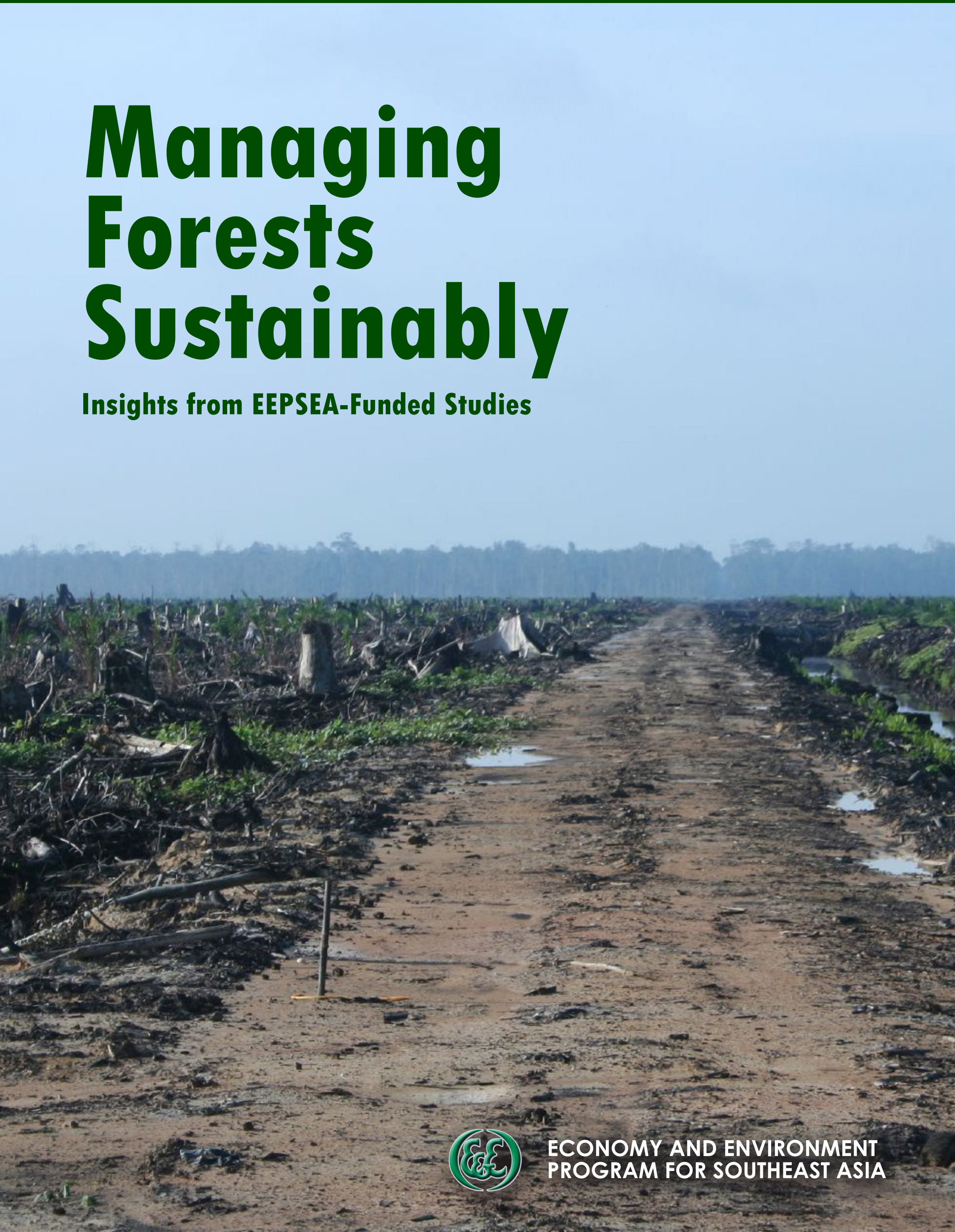
Managing Forests Sustainably

Insights from EEPSEA-Funded Studies



ECONOMY AND ENVIRONMENT
PROGRAM FOR SOUTHEAST ASIA

EEPSEA studies cited in this monograph

Amalia, M. and S. Syahril. 2016. Overview of the payment for ecosystem services implementation in Indonesia.

Bui D.T. and Hong B.N. 2006. Payments for environmental services in Vietnam: Assessing an economic approach to sustainable forest management.

Castillo, G.B.; C. Somaly; Li W.; Li Y.; L. Fatah; S. Malivarn; K.F. Lee; A.D. Anda, Jr.; P. Laengcharoen; Pham D.C; and B. Laplante. 2015. Fiscal gaps and financing of Southeast Asia's protected areas: A cross-country analysis.

Dang L.H. and Nguyen T.Y.L. 2009. Willingness to pay for the preservation of Lo Go – Xa Mat National Park in Vietnam.

Heng N. and Kong S. 2016. A review of PES implementation in Cambodia.

Hou, K. and S. Meas. 2010. A cost and benefit analysis of the community forestry project in Chumkiri district, Kampot province, Cambodia.

Jarungrattanapong, R.; P. Mahasuweerachai; and O. Nabangchang. 2016. Payment for ecosystem services in Thailand and Lao PDR.

Leimona, B.; B.K. Jack; B. Lusiana; and R. Pasha. 2009. Designing a procurement auction for reducing sedimentation: A field experiment in Indonesia.

Macandog, P.B.M. 2016. An overview of PES implementation in the Philippines.

McElwee, P.; Ngjiem P.T.; Le H.; and Vu H. 2015. Downscaling REDD policies in developing countries: Assessing the Impact of carbon payments on household decision making and vulnerability to climate change in Vietnam.

Nguyen T.Y.L. and Pham T.N. 2014. Payment for environmental services in Southeast Asia: A regional review of policy implementation.

Roongtawanreongsri, S.; P. Sawangchote; S. Bumrungsri; and C. Suksaroj. 2014. Economic benefits of management options for Kho Hong Hill, South Thailand.

Thanthathep, K.K.; D. Souphonphacdy; and M. Baylatry. 2009. Using CVM for in-situ biodiversity conservation and sustainability: A case of the Houay Nhang Protected Area.

Yem, D; N. Top; and V. Lic. 2011. Rubber plantation development in Cambodia: At what cost?

Front cover photo: An oil palm concession in Riau, Indonesia,
by Hayden, sourced from flickr.com

This monograph was written and packaged by Julienne Bariuan-Elca.

Managing Forests Sustainably

Insights from EEPSEA-Funded Studies

Economy and Environment Program for Southeast Asia (EEPSEA)
January 2017

Foreword

The Economy and Environment Program for Southeast Asia (EEPSEA) presents you with the fifth monograph in our *Practitioners Series*. This series provides natural resource managers and practitioners with quick, easy-to-use references on how to deal with environmental and natural resource management issues prevalent in the region. Each monograph of this series provides practical guidelines based on lessons distilled from environmental economics studies funded by EEPSEA.

Entitled *Managing Forests Sustainably*, this monograph explores ways by which natural resource managers can address the sensitive issue of deforestation and forest degradation in the region. Emphasized is the need to take into account the value of the ecosystem services that forests provide when considering plans for land use change, especially when turning primary forests into agricultural plantations. The strategies featured are general enough to transcend different socio-economic and political settings so that users will build upon them to better suit their unique situations.

It should also be noted that the featured studies were conducted from 2006 to 2016, thus, their recommendations are based on the realities and experiences prevailing at the time they were conducted.

The full text of the studies reviewed can be downloaded from the EEPSEA website (www.eepsea.org) as well as from the Economy & Environment Partnership for Southeast Asia (EEPSEA Partnership) website (www.eepseapartners.org).

This monograph is published as part of our continued commitment to improve natural resource management in the region through environmental and natural resource economics research.

Herminia A. Francisco
EEPSEA Program Director

Contents


Photo by Jan van der Ploeg/CIFOR, from flickr.com

Deforestation in Southeast Asia

Southeast Asia's rapid economic growth is exacting a toll on its forests. Home to the world's third largest tropical forests, the region is experiencing deforestation rates higher than almost anywhere in the world (UNEP, FAO & UNFF 2009).

The region lost nearly one-seventh of its forest cover during the past two decades, contributing 3% to global deforestation over the same period (UNESCAP 2011). More specifically, between 1980 and 2007, the region's forests have decreased by a total of 555,587 km^2, an area roughly the size of Thailand (ACB 2010). The annual average rate of deforestation is estimated at 20,578 km^2, an area almost 29 times the size of Singapore (ACB 2010).

The annual average rate of deforestation in Southeast Asia is an area almost 29 times the size of Singapore.

- ASEAN Centre for Biodiversity

For the Greater Mekong Subregion (GMS), an analysis of satellite imagery showed that nearly one-third of its remaining forest cover was lost from 1973 to 2009, with Vietnam and Thailand each losing 43% of their forest cover (WWF 2013). Myanmar accounted for nearly one-third (31%) of total forest loss for the GMS during the period followed by Thailand (27%), Vietnam (24%), Lao PDR (12%) and Cambodia (7%) (WWF 2013). If considering the whole of Southeast Asia, the major hotspots of forest conversion and loss of canopy cover were identified in Sumatra, Borneo, West Papua, and Myanmar (FAO 2011).

Scientists say that of all major tropical regions, Southeast Asia has the highest relative rate of deforestation, projecting that 75% of its forests could be lost by 2100 (Sodhi *et al.* 2004 as cited by ACB 2010). Clearly, in spite of the implementation of conservation and reforestation projects, rates of deforestation and forest degradation are still high in the region (Subramanian *et al.* 2011).

Conversion to agriculture

The main cause of forest loss in the region is conversion to agriculture (UNEP, FAO & UNFF 2009). In recent years, the establishment of cash crop plantations has had a stronger impact on forest cover than logging (Stibig *et al.* 2007 as cited by FAO 2011).

> **In Southeast Asia, the two most important crops in terms of forest conversion are rubber and oil palm.**
>
> ***- UN Food and Agriculture Organization***

The *Asia-Pacific Forestry Sector Outlook* (FAO 2011) mentions that in Cambodia, Lao PDR, Myanmar and the highlands of Vietnam the production of rubber, cashew nuts, coconut and sugar cane, and of cacao, coffee, and tea in highland areas has been a major cause of forest conversion to agriculture. The Outlook adds that forest loss in the uplands of Myanmar, northern Lao PDR and Thailand are due to shifting cultivation while large areas of forest have been cleared to establish rice paddies in central Myanmar.

In the Philippines, forest conversion is taking place for smallholder agriculture. The same is true for Indonesia's Sumatra and Kalimantan, which had also had forests cleared for the establishment of pulp plantations, along with West Papua (FAO 2011).

The Food and Agriculture Organization's (FAO) *2016 State of the World's Forests* indicates that large-scale commercial agriculture is the most prevalent driver of deforestation in the tropics and subtropics, accounting for 40% of forest loss. In Southeast Asia, the two most important crops in terms of forest conversion are rubber and oil palm (FAO 2011).

Oil palm plantations

Oil palm plantations, established for the food industry and biofuels production, have replaced substantial areas of natural forest in Southeast Asia (FAO 2016). Forest loss due to the establishment of oil palm plantations is occurring largely in Indonesia and Malaysia (ACB 2010). Together these countries capture more than 90% of the global market for palm oil, the demand for which has quintupled globally since 1990 (Mosbergen 2015; Subramanian *et al.* 2011). Palm oil demand is expected to be more than double by 2030 and triple by 2050 (Mosbergen 2015).

Princeton University and the Swiss Federal Institute of Technology estimate that between 1990 and 2005, 55%–60% of oil palm expansion in Malaysia and Indonesia occurred at the expense of virgin forests (WWF 2016; Subramanian *et al.* 2011). Oil palm growers prefer to convert forests because planting on grasslands or degraded areas is perceived to be more expensive since more chemical fertilizers will be needed (WWF 2016). In Malaysia, the area of oil palm plantations increased from 2.4 to 4.2 million hectares from 1990 to 2005, replacing an estimated one million hectares of forest. In Indonesia, oil palm plantations increased from 1.7 to 6.1 million hectares from 1990 to 2000, replacing an estimated 1.7 to 3.0 million hectares of forest (Fitzherbert *et al.* 2008 as cited by FAO 2016).

Photo by Agus Andrianto/CIFOR, from flickr.com

An oil palm plantation worker in Papua, Indonesia.

Like many other instances of land use change, the rapid expansion of the palm oil industry has led to displacement and conflict. In Indonesia, there are various reports that deforestation associated with palm oil has negatively affected the livelihood and rights of indigenous communities. Corrupt government officials and dishonest plantation owners have been known to illegally seize indigenous land. According to Tomaz Johnzon, a forest campaigner at the Environmental Investigation Agency, this has reduced once self-sufficient communities to being laborers in their own land, totally reliant on low-paid wage labor in oil palm plantations (Mosbergen 2015).

Land use conflicts arising from this situation have led to the uncontrolled use of fire, making the fast-growing oil palm industry in Indonesia a major cause of forest fires in the region. Fires have been used by some oil palm firms to reduce the value of land near their plantations. This makes it easier for them to buy out locals so that they may site their processing facilities as near as possible to save on transportation costs. Locals have also been known to start fires to protest the takeover of their land by oil palm firms and other plantations. Fires are also the preferred method of land clearing by oil palm plantations since land clearing by mechanical means is twice more expensive (Barber and Schweithelm 2000; Potter and Lee 1998; Wakker 2000 as cited by Fatah and Udiansyah 2009).

Photo by Aulia Erlangga/CIFOR, from flickr.com

Haze from the forest fires in Riau, Sumatra blanket most parts of the landscape including a nearby oil palm plantation.

It is estimated that Southeast Asia's peat lands, which are mostly in Indonesia, contain up to 21% of the terrestrial surface organic carbon of the world (ACB 2010). Hence, fires in this ecosystem significantly contribute to pollution and greenhouse gas (GHG) emissions. In Southeast Asia, Indonesia leads as the largest GHG emitter; it is ranked third in the world behind China and the United States (Greenpeace 2016). According to Agus Purnomo, then special assistant to the President of Indonesia and head of the secretariat for the National Council on Climate Change, deforestation and uncontrolled land conversion are the source of 85% of Indonesia's carbon footprint (Wharton Global Initiatives 2012). Palm oil cultivation in Indonesia and Malaysia has been conducted disproportionately in high carbon areas like tropical forests and carbon-rich peatlands thus releasing particularly large volumes of climate-warming gases into the atmosphere (Mosbergen 2015).

Palm oil cultivation in high carbon areas releases large volumes of climate-warming gases.

Indonesia's forest fires are also identified as the main source of the transboundary haze that affects the region (BBC 2015). The haze causes significant health and economic costs to Indonesia as well as to Singapore and Malaysia. Othman (2016) estimates the total economic cost of haze on peninsular Malaysia at MYR 1,494.4 million, with its most significant economic impact being on people's opportunity to earn. The cost of illness due to haze amounted to MYR 410.6 million (Othman 2016).

The conversion of forest associated with palm oil has also received negative press for its role in habitat destruction, especially in relation to the survival of wild orangutans. Orangutans live exclusively on the islands of Borneo and Sumatra, the main base of the world's rapidly growing palm oil industry. An article published by The World Post reports that an estimated 1,500 orangutans have been clubbed to death since 2006 after wandering onto oil palm plantations while thousands have died due to the widespread deforestation. The article adds that experts believe that wild orangutans will be extinct in 25 years or less if the current rate of forest loss continues (Mosbergen 2015).

Production forests: Rubber & fast-wood

In theory, productive forest plantations help relieve the pressure on natural forests by catering to the growing demand for forest products. But a worrying trend is that monocultural forest plantations are replacing natural forests (UNEP, FAO & UNFF 2009; Wilcove *et al.* 2013; Chakravarty *et al.* 2012). For example, according to Greenpeace (2016), in China's Hainan and Yunnan provinces, indigenous trees are felled to make way for fast-growing eucalyptus plantations.

Conversion to forest plantations accounts for 6%–7% of natural forest losses in tropical countries (Cossalter and Pye-Smith 2003). In Southeast Asia, productive forest plantations are established primarily for the production of sawlogs, pulpwood, bioenergy and rubber production (FAO 2011).

Photo by TC Davis, from flickr.com

A rubber tree plantation in Vietnam.

Southeast Asia produces 97% of the world's natural rubber (FAO 2013). The rapid and widespread land conversion to monoculture rubber plantations in continental Southeast Asia resulted from the boom in rubber prices during the first decade of the new millennium (Ahrends *et al.* 2015). Rubber production in the region increased by 76% from over 5 million tonnes in 2000 to over 9 million tonnes in 2013 (FAO 2013). It is the most rapidly expanding tree crop within mainland Southeast Asia (Fox *et al.* 2012 as cited by Warren-Thomas *et al.* 2015).

Tectona grandis (teak), which is grown for sawlogs, and fast growing industrial hardwoods (referred to as fast-wood) such as *Acacia mangium* and *Eucalyptus* spp., which are grown for pulpwood, are the main forestry species planted in Southeast Asia (FAO 2011; UNEP, FAO & UNFF 2009). The area devoted to pulpwood plantations in Asia doubled between 1990 and 2005 due to large-scale planting in China, Indonesia and Vietnam (FAO 2006). In Vietnam and Indonesia, pulpwood plantations increased from a negligible area in 1990 to over one million hectares each in 2005 (FAO 2006). This illustrates the trend for paper production to shift to southern tropical countries where the climate is more suitable for fast-growing trees (UNEP, FAO & UNFF 2009).

Concerns have been raised about the impact of fast-wood and rubber plantations on biodiversity (UNEP, FAO & UNFF 2009; Ahrends *et al.* 2015; Warren-Thomas *et al.* 2015). According to Ahrends *et al.* (2015), new rubber plantations are also frequently placed on lands that are important for biodiversity conservation and ecological functions. More than 2,500 km^2 of natural tree cover and 610 km^2 of protected areas were converted to rubber plantations between 2005 and 2010 in Southeast Asia (Ahrends *et al.* 2015).

"Plantations, whether they be rubber, oil palm, or another exotic species, are often biological deserts", says William Laurence, a professor and conservationist at Australia's James Cook University (Dasgupta 2015). Hence, although they also contain trees, forest plantations cannot replace the ecological value of primary forests (Greenpeace 2016; ACB 2010). Natural forests are home to many native species making them crucial to biodiversity.

Various studies have pointed to the loss in biodiversity resulting from the conversion of natural forests to production forests in Southeast Asia (Warren-Thomas *et al.* 2015; Ahrends *et al.* 2015; Aratrakorn *et al.* 2006; Wilcove *et al.* 2013). Given the region's rich biodiversity—it contains three mega diverse countries (i.e., Indonesia, Malaysia, Philippines) where four of the world's 34 biodiversity hotspots are located (Subramanian *et al.* 2011; ACB 2010)—the replacement of natural forests with rubber and fast-wood plantations is a global concern.

Forest plantations cannot replace the ecological value of primary forests.

According to the *2010 Global Forest Resources Assessment*, while the total forest cover in the Asia-Pacific is expanding, the proportion of primary forest area is declining (FAO 2010). Of Southeast Asia's roughly 200 million hectares of forest, only 29.9% are primary forests (FAO 2011). Except for Indonesia and Thailand, whose primary forest coverage is 50% and 35.5% of their total forest area in 2010, respectively, for other countries in the region this figure is less than one-fifth of their total forest area (FAO 2011). Vietnam and

Cambodia have the least primary forest cover, found to be below 1% and 4% of their total forest area, respectively, in 2010 (FAO 2011).

Several studies have also presented evidence that associates rubber monoculture with increased soil erosion when planted on steep slopes, increased landslide risk, and decline in stream water quality (Ziegler *et al.* 2009 as cited by Warren-Thomas *et al.* 2015); stream desiccation and potential water deficits in areas with pronounced dry season (Guardiola-Claramonte *et al.* 2010 as cited by Ahrends *et al.* 2015); and loss of soil carbon (De Blécourt *et al.* 2013).

The future of Southeast Asia's forests

The importance of forest health on economic activities cannot be underscored enough. The livelihood of over 1.6 billion people depends on forests, with trade in forest products alone estimated at USD 327 billion in 2004 (UN 2011). In Southeast Asia, an estimated 218 million people are classified as forest dependent (FPP 2012).

If current trends continue, only 14% of the Greater Mekong Subregion forests will be left by 2030.

- World Wildlife Fund for Nature

Forests also help regulate the earth's climate, a crucial ecological service, especially given the challenges presented by climate change. Deforestation and forest degradation contribute 17% of global carbon emissions, which is more than what is contributed by the entire transportation sector and is second only to the energy sector (UN-REDD 2016).

Southeast Asia now stands at a crossroads. It can continue on its current course or choose a more sustainable path that will support reasonable economic development. Continuing on the current path presents dire projections. According to the FAO (2011), if current trends continue, forest area will fall from 49% in 2010 to 46% in 2020. The World Wildlife Fund for Nature (WWF 2013) predicts that by 2030 another 34% of the GMS forests outside China would be lost leaving only 14% "capable of sustaining viable populations of wildlife".

The choice is clear. And so the succeeding sections offer ways by which the value of forests can be better accounted for when making decisions that may affect forest health and integrity. These are based on the results and recommendations of selected EEPSEA studies conducted in the region.

Valuing forest ecosystem services

Ecosystem services are the benefits received from ecosystems. According to the *Millennium Ecosystem Assessment* (MEA), these include the following: (a) ***provisioning services*** or products obtained from ecosystems (e.g., food, fiber, natural medicines, fresh water); (b) ***regulating services*** or benefits obtained from the regulation of ecosystem processes (e.g., regulation of air quality, climate, erosion, disease, pest, and natural hazard); (c) ***cultural services*** or the nonmaterial benefits received through spiritual enrichment, cognitive development, recreation and aesthetic experiences (e.g., cultural heritage, recreation and ecotourism); and (d) ***supporting services*** or those that are necessary for the production of the other three services (i.e., soil formation, photosynthesis, primary production, and nutrient and water cycling) (WRI 2005).

The non-marketed benefits from forests are often overlooked when decisions are made about the management of forest ecosystems.

- Millennium Ecosystem Assessment

Forests provide various ecosystem services vital to human survival. Besides the wood and non-wood products they provide, forests maintain terrestrial biodiversity—important in maintaining ecosystem health—by serving as home to various species of plants, animals, and organisms. Forests also help mitigate climate change by absorbing carbon dioxide, making them globally important carbon reservoirs and sinks (FAO 2011). The role of forests in protecting watersheds, protecting against downstream flooding, minimizing soil erosion, and maintaining water quality is also extensively discussed in literature (FAO 2011; UNEP, FAO & UNFF 2009).

Clearly, not all of the services that forests provide enter markets and so many of these benefits are largely unrecorded. As a result, these non-marketed benefits, which are often more valuable than the marketed ones, are usually overlooked when decisions are made about the management of forest ecosystems (WRI 2005).

To combat this economic invisibility, economic valuation techniques can be used to capture the value of the non-marketed services provided by forests and other ecosystems. Valuation techniques can be used in tandem with other economic decision support tools, such as cost-benefit analysis (CBA), so that the value of non-marketed forest services can be better considered when making decisions on how to manage natural resources.

The EEPSEA studies discussed in this section show how capturing the values of forest ecosystem services can be useful in informing different kinds of decisions faced in the management of forests. The studies show that the values generated with the use of valuation techniques are dependent on the characteristics of the ecosystem under study and the services it provides. Hence, the discussion goes as far as to describe the basis used by EEPSEA researchers in determining the value of the forest ecosystem services considered by their respective studies.

1. Valuing the trade-offs of land use options

Forest ecosystems have various competing uses and users. Hence, those who manage forests are often faced with the need to choose among various land use options. Making an informed decision in choosing an option involves valuing the trade-offs associated with each one and determining that which offers the most social gains.

To conserve or not to conserve?

Roongtawanreongsri *et al.* (2014) looked at the worrying deforestation rate in Kho Hong Hill (KHH), one of the last intact urban forests in south Thailand. Almost 40% of Kho Hong Hill's (KHH) forest has been deforested. This was mainly due to population increase, urbanization, and the continuous conversion of forest areas into rubber plantations. About 58% of KHH remains as primary and secondary forest whereas 36% has already been converted into rubber plantations. The effects of this have become apparent such as the occurrence of floods in areas that didn't used to get flooded, soil erosion, drought during the dry season, and loss of wildlife, among others (Roongtawanreongsri *et al.* 2014).

To help conserve and preserve KHH's ecological integrity, Roongtawanreongsri *et al.* (2014) developed three forest management options in consultation with various stakeholders in KHH. Among those consulted were local authorities as well as forest management experts from Prince of Songkhla University (PSU). The management options developed are as follows:

1. ***Business-as-usual (BAU) scenario*** (Scenario 1). As this serves as the base case, no intervention is introduced in this scenario. It assumed that KHH will suffer further deforestation at the current rate of 16.68 ha/year and that rubber farms will continue to propagate at the current rate of 14.30 ha/year.

2. ***Establishing a protected area*** (Scenario 2). In this option, KHH forests will be included as part of the Greater Songkhla Lake Basin Protected Area. Thus, the remaining forest (666.35 ha) and the existing rubber farms (469.78 ha) will be maintained with no further forest area being converted for other land uses.

3. ***Rehabilitating rubber plantation areas*** (Scenario 3). This option explores the conversion of rubber plantations back to its natural state. Two sub-scenarios are under this option.

    a. Scenario 3a proposes that rubber farmers be encouraged to restore the forest through *voluntary action*. It assumes that the forest would be restored at a rate equal to that by which forests are converted to rubber farms, which is 16.68 ha/year.

    b. Scenario 3b proposes that funds be raised to *buy back these rubber plantations* from its present owners and to restore them as conservation areas. This sub-scenario assumes that restoration rate would be approximately 10% of the current total area of rubber farms. The land can either be purchased at a price equal to the total land value (Scenario 3b1) or at a price equal to half of the total land value (Scenario 3b2).

To compare the net economic benefit of the three proposed management options, the researchers first determined the monetary value of KHH's ecosystem services. Because of resource constraints, only selected services were valued by the study. These include the *provisioning services* of (a) timber and (b) freshwater supply; the *regulating services* from (c) CO_2 storage and sequestration, (d) O_2 production, and (e) flood prevention; and the *supporting service* of (f) biodiversity. How each was valued is briefly discussed below.

Photo by Saowalak Roongtawanreongsri

Found in Hat Yai, Songkla, Thailand, Kho Hong Hill is 1,260 ft tall.

1. ***Timber value.*** This was estimated using data from an earlier study (Roongtawanreongsri *et al.* 2012 as cited by Roongtawanreongsri *et al.* 2014) that measured the volume of timber in KHH by tallying all the trees located within a sample plot (i.e., 1% of the total area of KHH) while data on timber prices were obtained from the Department of Forestry. The cost of harvesting was deducted. Total timber value was estimated at USD 23,089/ha per year.

2. ***CO_2 sequestration.*** The rate by which trees or plants absorb CO_2 in a span of one year was estimated using data from a field experiment in KHH. Fifteen (15) plot samples were selected to represent primary forest (≥40 years of forest stand age), secondary forest (<40 years), and rubber plantation. The researchers used the trading price of carbon credits in calculating the value of CO_2 fixing. CO_2 sequestration value was estimated at USD 406/ha per year.

3. ***O_2 generation.*** This was obtained by multiplying the CO_2 absorption rate of 1.2, following the method by Yolasiğmaz and Keleş (2009 as cited by Roongtawanreongsri *et al.* 2014). The price of O_2 was based on average prices from literature and from its cost when sold for medical purposes in Hat Yai, a nearby city. This was estimated at USD 3,496/ha per year.

4. ***Water supply.*** The economic value of this service was based on the water held and released by the forest, which was calculated using the Simple Hydrologic System Model and data on average annual rainfall. Unlike the ecosystem services mentioned above, its resulting values varied from year to year and cannot be reported as a standard annual rate. It is, however, useful to note that the generated values were higher than the ecosystem services previously mentioned given the importance of the water conservation services that KHH provides. KHH is the head watershed of Khlong Rian Canal, which then flows to Songkhla Lake Basin. Without the water supply provided by KHH, Hat Yai City will have to expand its water supply distribution coverage to include communities previously dependent on the lost water supply; this would require capital input from the government.

5. ***Flood control.*** A model was developed that can show the characteristics of the flood, the location of the flooded area (plotted on a GIS map), and the depth and volume of the flood for each of the three management options developed. Flooded areas with similar depths were grouped as one zone and the average damage cost was calculated in relation to the zone's flood depth. Costs from floods include damaged properties and household items, foregone income due to work suspension, cost of illness, and cost of rehabilitation after floods. Like water supply, the resulting values for this service varied from year to year and were higher in value than the first three ecosystem services listed.

6. ***Biodiversity.*** To estimate the value of this service, the value generated by Gumpoo (2002 as cited by Roongtawanreongsri *et al.* 2014) was used; Gumpoo's study focused on Pa Krad, a tropical forest that is in the same province as KHH, and the respondents had similar characteristics with those of Roongtawanreongsri *et al.* (2014). Gumpoo (2002) estimated respondents' willingness to pay to conserve Pa Krad at USD 4.12/person per year. This figure was estimated in 2001 so it was adjusted for inflation. The adjusted figure of USD 5.12/person per year was then transferred to reflect the value in KHH, multiplying it by the ratio of the incomes at the policy and study sites.

Using the monetary value of the six KHH ecosystem services listed above, the researchers conducted a cost-benefit analysis (CBA) to determine which among the three management options would be most economically feasible. A projection spanning 25 years was used.

CBA results indicate that although rubber farms generate high financial gains for rubber farmers, social gains would be very low. Scenario 1 (BAU) will result in positive annual net benefits at KHH's current condition but the values are seen to decline and would eventually turn negative within 15 years. Clearly, steps need to be taken to preserve the forest ecosystem to protect the well-being of the people around KHH.

If no intervention is introduced, Kho Hong Hill rubber farms will provide positive annual net benefits only until Year 14.

Of the two conservation scenarios, CBA results indicate that establishing a protected area (Scenario 2) had the higher benefit-cost ratio, indicating better viability, than forest rehabilitation (Scenario 3). This is because the costs associated with protected area (PA) establishment are lower. Scenario 2 costs include a budget for maintenance, operations, and overhead expenditures of government agencies tasked to manage and monitor the forest once it is declared a PA. Scenario 3 costs include the building and maintenance of seedling nurseries, replanting, labor, and transportation, among others.

CBA results also indicate that the faster the rubber farms are converted back into forests, the greater the benefits will be. Hence, although Scenario 3 (forest restoration) had a lower benefit-cost ratio compared to Scenario 2 (PA establishment), results show that it would lead to higher net benefits than PA establishment simply because the rate of forest return is higher in the former compared to the latter. In the same manner, Scenario 3b (buying back the land from rubber farmers) resulted in higher social gains than Scenario 3a (restoration through farmers' voluntary action) because the former would lead to faster forest restoration than the latter.

Moreover, CBA results indicate that the higher the financial incentives given to rubber farmers, the less social gains will be reaped. Hence, buying back the rubber plantation land at a price equal to the total land value (Scenario 3b1) resulted in lower social gains compared to buying it back at a price equal to half of the total land value (Scenario 3b2).

The researchers also pointed out that providing rubber farmers with financial incentives may raise serious issues. For instance, why should rubber farmers be given such incentives to reforest lands when, in the first place, clearing these lands for rubber violated the law? If this strategy is implemented, will it encourage more violation in order to be paid in the future? The researchers therefore recommend that a strategy that would incentivize farmers and landowners into keeping the forest environment suitable for yielding ecosystem services sustainably be used. Payment for ecosystem services (PES) is such a mechanism, and this will be more extensively discussed in the next section.

Overall, CBA results indicate that at the discount rate of 7%, the net benefit value for each land use option over a 25-year period is:

- THB 294,138,461 (USD 9,143,765) if no intervention is introduced;
- THB 2.383 billion (USD 74,087,197) if a PA is established;
- THB 2.840 billion (USD 88,289,397) if forests are restored through rubber farmers' voluntary action;
- THB 2.378 billion (USD 73,936,766) if forests are restored by buying back the land from rubber farmers at full price; and
- THB 3.062 billion (USD 95,210,370) if forests are restored by buying back the land from rubber farmers at half price.

It should be noted that these figures reflect only part of the total ecosystem services provided by KHH. Other services like tourism, prevention of soil erosion, soil fertility, pollination and microclimate regulation are not accounted for.

Based on these results, the researchers suggest that the remaining KHH forest areas be protected and that intermediate plans be put in place to encourage rubber farmers to re-convert their plantations into forest areas. Implementing a PES mechanism towards this end should be further investigated.

Is the land use change economically efficient?

Understanding the trade-offs associated with a land use change by looking at what happened in similar cases in the past can be very useful in informing future land use decisions. This was the focus of the study by Yem *et al.* (2011) who analyzed the trade-offs related to rubber plantation development in Cambodia.

The researchers looked into whether it is economically efficient to convert forestland to large-scale rubber plantations using CBA. They compared the net benefit derived from forest conservation and from large-scale rubber plantation. Net benefit is the difference between total economic benefits and total direct costs for each land use scheme.

To do this, they used the estimated returns from established rubber plantations of different ages in Kampong Cham and Kampong Thom provinces (i.e., Chamkar Andong, Krek, and Tumring rubber plantations). The researchers also extracted the values for the benefits and costs associated with these two land use types from various related studies conducted in Cambodia (i.e., Hansen and Top 2006; Bann 1997; CBNRM-LI 2008 as cited by Yem *et al.* 2011).

For the benefits of forest conservation, they considered the direct revenue from non-timber forest products (NTFPs) and the environmental benefits derived from forests such as value of water conservation, soil conservation, carbon sequestration, and biodiversity conservation. The costs of forest conservation included the cost of protection and silviculture as well as capital investment for the purchase of equipment used in NTFP collection.

The benefits from large-scale rubber plantation included the selling of dried rubber products, its by-products, old rubber trees at the 25th year, and the value of carbon sequestration. On the other hand, the costs incurred in large-scale rubber plantation schemes had six components: (a) tree maintenance, (b) tapping and harvesting, (c) materials and equipment, (d) manufacturing and coagulating, (e) taxes, and (f) overhead expenses.

Results of the CBA conducted indicate that although the net benefit from maintaining a large-scale rubber plantation is higher than that from maintaining forestland, the difference is very small. The present value of the net benefit for forestland and large-scale rubber plantation over a 25-year period with a discount rate of 10% was found to be USD 14,757/ha and USD 15,690/ha, respectively.

Hence, for the conversion from forestland to large-scale rubber plantation, the present value of the incremental net benefit—or the difference between the net benefit from rubber plantation and the net benefit from forestland—is only USD 933/ha over a 25-year period. Extrapolating from this result, it seems that the conversion from forestland to large-scale rubber plantation would not be economically viable in the long run.

Photo by Marina & Enrique, from flickr.com

A rubber tree plantation in Kampong Cham, Cambodia.

This CBA result agrees with the researchers' assessment of the impact of forest conversion to large-scale rubber plantation on local livelihood. Their study results indicate that the local population is generally worse off after forest conversion to large-scale rubber. Using the case of Tumring rubber plantation in Kampong Thom province, Yem *et al.* (2011) found that the establishment of a rubber plantation drastically changed people's livelihood in the area. Before the forestland conversion, 31% and 28% of the local population depended on rice production and forest products harvesting, respectively, as their main source of living. After the conversion, the proportion of locals who relied on these livelihoods dropped to 19% and 3%, respectively.

Tumring commune is in the middle of one of Cambodia's largest remaining pristine forests. In 2001, the Royal Government of Cambodia cancelled 6,200 ha of forest concessions and awarded 4,359 ha of this land to Chup Company for the development of industrial-scale rubber plantations. The rest of the land (1,841 ha) was offered to local people to develop smallholder rubber plantations at 3 ha per family. The deal also included that Chup Company will train the locals on the development of family-scale rubber plantations.

Results show that forest conversion to large-scale rubber plantation would not be economically viable in the long run.

According NGO Forum (2005 as cited by Yem *et al.* 2011), this land conversion was done without proper consultation or regard for the livelihood of the locals who traditionally depended on non-timber forest products (NTFPs) collected from the forest. Yem *et al.* (2011) further indicate that many of the respondents (67%) felt that the rubber plantation contributes poorly to poverty reduction, which was purportedly one of the main objectives of the project as stated by Prime Minister Hun Sen during his speech in Tumring in 2001 (Cock 2004). Majority (77%) of the locals surveyed by the study stated that they lacked sufficient income to support their family after the rubber plantation was established.

Loss of their agricultural land and forest resources depletion were cited as the main reasons for the locals' discontent with the rubber plantation's establishment. People stated that rubber could not compare with natural forest as a source of income. They added that rubber plantations should be developed in other areas with no valuable forest. They also shared that rubber could only generate higher income to the plantation owner and some people who have enough know-how to plant it.

Given these findings, Yem *et al.* (2011) recommend that an analysis of the trade-offs be done first for projects that involve forestland conversion and that the social component of forest conversion schemes be considered a high priority so as not to exacerbate poverty among the local population.

2. Valuing non-timber forest products

Non-timber forest products (NTFPs) are very important to forest-dependent communities. Taking away or limiting the collection of NTFPs can severely threaten the livelihood of the local population. This was the case in Tumring, Cambodia where the development of a large-scale rubber plantation had a detrimental impact on the local population as it took away their access to forest resources, most notably their ability to collect resin. Resin collection was among the primary sources of living of the Tumring locals until the resin trees were cut to make way for the rubber plantation (Cock 2004).

The value of NTFPs is usually grossly underestimated. In her study on the benefits of alternative uses of forestland in Cambodia's Ratanakiri province, Bann (1997) found that NTFPs (i.e., fuelwood, rattan, bamboo, malva nuts, construction materials, and wildlife) from Tapean forest have a value that may be as high as USD 3,992/ha. However, cash compensation levels given to locals because the forest was under concession to an Indonesian logging company have typically been around USD 36/ha only—a value less than 1% of that of NTFPs.

Photo by Oxfam GB Asia, from flickr.com

A local harvests resin at O Preah village, O Khreang commune, much like what many locals did in Tumring commune before the resin trees were cut to make way for the large-scale rubber plantation.

If the forest were to be harvested for timber, it would be valued no more than USD 1,697/ha. Adding the values of other ecosystem services provided by the forestland (i.e., watershed functions and biodiversity benefits) would further diminish the net benefits from harvesting timber. With detailed surveys in this region demonstrating that NTFPs provide an important natural mechanism for alleviating poverty without explicit government investment, clearly the loss of the forestland and, consequently, the loss of access to NTFPs will result in a loss of this "natural subsidy" (Bann 1997).

NTFP collection vis-à-vis conservation goals

Clearly forest-dependent communities must not be forgotten in the land use change equation—whether the change will entail deforestation or is for conservation purposes—as any kind of change in land use can potentially create significant impacts on their source of living.

For instance, in her study on the impact of a biodiversity conservation policy in Fanjingshan National Nature Reserve (FNNR) in China's Guizhou province, Gong (2004) found that forestry activities such as firewood collection in the FNNR played the most significant role in local people's livelihood, followed by crop cultivation. On the average, forestry income accounted for about 65% of total local household income. As such, under the biodiversity conservation program, locals would suffer a loss of about CNY 270,000, which represents the total net benefit from NTFP collection for five years, since the program would strictly limit their access to NTFPs.

On the other hand, Gong (2004) also found that people living outside of FNNR are willing to pay for biodiversity conservation in the reserve. For instance, total willingness to pay (WTP) of people from Guizhou's Longli county was estimated at CNY 2.6 million. If all residents of Guizhou province—29 million rural and 9 million urban population at the time of the study—will contribute toward the conservation program by paying tax, total WTP was estimated to be much greater than all the cost that will be incurred in program implementation. These include local people's opportunity costs (CNY 2.6 million) and the program's implementation costs (CNY 60 million).

The importance of access to NTFPs to the livelihood of forest-dependent communities points to the need to consider their value to locals when designing sustainable forest resource utilization schemes. This was what Hou and Meas (2010) did in their study to determine the best utilization scheme in ensuring the sustainable use of forest resources in Cambodia's Chumkiri district.

Along with NTFPs, the value of timber products, biodiversity, and carbon sequestration were also used in examining the costs and benefits of three community forestry (CF) schemes. Broadly speaking, CF aims to support and empower local communities to continue to use forest resources in a traditional and sustainable manner. It is part of Cambodia's poverty alleviation strategy as it enables local communities to participate in forest management by focusing on forest resources they depend on.

The three CF management options assessed were:

1. ***Conservation scheme.*** The 992-hectare forest is divided into a conservation zone (602 ha) and a multiple use zone (302 ha). Only the multiple use zone would be open for exploitation under a payment fee system. This zone is divided into five parts (i.e., 54 ha, 55 ha, 56 ha, 60 ha, and 51 ha), and forest products are collected from each zone in a five-year rotation. A forest growth rate of 3% was used in calculating the benefit gained.

2. ***Exploitation scheme.*** The forest is divided into five zones of equal surface area. Exploitation of each zone, under a payment fee system, would be in a five-year rotation.

3. ***Combined scheme.*** The conservation area makes up only one-third (300 ha) of the total forest area; the remaining area (692 ha) would be fully exploited under a payment fee system in a five-year rotation.

The conservation scheme offers the greatest overall benefits to society and was found to be the most economically viable option.

The assessment used primary data from a survey of randomly selected households from three CF villages in Srae Khnong commune in Chumkiri district. Data on the utilization as well as the marketing of timber and non-timber forest products by households were gathered. Three non-CF villages from Chumpouvoan commune of Chumkiri were also surveyed to serve as the baseline. The population density, size of the forest, and the level of the villagers' livelihoods of both the CF and the non-CF areas were broadly comparable. For both CF and non-CF areas, the study assumed the value of biodiversity and the value of carbon to be USD 300/ha and USD 5/ton, values from previous studies conducted in Cambodia (i.e., Bann 1997 and Top 2005 as cited by Hou and Meas 2010).

Study results indicate that, over a 30-year period with a discount rate of 10%, the present value of the total benefits from the forest that will be received per household would be:

- USD 9,950 if the conservation scheme is applied;
- USD 7,920 if the exploitation scheme is applied; and
- USD 9,350 if the combined scheme is applied.

Compared to the USD 7,876 value of benefits to be received per household if no CF scheme is implemented, it is clear that the conservation option offers the greatest overall benefits to society. The conservation scheme also turns out to be the most economically viable option. It still ranked first even under assumptions of higher price of timber and non-timber products, and different project durations and discount rates.

Financing conservation

The previous section features EEPSEA studies that show how valuing the ecosystem services provided by forests can be used in making informed decisions about land use change and forest resource management. In this section, the use of ecosystem service values in generating funds for conservation and preservation activities is discussed.

Conservation finance involves raising and managing money for conservation (Clark 2007). The need to fund conservation in Southeast Asia is dire. Castillo *et al.* (2015) found that protected areas (PAs) in Southeast Asia and China need to increase their staff numbers and operating expenditures by at least twice to up to three or four times current levels to adequately respond to the internal and external pressures that they face. The study sampled 402 PAs from Cambodia, China, Indonesia, Lao PDR, Malaysia, Philippines, Thailand and Vietnam and compared these PAs' number of full-time staff and annual budget for operations with the average and highest levels in their country and in the region.

Photo by Jack Versloot, from flickr.com

El Nido in Palawan, Philippines is one of the protected areas covered in the study by Castillo *et al.* (2015).

Staff numbers and operating expenditures of protected areas in Southeast Asia and China need to be at least doubled.

Results indicate that PAs in the region and in China are understaffed by between 50% and 230%, with average understaffing gap being between 313% and 341%. The Philippines was consistently the least-performing country in terms of understaffing; based on the regional benchmark, the country needs to increase its present staffing level by eight times with the other countries needing to increase staff levels by at least 1.5 times.

Castillo *et al.* (2015) also found that, at the country level, PAs in the region have been underfunded by between 25% (as in the case of Malaysia) and 324% (as in the case of the Philippines). The average underfunding gap was between 115% and 139%. Fiscal gaps in terms of operating expenditure per hectare ranged between 25% and 300% for the country-level analysis, and between 200% and 900% at the regional level.

The significant funding and staffing shortfalls faced by the region's PAs clearly point to the need to explore additional internal sources of funding along with looking for external sources. Ways by which this can be done are explored in this section.

1. Determining willingness to pay for conservation

Castillo *et al.* (2015) point to the need to look for internal opportunities to source funds for PA staff and operating expenditures by promoting user charges, fees, and other payment mechanisms. Determining the feasibility of an ecosystem service charge involves determining the rate by which beneficiaries of these services are willing to pay for its continued provision. This rate can be determined using the contingent valuation method (CVM).

CVM is used to estimate recreation values and non-use values—or values that are not associated with actual use (e.g., landscape or biodiversity values)—for which price data do not exist and/or links to marketed goods cannot be easily established (Dlamini 2012). It uses surveys to elicit people's hypothetical willingness to pay (WTP) for the preservation of a resource or opportunity in a simulated market

(Dlamini 2012). A specific hypothetical scenario and description of the environmental service to be paid for is usually provided to survey respondents.

For example, Dang and Nguyen (2009) presented a hypothetical preservation plan in their study to find out Ho Chi Minh households' WTP for the preservation of Lo Go – Xa Mat National Park. The plan was developed based on consultations with local authorities, the management board of the park, and some environmental experts in Tay Ninh province where the park is located. It includes activities that support afforestation; raise awareness of demarcation boundaries and management regulations of the park; provide interest free loans, tree saplings, and training on planting techniques to residents of the park and the park's buffer zone; increase and properly equip park staff; and foster better cooperation among authorities that should work together in managing the park and enforcing laws that govern resource use.

The proposed preservation plan also involves compensating local communities for income foregone from exploiting forest resources, the same intent as the study by Gong (2004). The local communities' foregone income was estimated based on the average income per capita and the proportion earned from forest resources. Overall, the study found that the annualized benefit value of the preservation project (VND 107 billion) was larger than its annualized cost value (VND 26 billion) indicating that the plan is economically viable.

Dang and Nguyen (2009) found that Ho Chi Minh households were willing to pay VND 6,209/month through their electricity bill for three years to preserve Lo Go – Xa Mat National Park. Reasons for supporting the preservation plan were that they wanted to protect the environment of Vietnam and preserve the park for the use of future generations. On the other hand, those unwilling to contribute to the preservation fund felt that it was the government's responsibility since it collected taxes. Many also did not trust the organization that would handle the fund.

Ho Chi Minh households were willing to pay VND 6,209/month for three years to preserve the national park.

Dang and Nguyen (2009) also found that Ho Chi Minh households with high monthly electricity bills were more willing to contribute to park preservation since it is likely that they earned higher incomes.

People with higher education levels were also found to pay more attention to environmental concerns and were more willing to contribute to the preservation fund.

Lo Go – Xa Mat has great biodiversity value with different ecosystems for different types of fauna (Saigonet 2005 as cited by Dang and Nguyen 2009). According to a survey conducted by Birdlife International in 1999, the park is home to 250 bird species and 35 mammal species, many of which are rare. The park's forests also protect the watershed of the Vam Co River. However, illegal logging and hunting, land encroachment, overexploitation of NTFPs, and forest fires easily occur in the park because of its large areas, easy access, and weak security. The biggest threat to the park's biodiversity if the conversion of inundated grasslands to agricultural lands; parts of the park have been encroached by sugarcane and cassava farms, rubber and cashew plantations, and housing projects, many of which are illegal and involve the cutting down of forests (Birdlife International 2005 as cited Dang and Nguyen 2009).

Vientiane residents were willing to pay LAK 5,000 for the park's biodiversity conservation.

Likewise, in their study on Vientiane Capital City (VCC) residents' WTP for biodiversity conservation in Houay Nhang Protected Area (HNPA), Thanthathep *et al.* (2009) presented a hypothetical plan in which the PA would be divided into three zones: the preservation, the recreation, and the study zone. Activities to be implemented included the preservation of existing forests and biodiversity resources; regulatory monitoring and maintenance; the establishment of an ecological center for research, education and awareness-building; and the establishment of a butterfly house to conserve existing butterfly species.

The plan was that this Proposed Policy for the Sustainable Ecology/Biodiversity Conservation to improve the sustainability of HNPA would be implemented by setting up an Ecological/Biodiversity Trust Fund. The Fund will collect monthly contributions from VCC households for a period of five years, after which funds to continue the conservation activities will come from entrance fees.

The study found that despite the overall low level of education among the 383 respondents, majority had a high level of awareness on environmental protection and natural resource conservation issues. The highest monthly contribution that would be acceptable to the respondents was LAK 5,000, which represents less than 0.5% of an average household's monthly expenditure based on information on household expenditure from the Sub-National Estimates of Food Security Statistics. Most of those who voted in favor of the conservation plan (70%) cited the importance of HNPA as a habitat for many species that are worth protecting for future generations. Most of those who did not support it (69%) indicated that they could not afford the monthly payment.

The probability of voting in favor of the plan to collect payments for HNPA conservation was higher among women and more educated respondents. Moreover, location of residence was found to not influence WTP. This is contrary to the expectation that those who lived in the core or close to HNPA would more likely be willing to pay than those who lived further away.

HNPA is among the four PAs situated in VCC. Based on a recent estimate at the time of the study, it is one-third smaller than its size in 1952. Its forest density has decreased due to illegal logging, unsustainable collection of NTFPs, and inadequate PA management. Some areas have been converted into illegal garbage dumps (Thanthathep *et al.* 2009).

2. Exploring the use of a payment for ecosystem services scheme

Castillo *et al.* 2015 also point to the need to look for external sources of funding to offset deficits in funding by government institutions. Their study found that many of the PAs included in the study had no or very limited external funds. Majority of those with external funding had unique features or global benefits hence attracting international donors. Small-sized PAs rarely had funds coming from external sources.

Payment for ecosystem services (PES) is a mechanism that can source external funds as well as funds from the local private sector and private citizens. Examples of PES as provided by Wunder (2005) include initiatives where conservation donors pay local people for setting aside or naturally restoring areas to create a biological corridor (for biodiversity conservation) and initiatives where downstream water users pay upstream farmers for adopting land uses that limit deforestation, soil erosion, flooding risks, etc. (for watershed protection). As these examples show, the main principle of PES is that external ecosystem service (ES) beneficiaries pay local landholders and users for adopting practices that secure ecosystem conservation and restoration (Wunder 2005).

Wunder (2005) defines PES using five simple criteria: (1) a voluntary transaction in which (2) a well-defined ES (or a land use likely to secure that service) (3) is being bought by at least one ES buyer (4) from at least one ES provider (5) if, and only if, the ES provider ensures the supply of the service (i.e., the *conditionality criterion*, which is the business-like principle of paying only if the service is actually delivered). Few schemes in Southeast Asia satisfy all five criteria making them more "PES-like" than "true PES". Regardless, the lessons learned from these experiences are still useful in informing future PES schemes to be established.

Some impacts of PES and PES-like initiatives in the region

In their study which reviewed and analyzed the implementation of 12 PES and PES-like schemes in Cambodia, Indonesia, the Philippines, and Vietnam, Nguyen and Pham (2014) noted that the development of such schemes has mainly been driven by national and international donors and were set up to deal with degraded environmental services, deforestation, degraded water resources, and inefficient environmental command and control (CAC) mechanisms.

Through interviews with key informants and field visits to at least two PES sites per country, Nguyen and Pham (2014) found that among the positive impacts of these schemes are that they: (a) created a source of revenue for communities and governments; (b) addressed environmental improvement and poverty reduction concerns simultaneously; (c) increased awareness of environmental services values; (d) improved cohesion of rural society through projects in which contracts are signed between groups of farmers; and (e) improved social conditions as a result of the in-kind payments made by ES users such as the provision of ground water collection devices, roads, schools, medical clinics, and nourishment programs. They also found that the 12 projects resulted in approximately 375,232 ha of forest being reforested and protected from illegal logging and agricultural expansion.

Photo by Nguyen Thi Y Ly

Lam Dong is one of the two provinces selected for implementing the pilot phase of Vietnam's payment for forest environment services. Vietnam is the first Southeast Asian country to establish a PES policy (ACB 2011).

McElwe *et al.* (2015), however, found during their study's survey that existing statistics by Vietnam local authorities have shown little land use change in response to the country's PES implementation. Through a household survey conducted in the provinces of Lam Dong, Son La, and Thua Thien Hue, sites of the country's payment for forest environmental services (PFES) and other forest protection payments, they found that PES implementation seemed to not have prevented households from practicing their usual food production activities. Most households felt that they were not restricted from continuing to collect NTFPs even if they were not given explicit permission in their forest protection contracts. In a village in Lam Dong, many households simply continued to use agricultural fields that had been cut in forests in the next province and those which have not been included as PES pilot sites.

IMPROVING SUSTAINABILITY: The importance of meeting the conditionality criterion

This observation from McElwe *et al.* (2015) may be seen as providing credence to some service users' suspiciousness of the link between land use and ES provision, which Wunder (2005) mentions as one of the main reasons why too few service users are confident enough about the PES mechanism that they are willing to pay. Wunder (2005) adds that this lack of confidence in PES effectiveness is one of the two key obstacles to PES mainstreaming in the tropics.

As most countries in Southeast Asia have limited and unreliable high-resolution ES improvement data, the correlation between ES payments and ES improvements is currently intangible in all of the region's PES projects (Nguyen and Pham 2014). Unlike wildlife conservation, ecosystem services are more difficult to understand and appreciate making it difficult to encourage service users to trust in the mechanism's effectiveness enough to invest (Jarungrattanapong *et al.* 2016).

For instance, McElwe *et al.* (2015) mentioned that ES buyers in Vietnam wanted more information on land cover change to ensure that they are getting the services they paid for; however, as of the time of the study, they have received no information about where their money goes and if it is being used effectively. In the Maasin watershed PES project in the Philippines, ES buyers were dissatisfied because they observed that the water supply that flows in the streams was significantly reduced despite reforestation activities (Macandog 2016). In the Citarum and Cidanau watershed PES schemes in Indonesia, the services provided by the local communities were also seen as an unprofessional approach to water production; hence, having little information to defend their claim on the services they are providing, the local ES sellers had no voice when buyers decided to discontinue their payment to local upland communities (Amalia and Syahril 2016).

Too few ecosystem service users are confident enough about the PES mechanism that they are willing to pay.

Clearly, meeting the PES criterion of conditionality is crucial to the sustainability of PES schemes in Southeast Asia, especially since there is a general lack of planning to sustain the region's PES projects in the future. According to Nguyen and Pham (2014), instead of employing user-payment mechanisms, most PES or PES-like schemes in Southeast Asia have been driven and sponsored by donors (i.e., national or international organizations, private sector, local government), support which only lasts for a limited period. For instance, PES-like forest conservation schemes in Thailand are mostly funded through private sector corporate social responsibility (CSR) activities, donations that have tended to be one-time investments with no guarantee of continuity in funding because investors do not directly benefit from the ecosystem services they are paying for (Jarungrattanapong *et al.* 2016). Dependence on external donors is also one of the key challenges to full PES implementation in Cambodia (Heng and Kong 2016). There is also no assurance of long-term payments for all types of ES provided in Indonesia (Amalia and Syahril 2016).

Setting up a system to measure the relationship between payments and changes in ecosystem service quality will improve PES sustainability.

Hence, in order to ensure the sustainability of PES schemes in the region, Nguyen and Pham (2014) recommend that funds be obtained not only from a sustainable financial resource but from as wide a range of financial sources as possible. They also found that PES schemes whose funds are generated by water-related taxes or user fees are better assured of their financial sustainability because such taxes or fees have the backing of government regulations.

However, in order to effectively widen PES financial sources, a system that can provide a clear assessment of whether ES buyers are getting an equitable deal must be put in place. Nguyen and Pham (2014) suggest that a group of technical experts be set up to evaluate the baseline of environmental services and to measure the relationship between payments and changes in ES quality.

ENCOURAGING PARTICIPATION: Capturing the opportunity cost of ES provision

The second key obstacle to mainstreaming PES in the tropics according to Wunder (2005) is the current poor knowledge about the dynamics of ES supply. Among the various EEPSEA studies that looked into PES implementation in the region, the insecurity of land tenure and the determination of the "right" payment rate are among the common concerns related to ES supply.

Nguyen and Pham (2014) pointed out that the insecurity of individual land tenure in most countries they surveyed has limited PES participation to specific communities and particular locations only. Land tenure is important because ES buyers want to be sure that they are entering into a contract with those who are able to determine land use over the long term (UNESCAP 2009). Likewise, ES sellers are unlikely to participate in PES schemes unless their rights to the land are strong enough to guarantee that their investment will not be lost (UNESCAP 2009).

Moreover, the lack of human resources for evaluating the value of ecosystem services as basis for payment calculations has led to payments not really being based on the total value of services or the opportunity cost of generating these services (Nguyen and Pham 2014; Jarungrattanapong *et al.* 2016; Heng and Kong 2016). Instead, PES payment rates have been based on negotiations and agreements so ES values tend to be underestimated with most payments not large enough to convince stakeholders that it makes financial sense to participate.

To encourage stakeholder participation in a PES scheme, the opportunity cost in generating ecosystem services should inform the setting of PES payment rates. This is the core idea behind the study by Leimona *et al.* (2009) in designing a PES contract procurement auction method.

A procurement auction method is an alternative policy to extract from ES providers information on level of payments that cover all their costs in joining a conservation program (Ferraro 2004; Latacz-Lohman and Schilizzi 2005 as cited by Leimona *et al.* 2009). Such an auction is believed to be able to reveal the hidden information on the opportunity costs of supplying environmental services. Leimona *et al.* (2009) designed their procurement auction method through an experiment conducted in Sumberjaya, Indonesia.

Sumberjaya is a watershed area where soil erosion has broad implications for both on-site and off-site environmental damage (i.e., loss of topsoil from coffee farmlands that dominate the watershed; the resulting siltation reduces the capacity of a downstream reservoir and adversely affects irrigated agriculture and hydroelectricity generation) (Sihite 2001; Ananda and Herath 2003 as cited by Leimona *et al.* 2009). The one-year PES contract offered to upland coffee farmers through the study involved several soil conservation activities, which were identified based on discussions held with selected farmers. It is the payment rate for this PES contract that the procurement auction method was designed for.

The study's results revealed that a sealed-bid, multiple round, second-price Vickrey auction with a uniform price is the recommended auction method. In this procurement auction method, each farmer-participant independently filled out and submitted an offer-submission card that specified the per-hectare price and the number of hectares he proposes to join the contract. After the provisional winners were announced by their ID numbers, all participants were given the opportunity to hand in a revised offer. This continued until the pre-announced number of rounds was completed. When the auction ends, the provisional acceptances from the most recently completed round become the final acceptances. The multiple rounds reduced confusion over the mechanism and allowed participants to learn about the willingness to accept (WTA) level of other participants. The payment format is a uniform format where the second highest bid was accepted.

The opportunity cost in generating ecosystem services should inform the setting of PES payment rates.

According to Leimona *et al.* (2009), this auction method can be applied in a rural setting of a developing country where most of the auction participants have a low education level, low asset endowment, small plot size, and where market-based competitiveness is not common. The authors also found that this procurement auction method does not harm social relationships and that farmers' bids to be involved in conservation contracts was more dependent on their learning process during the auction than observable factors such as their socioeconomic background, their awareness of conservation, and their social capital state.

CREATING TRUST: Setting the payment rate and ensuring transparency

Most of the developing countries in Southeast Asia are found to have high levels of government corruption, with public institutions lacking transparency and accountability (Bray and Tsai 2016; Transparency International 2015). It therefore comes as no surprise that, in their review of PES implementation in the region, Nguyen and Pham (2014) found that many ES buyers do not trust the planning, distribution, and accountability of the PES fund.

Transparency in the management of PES funds and a good monitoring system can increase voluntary payment for ecosystem services

Transparency in the management of funds and the presence of a good monitoring system are important features that can increase voluntary payment for environmental services and provide higher possibility of replication in other critical landscapes (Amalia and Syahril 2016). Nguyen and Pham (2014) therefore suggest that finance regulations for PES funds be established to ensure that such funds are controlled by the relevant government financial department since most payers and donors are not confident to pay unless the schemes they are paying into are regulated and monitored.

Multi-stakeholder forums have also had some success in helping ensure transparency in fund management as well as in providing a means of communication among PES actors (Amalia and Syahril 2016; Macandog 2016). Multi-stakeholder forums, which usually consists of sellers, local government, local or international NGOs, professional associations, and researchers from local or national universities, serve as intermediaries between sellers and buyers of environmental services (Amalia and Syahril 2016).

Through a multi-stakeholder management, goals and visions are collectively owned by the parties involved. Because of the collective vision, stakeholders take ownership of outputs and outcomes of the project (Macandog 2016). However, the number of stakeholders within such a forum is crucial as it can reduce the effectiveness of a PES scheme especially when a significant portion of the funds are allocated for operational costs instead of actual conservation (Amalia and Syahril 2016).

Conclusion

Determining the economic value of non-forest products (NTFPs) and the ecosystem services that forests furnish human settlements with provides insight as to just how much is sacrificed every time natural forests are converted into agricultural plantations. Given the heavy dependence of Southeast Asia's developing countries on their natural resources in order to push forward their goals of economic development and poverty alleviation, it is crucial that these countries manage their forests sustainably.

The cases in this booklet point to the need to compensate two groups when making forest management decisions: (a) those whose livelihoods will be disenfranchised by land use change, whether because of deforestation or the implementation of a conservation program; and (b) those who will commit to performing land use activities that better ensure the continued provision of the forest ecosystem services needed for human settlements to prosper through payment for ecosystem services (PES) schemes. The booklet's cases show that valuing forest ecosystem services and NTFPs that do not enter formal markets allows for appropriate compensation levels for these two groups to be determined.

Photo by Jan van der Ploeg/CIFOR, from flickr.com

Other references

ACB (ASEAN Centre for Biodiversity). 2010. ASEAN Biodiversity Outlook. ACB. Philippines. http://www.aseanbiodiversity.org/index.php?option=com_content&view=article&id=96&Itemid=114&current=110 (Retrieved Sep 19, 2016)

ACB. 2011. 3rd Southeast Asia Workshop on Payments for Ecosystem Services: Investment in Natural Capital for Green Growth. http://www.aseanbiodiversity.org/?option =com_content&view=article&id=114:3rd-southeast-asia-workshop-on-payments-for-ecosystem-services-investment-in-natural-capital-for-green-growth&catid=12:events&Itemid=104 (Retrieved Nov 25, 2016)

Ahrends, A.; P.M. Hollingsworth; A.D. Ziegler; J.M. Fox; H. Chen; Y. Su; and J. Xu. 2015. Current trends of rubber plantation expansion may threaten biodiversity and livelihoods. Global Environmental Change. 34:48-58. http://www.sciencedirect. com/science/article/pii/S0959378015000801 (Retrieved Oct 3, 2016)

Aratrakorn, S.; S. Thunhikorn; and P.F. Donald. 2006. Changes in bird communities following conversion of lowland forest to oil palm and rubber plantations in southern Thailand. Bird Conservation International. 16(1): 71-82. https://www.cambridge.org/core/journals/bird-conservation-international/ article/changes-in-bird-communities-following-conversion-of-lowland-forest-to-oil-palm-and-rubber-plantations-in-southern-thailand/69E82B0976E48415F8FE 2B9FC6C0555E (Retrieved Oct 4, 2016)

Bann, C. 1997. Logs or local livelihood? The case for legalizing community control of forest lands in Ratanakiri, Cambodia. EEPSEA, IDRC. Singapore.

BBC. 2015. What causes Southeast Asia's haze? http:/www.bbc.com/news/world-asia-34265922 (Retrieved Oct 4, 2016)

Bray, J. and F. Tsai. 2016. Corruption risks in South-East Asia: Where are the greatest concerns for US investors. Forbes. http://www.forbes.com/sites/riskmap/2016/03/02/corruption-risks-in-south-east-asia-where-are-the-greatest-concerns-for-us-investors/#19b16c1933ae (Retrieved Nov 29, 2016)

Chakravarty, S.; S.K. Ghosh; C.P. Suresh; A.N. Dey; and G. Shukla. 2012. Deforestation: Causes, effects and control strategies. C.A. Okia (ed) In Global perspectives on sustainable forest management. InTech. http://cdn.intechopen.com/pdfs/ 36125/InTechDeforestation_causes_effects_and_control_strategies.pdf (Retrieved Sep 28, 2016)

Clark, S. 2007. A Field Guide to Conservation Finance. Island Press. Washington, DC, USA. https://books.google.com.ph/books?id=dpOuZK_Q3DEC&printsec=frontcover&redir_esc=y#v=onepage&q&f=false (Retrieved Nov 18, 2016)

Cock, A. 2004. Forest destruction for poverty reduction: The Tum Ring rubber plantation. In Plantations are not Forests: Commercial Tree Plantations in the Mekong Region. 9(3). Towards Ecological Recovery and Regional Alliance (TERRA). http://wrm.org.uy/other-relevant-information/forest-destruction-for-poverty-reduction-the-tum-ring-rubber-plantation/ (Retrieved Oct 7, 2016)

Cossalter, C. and C. Pye-Smith. 2003. Fast-Wood Forestry: Myths and Realities. Center for International Forestry Research (CIFOR). Bogor, Indonesia. http://www.cifor.org/publications/pdf_files/Books/ForestPerspective.pdf (Retrieved Oct 3, 2016)

Dasgupta, S. 2015. Unrestrained rubber expansion wreaking havoc on forests. https://news.mongabay.com/2015/07/mrn-gfrn-dasgupta-unrestrained-expansion-of-rubber-plantations-is-economically-risky-and-is-wreaking-havoc-on-biodiversity-new-study-finds/ (Retrieved Sep 29, 2016)

De Blécourt, M.; R. Brumme; J. Xu; M.D. Corre; and E. Veldkamp. 2013. Solid carbon stocks decrease following conversion of secondary forests to rubber (Hevea brasiliensis) plantations. PLOS ONE. 8(7). http://journals.plos.org/plosone/article?id=10.1371/ journal.pone.0069357 (Retrieved Oct 4, 2016)

Dlamini, C.S. 2012. Types of values and valuation methods for environmental resources: Highlights of key aspects, concepts and approached in the economic valuation of forest goods and services. Journal of Horticulture and Forestry. 4(12):181-189. http://www.academicjournals.org/JHF (Retrieved Nov 11, 2016)

FAO (Food and Agriculture Organization of the United Nations). 2006. Planted Forests and Trees Working Paper FP38E: Global planted forests thematic study: Results and analysis. FAO. Rome, Italy. http://www.fao.org/forestry/12139-03441d093f070ea7d7c4e3ec3f306507.pdf (Retrieved Oct 3, 2016)

FAO. 2010. Global Forest Resources Assessment 2010. FAO. Rome, Italy. http://www.fao.org/docrep/013/i1757e/i1757e.pdf (Retrieved Jul 15, 2016)

FAO. 2011. Southeast Asia Subregional Report: Asia-Pacific Forestry Sector Outlook Study II. FAO. Bangkok, Thailand. http://www.fao.org/docrep/013/i1964e/i1964e00.htm (Retrieved Sep 29, 2016)

FAO. 2013. FAO Statistics Division. http://faostat3.fao.org/compare/E (Retrieved Oct 3, 2016)

FAO. 2016. State of the World's Forests 2016. Forests and agriculture: Land-use challenges and opportunities. FAO. Rome, Italy. http://www.fao.org/3/a-i5588e.pdf (Retrieved Sep 2, 2016)

FPP (Forest Peoples Programme). 2012. Forest Peoples: Numbers across the world. http://www.forestpeoples.org/sites/fpp/files/publication/2012/05/forest-peoples-numbers-across-world-final_0.pdf (Retrieved Sep 19, 2016)

Greenpeace. 2016. The problems of deforestation in Asia. http://www.greenpeace.org/eastasia/campaigns/forests/problems/ (Retrieved Sep 19, 2016)

Mosbergen, D. 2015. Palm oil is in everything—and it's destroying Southeast Asia's forests. The World Post. http://www.huffingtonpost.com/entry/palm-oil-impacts_us_55a4c391e4b0b8145f737dd5 (Retrieved Sep 19, 2016)

Othman, M.S. 2016. The Economic Value of the June 2013 Haze Impacts on Peninsular Malaysia. EEPSEA, WorldFish. Los Baños, Philippines.

Subramanian, S.; A. Gasparatos; A.K. Braimoh; and W. Elliott. 2011. Unravelling the drivers of Southeast Asia's biodiversity loss. United Nations University. http://unu.edu/publications/articles/unraveling-the-drivers-of-southeast-asia-biodiversity-loss.html#info (Retrieved Sep 19, 2016)

Transparency International. 2015. Why ASEAN needs to confront corruption in Southeast Asia. http://www.transparency.org/news/feature/why_asean_needs_to_ confront_corruption_in_southeast_asia (Retrieved Nov 29, 2016)

UN (United Nations). 2011. Forests for People Fact Sheet. http://www.un.org/en/events/iyof2011/wp-content/uploads/2011/10/Fact_Sheet_ForestsandPeople.pdf (Retrieved Sep 19, 2016)

UNEP, FAO & UNFF (United Nations Environment Programme, Food and Agriculture Organization of the United Nations, and United Nations Forum on Forests Secretariat). 2009. Vital Forest Graphics. UNEP, FAO, UNFF. http://www.unep.org/vitalforest/ (Retrieved Sep 2, 2016)

UNESCAP (United Nations Economic and Social Commission for Asia and the Pacific). 2011. Statistical Yearbook for Asia and the Pacific 2011. http://www.unescap.org/stat/data/syb2011/II-Environment/Biodiversity-protected-area-and-forests.asp (Retrieved Sep 19, 2016)

UNESCAP. 2009. Innovative socio-economic policy for improving environmental performance: Payments for ecosystem services. United Nations. http://www.greengrowthknowledge.org/sites/default/files/downloads/resource/Paypment%20for%20ecosystem%20services_UNESCAP.pdf (Retrieved Nov 24, 2016)

UN-REDD (United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation). 2016. About REDD+. http://www.unredd.net/about/what-is-redd-plus.html (Retrieved Oct 4, 2016)

Warren-Thomas, E.; P.M. Dolman; and D.P. Edwards. 2015. Increasing demand for natural rubber necessitates a robust sustainability initiative to mitigate impacts on tropical biodiversity. Conservation Letters. 8(4):230-241. http://onlinelibrary. wiley.com/doi/10.1111/conl.12170/epdf (Retrieved Oct 3, 2016)

Wharton Global Initiatives. 2012. Deforestation in Southeast Asia: The future is being decided in Indonesia. https://global.wharton.upenn.edu/post/deforestation-in-southeast-asia-the-future-is-being-decided-in-indonesia/ (Retrieved Sep 19, 2016)

Wilcove, D.S.; X. Giam; D.P. Edwards; B. Fisher; L.P. Koh. 2013. Navjot's nightmare revisited: Logging, agriculture, and biodiversity in Southeast Asia. Trends in Ecology & Evolution. 28: 531-540. https://www.uvm.edu/giee/pubpdfs/Wilcove_2013_ Trends_in_Ecology_and_Evolution.pdf (Retrieved Oct 4, 2016)

WRI (World Resources Institute). 2005. Millennium Ecosystem Assessment: Ecosystem and Human Well-being: Synthesis. Island Press. Washington, DC., USA. http://www.millenniumassessment.org/documents/document.356.aspx.pdf (Retrieved Sep 13, 2016)

Wunder, S. 2005. Payments for environmental services: Some nuts and bolts. Center for International Forestry Research. Bogor, Indonesia. http://www.cifor.org/ publications/pdf_files/OccPapers/OP-42.pdf (Retrieved Nov 21, 2016)

WWF (World Wildlife Fund for Nature). 2013. Ecosystems in the Greater Mekong: Past trends, current status, possible futures. World Wildlife Fund for Nature, Greater Mekong. http://awsassets.panda.org/downloads/greater_mekong_ecosystems_report_020513.pdf (Retrieved Sep 19, 2016)

WWF. 2016. Palm oil & forest conversion. http://wwf.panda.org/what_we_do/footprint/agriculture/palm_oil/environmental_impacts/forest_conversion/ (Retrieved Jul 14, 2016)

EEPSEA is administered by WorldFish on behalf of its donors, Sida and IDRC.

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