



The Importance of Non-timber Forest Products in Rural Livelihoods and Ecosystem Services at Phnom Prich Wildlife Sanctuary, Cambodia

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Abstract This study aims to answer the research questions as follows: What is the current context of Phnom Prich Wildlife Sanctuary (PPWS)? Where are the most accessible sites of non-timber forest products (NTFPs) over the landscape of PPWS? Who are NTFPs-dependent people? What is the importance of NTFPs in rural livelihoods? What is the contribution of NTFPs in ecosystem services? Analyzed the NTFPs endowment, the open access simulation model was applied. From the 310 sample households, NTFPs dependency and intensity were analyzed through descriptive statistics. Cross tabulation was applied to identify the main users of NTFPs. The role of NTFPs in rural livelihoods and ecosystem services were discussed. The simulation result clearly shows that NTFPs are rich over the landscape, which local people can easily access. Among many types of NTFPs, eight of them are considered as the most importance for rural livelihoods including liquid resin, solid resin, bamboo shoot, bamboo poles, wild honey, orchid flower, fuelwood, and Prich leaf (*Melientha suavis* Pierre). Around 93% of sampled households collect NTFPs for foods, cash incomes, house construction, and farm equipment. NTFPs are the resources not only for the poor but also to all rural households at PPWS. Some of NTFPs also contribute to ecosystem services.

Keywords NTFPs, rural livelihoods, ecosystem services, Phnom Prich Wildlife Sanctuary, Cambodia

INTRODUCTION

Policy makers tend to forget the role of non-timber forest products (NTFPs) because they lack available information on contribution to the daily life of rural people and ecosystem services at national or global levels (De Beer and McDermott, 1996). In Cambodia, about 84% of rural people heavily depend on forest resources, especially on NTFPs for domestic consumption and complementary cash income (MoE, 2011). NTFPs are also an intrinsic part of culture and traditions of forest-based and indigenous communities of Cambodia (EC-FAO, 2002). Local people have collected NTFPs traditionally for various purposes without any statistical recording to the national economy, yet the importance of NTFPs are not recognized well by the policy makers (Tola and McKenney, 2003). Royal government of Cambodia has implemented the forest protection and management in various policies, but they do not include NTFPs in their primary development agenda (FA, 2009). At present, the empirical evidence on the importance of NTFPs is not well documented in Cambodia. The role of NTFPs has traditionally measured regarding direct benefits from only the amount sold. This description does not reflect the real benefits of NTFPs to rural livelihood, national economy, or global ecosystem services. To understand the real importance of NTFPs; first, the uniform category of NTFPs-dependent people must be known because it gives insight into who are actually utilizing these

resources for livelihoods. Then, the role of NTFPs in ecosystem services should also be revealed to reflect the real importance.

OBJECTIVE

The objective of this study is to explore the importance of NTFPs in rural livelihoods and ecosystem services at Phnom Prich Wildlife Sanctuary (PPWS). This study addresses the following questions: What is the current context of rural households in PPWS? Where are the most accessible sites of NTFPs over the landscape of PPWS? Who are NTFPs-dependent people? What is the importance of NTFPs in rural livelihoods? What is the contribution of NTFPs in ecosystem services?

METHODOLOGY

Study Site Selection

Phnom Prich Wildlife Sanctuary (PPWS) is located in the west of Mondulkiri province, north-east Cambodia. The whole areas of PPWS are 2,225km². PPWS has a rich intricate mosaic of forest habitats, which consists of a mosaic of deciduous dipterocarp forest (1027 km²) and wetter semi-evergreen/mixed-deciduous forest (1070 km²) (WWF, 2016). Whilst PPWS regards as the wealth of ecosystems, and it is also of great importance to local communities who thrive to enhance livelihood through extraction of NTFPs. Currently, there are eight community protected areas (CPAs) have been established. However, this study selected six communities including Nglaoaka, Sre Y, Chi Klab, Poutong-Pouhoung, Toul, and Srae Khtong.

Data Collection and Analysis

Fieldworks took place in September 2015, March and April 2016. Questionnaire testing and adjusting were conducted prior to the survey. Secondary data were mainly gathered to produce the NTFPs accessibility map. The types of secondary data were the dataset of forest cover 2010, population centers and road locations over the landscape. Participatory rural appraisals (PRA) were conducted in four focus group discussions from four communities protected areas (CPAs) in the different areas of PPWS. Two primary tools were applied including seasonal calendar and NTFPs accessibility stocks. Structured questionnaire interview were conducted with the 310 sampled households, which were randomly selected from six communities.

Descriptive statistics were used to describe social characteristics of local people in PPWS, the frequency of forest resources dependence, and frequency of people who involved with NTFPs. Then the people-forest relationships were indicated by the seasonal calendar and people's dependence on the forestry resources. The simulation of "Open Access" model in Arc-GIS software (version 10.1) was run to get the map of NTFPs accessibility stock over the landscape of PPWS. The inputs data for processing were current land use and land cover (LULC) 2010, NTFP harvest products stocks (unique value 0, 0.3, 0.5, 0.7, 1), maximum travel distance to the product, population center, road locations and size and legal accessibility for harvesting. The output by whether NTFP resources are abundant in the area or not and how local people make use those resources for their daily life were interpreted. Crosstabs tabulations were used to analyze the people's dependence on the NTFPs, which varies in different categories of households. The importance of NTFPs to rural livelihoods through the types and utilization level of NTFPs was analyzed. Last, the role of NTFPs in ecosystem services by using literature reviews was described.

RESULTS AND DISCUSSION

Current Context of Rural Households in PPWS

Figure 1 shows the current livelihood activities of local people in PPWS. All agricultural activities, including rainfed rice, cash crop, and vegetables are done, in the rainy season. Livestock, fishing, and small business are done in the year-round. People, who were landless or owned small farmland, worked for other farmers especially in the sowing and harvesting periods of the rice crop. Also, local people collected NTFPs in both seasons upon the types of NTFPs. For illustration, bamboo shoot can be collected in the rainy season, but wild honey and Prich leaf (*Melientha suavis* Pierre) are available only in the dry season. Liquid resin, solid resin, bamboo pole, orchid flower, and fuelwood can be collected in year-round. In the dry season, local people often traded liquid resin, solid resin, wild honey, and orchid flower. However, this result indicates that NTFPs play the vital role in livelihood diversification especially during the off-season, when local people are free from farming.

Livelihood Activities	Dry Season (Nov-April)				Rainy Season (May-October)							
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Rainfed Rice												
Chamkar												
Vegetables												
Livestock												
Fishing Activity												
Small Business												
Off-farm												
Liquid Resin												
Solid Resin												
Wild Honey												
Orchid Flower												
Bamboo-Pole												
Bamboo-Shoot												
Prich Leaf												
Fuelwood												

Fig. 1 Seasonal livelihood activities

Noted: Blank, light grey and pattern represent no activity, occasionally activity, and intensively activity respectively

NTFPs Resources Endowment in Phnom Prich Wildlife Sanctuary

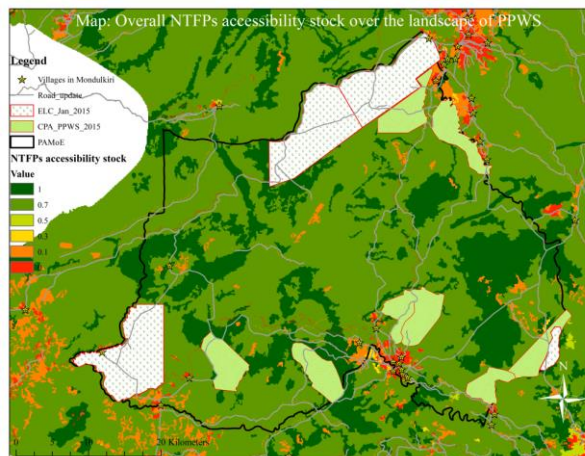


Fig. 2 NTFPs resources endowment in PPWS

Figure 2 shows the result of “Open access” model simulation. Through the NTFPs accessibility map, it clearly shows that NTFPs are abundant over the landscape, according to the identified value of high accessibility - light green (0.7) and dark green (1.0). The value of resources accessibility is likely to be less in the areas nearby roads, village zones, and city, as indicated by the red, orange, and yellow colors. Each NTFP has different characteristics of habitats and capacity to produce. Bamboo, fuel wood, and prich leaf (*Melientha suavis* Pierre) are very abundant, so local people easily access nearby the village zones. The commercial NTFPs including liquid resin, solid resin, wild honey, and orchid flower are located in further distance, mostly in evergreen and semi-evergreen forests where the distance ranged from 9 km to 14 km from their villages.

NTFPs Dependent People in Phnom Prich Wildlife Sanctuary

Households’ characteristics make a crucial distinction between people who rely on NTFPs as the main source or starting point of livelihoods. Fig. 3 shows that indigenous people (Bunong) tend to depend more on NTFPs because it is the traditional activities to sustain their livelihoods. The study also finds that households, who had moderate livelihood diversification (3 to 4 occupations per household), seem to collect more NTFPs. Also, low education people were more likely to rely on NTFPs. However, this finding agrees with other studies that native people and low education people are more likely to depend on NTFPs for livelihoods (Shackleton and Pandey, 2014). The claimed from Wunder (2001) that only less income diversification households depend more on NTFPs is rejected because NTFPs are very important for everyone living in the forest sanctuary. Regarding households’ production factors, the household group having more members collected NTFPs more than the households who have less, as be shown in Fig. 4. This result indicates that collection NTFPs is labor intensive. Also, households owned a motorcycle for transportation enables to travel further to collect more NTFPs. Moreover, the households owned average agricultural land are likely to collect more NTFPs than the landless or people owned large land. Despite the claimed from Cavendish (2002) that only local people who limit the land ownership, limit capital, limit labor, and less income diversification tend to depend on NTFPs heavily, is rejected.

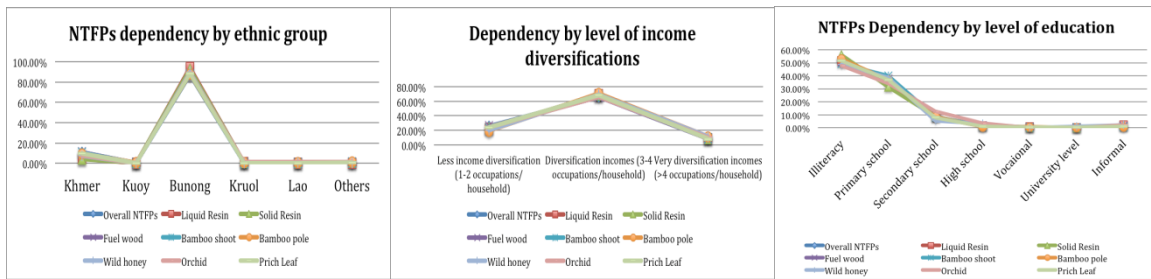


Fig. 3 NTFPs dependency level by households’ characteristics

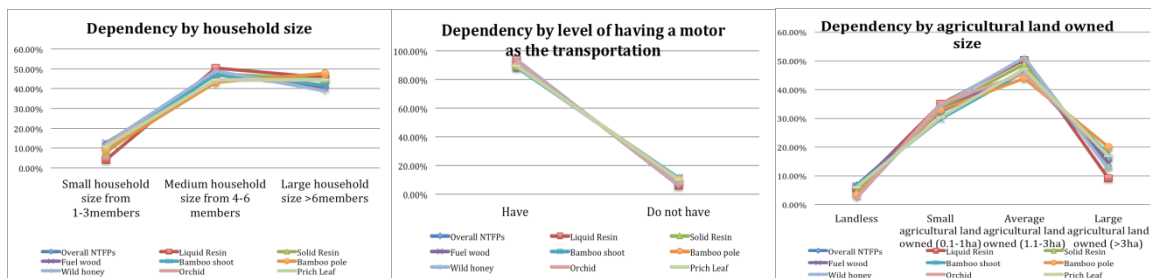


Fig. 4 NTFPs dependency level by households’ production factors

Importance of NTFPs in Rural Livelihoods

The results from focus group discussions indicated 14 NTFPs which local people have collected the most in PPWS. Among the 14 NTFPs, six NTFPs are considered as the most important NTFPs including fuelwood, bamboo shoot, prich leaf, solid resin, bamboo poles, and liquid resin, which represent 98%, 85%, 83%, 56%, 56%, and 50% respectively, based on 288 sampled households, who collected NTFPs. Additionally, wild honey and orchid flower are considered as importance NTFPs because they constitute as sources of households' cash income. Table 1 shows the diversity of NTFPs use and commercialization in PPWS. The most important NTFPs for subsistence use in PPWS were fuelwood, bamboo shoot, bamboo poles, prich leaf, wild honey, and liquid resin which identified by the sign + and +/- in Table 1. Bamboo shoot and prich leaf were consumed for food during the wet season and the dry season respectively. Fuelwood ultimately serve the local communities for energy sources for cooking. Local people used the bamboo poles for construction, fencing, and furniture. Wild honey was used for traditional medicine and food ingredient. Liquid resin was used as the raw material for small construction. Table 1 shows that liquid resin, solid resin, wild honey, and orchid flower were widely collected for commercialization in PPWS. Wild honey, orchid flower, and solid resin were seasonally collected and sold. Liquid resin was the only NTFP that local people extracted intensively and sold in the year-round. In a few cases, bamboo poles and prich leaf were sold to the market. This result is similarly to another study that many NTFPs are the critical subsistence in rural households' economy. People traded NTFPs when only the markets were available at their locations (Cavendish, 2002).

Table 1 Importance of NTFPs to local livelihoods

NTFPs	Key species	Importance to rural livelihoods	
		Use	Commercial
Liquid resin (n=143)	1. <i>Dipterocarpus alatus</i> 2. <i>Dipterocarps intricatus</i> Dyer	+/-	+
Solid resin (n=162)	1. <i>Shorea guiso</i> 2. <i>Shorea siamensis</i> 3. And some of <i>Genera of Dipterocarpaceae (Vatica & Hopea)</i>	-	+/-
Wild honey (n=89)	1. <i>Apis dorsata</i> 2. <i>Apis florae</i> 3. <i>Apis cerana</i>	+/-	+/-
Orchid flower (n=91)	1. <i>Vandopsis gigantea</i>	-	+/-
Bamboo poles (n=160)	1. <i>Bambusa sp.</i> 2. <i>Bambusa bambos</i>	+/-	-
Bamboo shoot (n=244)	1. <i>Bambusa sp.</i> 2. <i>Bambusa bambos</i>	+/-	-
Prich leaf (n=239)	1. <i>Melientha suavis</i> Pierre	+/-	-
Fuelwood (n=281)	Diverse long-lived tree species	+	-

Noted: Frequency of use/sell: - not or little use/sell; +/- sometimes use/sell (moderate amount/seasonally); + often use/sell (regularly in year round)

Source: Author's structured interviews (2016).

Contribution of NTFPs to Ecosystem Services

Although most of the NTFPs do not play a direct role in ecosystem services, they are ones among the final products provided by ecosystem services. However, trees/forests, which provides NTFPs, play a crucial role in ecosystem services as follows.

First, many of the trees providing NTFPs are the long-lived trees, so all parts of the trees play a role in carbon sequestration, (Table 2). The carbon storage function has the social value which equals to the social damage avoided by not releasing the CO₂ into the atmosphere (Nordhaus, 2007). Second,

the forest can regulate the runoffs the rainwater. It can reduce flood volumes during torrential rains, and in dry seasons, forest gradually releases the absorbed water that maintains river flow. The value of watershed protection is commonly equal to water treatment costs, water supply or investment costs of reservoir construction (Gaodi et al., 2010). Third, the trees/forest helps to prevent soil erosion and minimize sedimentation in water reservoir or rivers. This service has a value that equal to the cost of sediment removal from rivers and reservoirs (Keeler et al., 2012). Fourth, the honey bee not only provides the honey products but also to crop plants pollinated. They are the pollinators that can increase yield, quality, and stability of fruit and seed crops. Value equals to the investment costs to optimize agriculture and conservation (Breeze et al., 2016). Last, some species, especially wild orchid flower also contribute a role in aesthetic or recreation. The value of recreation equal to the travel costs of tourists to visit the particular site (Gaodi et al., 2010). This finding is consistent with other studies that NTFPs play a direct or indirect role to maintain the value of ecosystem services because extraction activities do not impact critically to the forest or trees (Arnold and Pe´rez, 2001; Neumann and Hirsch, 2000; Ros-Tonen and Wiersum, 2005).

Table 2 Contribution of the NTFPs to environmental services

Primary NTFPs	Ecosystem Services	Description of functioning contributed by NTFPs
Long-lived trees: Liquid resin, Solid resin, Fuelwood, Bamboo, and Prich leaf (<i>Melientha suavis</i> Pierre)	Carbon storage	Leaves, branches, stems, barks, and roots of the long-lived trees play role in carbon storage
	Watershed protection	Water can be relocated to regulate availability of surface water and runoff through the crown, trunk, undergrowth vegetation and forest litter and soil.
	Soil erosion prevention	Trees/forest help to prevent soil erosion and minimize sedimentation in reservoirs and rivers.
Honey bee	Pollination	A honey bee is the key animal pollinator for crop pollination
Ornament plant: Orchid flower	Aesthetic	Slightly contribute to recreation and eco-tourism (physical wellbeing, learning, and quality of life)

Source: Author's literature reviews (2016).

CONCLUSION

The contribution of NTFPs to rural livelihoods and forest conservation is regarded as very promising. NTFPs are the common natural wealth for all residents, and their importance in rural livelihoods is confirmed because of the strong dependence from most of the local people regardless their different households' characteristics. NTFPs make a significant contribution to the local economy such as food, house construction, fencing, energy, farm equipment, and cash income. Some primary types of NTFPs also contribute simultaneously to ecosystem services through carbon storage, watershed protection, soil erosion prevention, pollination, and aesthetic.

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