



The value of ecosystem services obtained from the protected forest of Cambodia: The case of Veun Sai-Siem Pang National Park



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ABSTRACT

This research provides for the first time a valuation of Veun Sai-Siem Pang National Park (VSSPNP) in Cambodia, which is a forest largely unfamiliar to the international community yet extremely significant in terms of biodiversity value. This study aimed to measure the monetary and non-monetary values of ecosystem services (ESS) of the forest. We estimated the total annual contribution of VSSPNP was US \$129.84 million. Its primary contribution was air purification (US\$56.21 million yr⁻¹) followed by water storage (US\$32.31 million yr⁻¹), soil-erosion reduction (US\$22.21 million yr⁻¹), soil-fertility improvement (US\$9.47 million yr⁻¹), carbon sequestration (US\$7.87 million yr⁻¹), provisioning services (US \$1.76 million yr⁻¹) and recreation (US\$0.02 million yr⁻¹). Traditionally the forest is used for timber and non-timber forest products, which in fact, composed only 1.36% of the total benefits. By analysing the published articles and reports on VSSPNP we determined the area had generated valuable academic and non-academic knowledge on natural resources. This forest had also created a diverse network among scientists and different organizations worldwide. We also identified the forest to be of cultural importance for indigenous people as they believe that their ancestors live inside the forest and protect them from vulnerabilities. Despite being part of one of the most important eco-regions in the world VSSPNP is undervalued and facing multiple threats such as illegal logging, poaching, population pressure and corruption. The current estimation of ESS would thus assist in the sustainable management of VSSPNP.

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1. Introduction

Forest ecosystems are capital assets that yield many vital services for humans (Costanza et al., 2011). Their importance, however, is often determined by comparing their value with that which could be obtained from converting forests for other land uses (i.e. agriculture) (Costanza et al., 1997). The ecosystem services (ESS) of forests identified by previous researchers are food, water, fuel, timber, fibre, climate regulation, flood regulation, disease regulation, water purification, and spiritual and recreational considerations (MEA, 2003; Fisher et al., 2014). These are broadly categorised in four groups- provisioning, regulating, cultural and supporting services.

Despite large potential ecosystem values, the increasing conversion of native ecosystems into agricultural land to meet ever

increasing food demands worldwide is a major cause of habitat destruction and losses of valuable ecosystems (Tilman et al., 2001; Sunderlin et al., 2005). Land for agricultural expansion comes from forest, grassland and other natural ecosystems. If current global trends continue, net loss of natural ecosystems to agriculture would amount to 10⁹ ha by 2050 – larger than the total area of the USA (Tilman et al., 2001). Tropical forests, by nearly all means, account for the richest biodiversity found anywhere in the world, yet, ironically, these forests are also among the most threatened (Valiela et al., 2001). Tropical forests are more than just a combination of flora and fauna; they are home to many indigenous people, and are vital source of numerous services such as flood amelioration, soil erosion control, fresh water supply, air purification, recreation, education and so on (Laurance, 1999; Costanza et al., 2014). The most prominent impact of tropical forest destruction is the loss of these precious ESS (Costanza et al., 1997; Daily et al., 2009; de Groot et al., 2012). This issue, however, has been largely ignored in forest and environmental policies, and conventional economic justifications have often underestimated the true contributions of forests. This has often led to the conversion

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of forests to agricultural land uses, as well as to lower investment in forest conservation (Costanza et al., 1997; Daily et al., 2009).

Forest ecosystems are great sources of knowledge and destinations for diverse research efforts. Scientific articles, reports, popular articles and visits to forest ecosystems can serve to increase awareness about the ecological importance of a region with the wider community (Costanza et al., 1997). Every year countless meetings, conferences, workshops and symposia are organized worldwide to share knowledge and determine priorities in social, economic and environmental policies. Climate change from carbon emission, rapid biodiversity loss, local and national dependence, conversion into commercial plantation and numerous management challenges (Laurance, 1999; Bawa, 2006; Boon, 2013) make it more important than ever to make connections and start a dialogue among researchers and public and private land owners (Andersson et al., 2000). The field of ESS is one such platform where these discussions can be had as they support millions of people worldwide and have the potential to contribute to the economic and social development of local communities (Adhikari et al., 2004; MEA, 2005; Babulo et al., 2008) through the provisioning of food and water security along with other cultural and social benefits.

Given the importance of ESS to sustainable human development, it is time for some important questions to be addressed: How important are ESS? And At what scale? The answers to these questions are not entirely academic. We make choices among the competing options by comparing 'benefit to be gained' from them which implies 'valuation'. In most cases environmental benefits are not properly evaluated and, thus, tend to be underestimated in the cost-benefit analysis of any proposed action (Costanza, 2000). Valuation of all the possible ESS would not only increase the economic value of the ecosystem, it also will highlight the socio-cultural services of natural ecosystems (Daniel et al., 2012; Barrena et al., 2014). Communities have their own considerations in valuing the ecosystems and often the socio-cultural values are not adequately incorporated in decision making (van Riper et al., 2012). Monetary and non-monetary values can complement each other and generate greater ESS by facilitating communications between stakeholders and enabling comprehensive evaluation that frames all the aspects of an ecosystem's contribution within the broader ESS framework (deGroot et al., 2010; Daniel et al., 2012). The decline of any type of ESS in and outside the sources of services often create conflicts within communities (Zarandian et al., 2016).

Decision makers require better information on the comprehensive values of nature for weighing human actions on the ecosystem (Bingham et al., 1995). Millions of people in developing countries live adjacent to forests and their wellbeing is closely linked with forest resources (Smith et al., 2013). Moreover, many services are of benefit to humans at national and regional levels, which suggests that forest destruction would cause irretrievable damage to general human wellbeing (Daily et al., 2009). Unless we drastically improve our understanding of the values offered by ecosystems in conservation efforts, we cannot hope to improve forest conservation and thus the sustainability of human wellbeing cannot be ensured (Smith et al., 2013).

Cambodia has one of the highest rates of land-use change globally (Hansen et al., 2013; Davis et al., 2015). The country is of global conservation importance because it contains the largest remaining examples of habitats that were previously spread across much of Indochina and Thailand, and which still contain nearly intact species assemblages, albeit at heavily reduced densities (Loucks et al., 2009). Veun Sai-Siem Pang National Park (VSSPNP), which was granted National Park status on May 9, 2016, before which it was a Conservation Area, has been listed as a Key Biodiversity Area in the World Biodiversity Database and is also part of the Virachey Important Bird Area (Chan et al., 2004). VSSPNP contains significant populations of rare and endangered species (e.g. the red

shanked douc langur and the giant ibis) and is home to several indigenous hill tribes and other people including Brao, Lao, Kavet and Kinh. Due to chronic poverty, illegal logging and poaching activities are threatening the site's ecological integrity which when paired with other human induced ecosystem changes and general impacts of climate change, may result in catastrophic consequences (POH-KAO, 2012). Conservation International has been implementing conservation projects in the forest, but in the absence of an estimation of ESS for the area to justify greater investment and attention provided towards its protection, this has been challenging. To address this research gap and to improve management of the area our study aimed to estimate ESS values derived from VSSPNP.

2. Methodology

2.1. Study site

VSSPNP is located in North-eastern Cambodia at 14°01'N, 106°44' E and consists of approximately 55638.72 ha of evergreen (54486.81 ha) and semi-evergreen (1151.91 ha) forest (Fig. 1). This area experiences two distinct seasons: the wet season from May through October and the dry season from November to April. It has a mean annual temperature of 28 °C (ranges from 38 °C in April to 17 °C in January) while the mean annual precipitation ranges from 1200–2000 mm and is governed by monsoons (Thoeun, 2015). Topographically the area is mixed with hilly and plain lands with red sandy soil. VSSPNP is a large mostly pristine forest in the Veun Sai District of Ratanakiri Province and Siem Pang District of Stung Treng Province of North-eastern Cambodia. It is contiguous with Virachey National Park which borders Vietnam and Laos. The forest is characterized by patches of mixed deciduous and semi-evergreen forests (Chan et al., 2004). Ecologically, the area is located within the Indo-Burma hotspot (Myers et al., 2000), and is part of the 200 globally most important ecoregions, the Eastern Indo-China Dry and Monsoon Forest (Olson and Dinerstein, 1998) and part of the Critical Ecosystem Partnership Fund's (CEPF) Cambodia-Lao PDR-Vietnam Tri-border Forests priority corridor (Critical Ecosystem Partnership Fund, 2012).

In VSSPNP 255 animal species have been recorded of which four are classified as Critically Endangered, 12 as Endangered, and 19 as Vulnerable on the IUCN Red List of Threatened Species (Ramachandra et al., 2012). Primates of this area are of special conservation concern. The population of gibbons at the site is considered globally significant (Rawson and Bach, 2011) as it is believed to be the biggest population of the species *Nomascus annamensis* in existence. Other species of concern include black-legged douc langur (*Pygathrix nemaeus*), dhole (*Cuon alpinus*), malayan sun bear (*Helarctos malayanus*), gaur (*Bos gaurus*), banteng (*Bos javanicus*), eastern Eld's deer (*Panolia siamensis*), and two species of slow loris (genus *Nycticebus*). The site is also home to rare birds such as: white-winged duck (*Asarcornis scutulata*), giant ibis (*Thaumatibis gigantea*) and white-shouldered ibis (*Pseudibis davisoni*) (Ramachandra et al., 2012).

2.2. Valuation of ESS

We considered food, water, non-timber forest products (NTFPs) and timber as provisioning services; water purification and soil erosion reduction as regulating services; recreation, education, traditional ethno-cultural belief as cultural services; and nutrient improvement as a supporting service (MEA, 2003; Fisher et al., 2014; Maynard et al., 2015). These ESS were chosen for this study as they were flagged by local people and NGO officials as being of particular importance. In this research we used simplified methods

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