

Contribution of NTFPs to local livelihood: a case study of Nong Sai Sub-district of Nang Rong district under Buriram Province in Northeast Thailand

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Abstract: In many areas near forests in rural Thailand, people collect non-timber forest products (NTFPs) for both subsistence and trade. This paper explores the spectrum of NTFPs being collected from dry dipterocarp forests in the Khao Angkhan National Forest Reserve and Khokyai community forest. Villagers in Nong Sai Sub-district of Nang Rong district under Buriram Province were interviewed using a structured questionnaire to examine the contributions of NTFPs to the livelihood and assets of local people. The study parameters included (1) the species of NTFPs collected (2) the seasonal and duration of collection (3) the methods of collection (4) the purpose of collection and (5) the income generated from NTFPs. Villagers perceived the forest's value as a source of goods and services, especially NTFP harvesting. The NTFP collectors generally collected minor products using relatively low-impact indigenous methods. For example, mushrooms were harvested in the morning because they are easier to cook and can be sold for a higher price. Therefore, NTFPs are collected for both subsistence and commercial purposes. Common NTFPs for subsistence use consisted of mushrooms (16 species), wild vegetables (15 species), wild fruits (18 species), medicinal plants (20 species), fuel wood (five species), insects and their products (three species), and wildlife (seven species). NTFPs collected for trade included mushrooms (seven species), wild vegetables (five species), and insects and their products (one species). Overall patterns of NTFP use indicated that the forest makes positive contributions to the lives of people living in and around in terms of both subsistence and cash income but that NTFP collection creates both positive and negative incentives with respect to forest conservation and management if users ignore regulations for sustainable use.

Key words: Non-timber forest products (NTFPs), dry dipterocarp forest, local livelihood, Northeast Thailand.

Introduction

For traditional peoples, the forest serves as a convenience store, grocery, pharmacy, hardware outlet, lumberyard, and department store (Bennett, 2002), and the importance of forest products to households living in or near forests has been increasingly recognised. Estimates of the number of people who in some way rely on forests, for either survival or livelihood, vary widely (Byron and Arnold, 1999), especially with respect to non-timber forest products (NTFPs). NTFPs which have long been considered "minor" or "secondary" forest products, are defined as any tangible animal or plant products other than industrial timber that can be collected from forests for subsistence and trade (Ros-Tonen *et al.*, 1995). Thus, the NTFP category includes wild plants for food (including food for domesticated animals), game, medicinal herbs, small-scale wood for tools and handicrafts, latex for rubber, and building and dying materials (De Beer and McDermott, 1989). NTFPs are central to interactions between local people and forests, and help to sustain rural livelihoods through subsistence and commerce (Anderson, 1993; Sato, 1998; Satién-Thái, 1999; Sharp *et al.*, 1999). NTFP use is less ecologically destructive than timber harvesting, encouraging the belief that more intensive management of forests for such products could contribute to both development and conservation objectives (Michael Arnold and Ruiz Pe' rez, 2001). Consequently, conservationists and environmental economists have promoted the extraction of NTFPs as an alternative to forest conservation and as a benefit to those who are reliant on forests (Bennett, 2002). Therefore, understanding NTFP use is a prerequisite to motivating subsistence-level forest users to enrich and manage the forests on which they rely. Northeast Thailand, known as Isaan, contains some of Thailand's the highest populations, but is also the poorest part the country (Grandstaff *et al.*, 2008). Forest cover accounts for 16.32% or 27,555.54 km² of the region's overall area, of which about 1,505 km² is community forest (Royal Forest Department, 2009). Most people in

the region are farmers whose livelihoods are connected to the forest in terms of both traditional cultural practices and food acquisition. NTFPs are a critical component in the subsistence of farmers and play an essential role in the rural diet of Northeast Thailand. In the past, research on NTFPs in Northeast Thailand focused on *ethnobotany and NTFP use and diversity* (Somnasang *et al.*, 1988; Somnasang *et al.*, 1998; Wester, 1996; Prachaiyo, 2000), while a small number of studies examined the potential for NTFPs to modernise modes of subsistence in southern Isaan. Clearly, NTFPs are not limited to household consumption but are also used to generate secondary income. Generally, academic understanding of the role and potential of NTFPs to contribute to capital accrual and poverty alleviation is based on case studies, which hold little value in terms of generalisation (Marshal *et al.*, 2003; Belcher *et al.*, 2005; Ros-Tonen and Wiersum, 2005). Hence, questions remain about whether, or to what extent, NTFPs contribute to local livelihoods, community development and forest resource conservation. Thus, we selected the dry dipterocarp forest in Khao Angkhan national forest reserve and Khokyai community forest in Buriram for our study because they are important sources of NTFPs for the region's rural residents. We report a preliminary study of NTFP contributions to local livelihood, and include general information on NTFP species, use, and objectives of collection.

Materials and Methods

Study area: Our study took place in four districts of the Khao Angkhan National Forest Reserve (locally known as the Khao Angkhan conservation forest area) and Khokyai community forest-Nang Rong, Lahansai, Chaloe Phrakiat, and Pakham- in Buriram Province, Northeast Thailand (Fig. 1). The region comprises dry dipterocarp forest with an area of about 51 km², bounded mainly by agricultural land and settlements. The elevation is about 200 meters above mean sea level. The area is dominated by a tropical seasonal monsoon climate, with three marked

seasons: hot, rainy, and dry. The mean monthly temperature is 31.5°C (min. 24°C, max. 34°C), with extreme high of 40°C or more in April and May. The mean annual rainfall during the monsoon (June–October) is about 1,000 mm, and the mean monthly humidity is 70%.

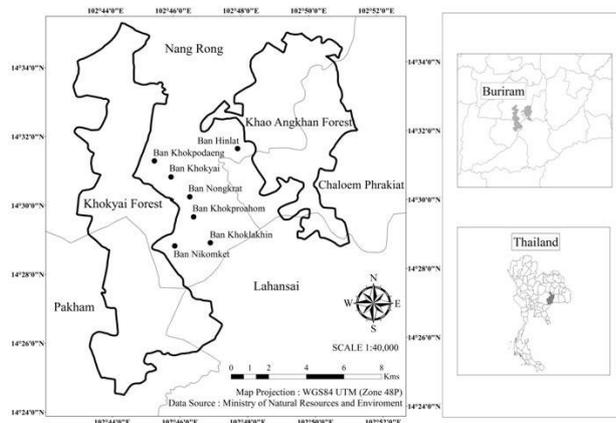


Fig. 1. Geographical position of study area

The population of the study area in 2009 was 6,556 (3,253 males and 3,303 females) with a population density of 80.93 km⁻² unevenly distributed around the forest. Agriculture is the main occupation of ~80% of forest inhabitants, with rice and cassava the main crops. Rearing animals such as chickens and cattle is common in most households.

Methods: Field data collection comprised two parts. First, we used questionnaires to interview household representatives, completing a total of 150 interviews with participants from seven villages: Hinlat, Khokyai, Khokpodaeng, Nongkrat, Khokprohom, Khoklakhin, and Nikomket in Nong Sai Sub-district, Nang Rong District, Buriram Province. Second, we used a participatory rural appraisal approach (PRA), including interviews with village NTFP buyers (“middle men”), using semi-structured interviews and group discussions and meetings to ascertain NTFP use, particularly of NTFPs collected for commercial purposes.

All field survey data were synthesised and analysed using the Statistical Package for Social Science for Windows (SPSS). The programs were used to analyse general information from the respondents’ households, and content analysis was used to analyse the PRA data.

The names of the various plant and animal species that the villagers collected were originally given as local names; these were changed to common and scientific names using a variety reference books and consultations with local experts.

Results and Discussion

Sociodemographic and economic characteristics of the community: In the field survey, 63% of respondents were female, and the overall average age of respondents was 46. Most respondents had completed primary school and were born in the study area. Most respondents were farmers, generally producing Thai jasmine rice and cassava. Some had established agroforestry systems, cultivating various species of plants and animals for household consumption and selling surplus products to generate income. The main

income of the villagers was derived from agricultural products such as Thai jasmine rice and cassava; average household income from agriculture was about 50,941 Baht (USD 1,491.7) per year. Other important sources of income included wage labour and NTFP trade, together averaging about 35,108 Baht (USD 1,028.1) per year per household. The average total household income in the target villages was 86,049 Baht (USD 2,519.7) per year. However, most respondents stated that their income was insufficient, and 77% had debts. Loans were mainly obtained from village funds, and were used to purchase agricultural supplies and to cover necessary daily expenses.

Land tenure: Most respondents occupied land and possessed land certificates such as title deeds (Nor Sor 3), or certificates of local maintenance tax (Por Bor Tor 5). The average size of land holdings was about 1.3 ha. More than half of respondents wanted to expand their holdings, mostly to accumulate land for their children.

Villager dependency on the Khao Angkhan and Khokyai forests: As mentioned, villagers in Nong Sai Sub-district perceived the value of the forest as a source of various goods and services such as recreation, watershed functions, and NTFPs. Most villagers stated in their interviews they collected NTFPs for both subsistence and commerce. NTFP provision is the main function of Khao Angkhan and Khokyai forests, according to the villagers.

Mushrooms, wild vegetables and fruits, medicinal plants, fuel wood, insects and their products, and wildlife were collected for subsistence use. NTFPs collected for trade included mushrooms, wild vegetables, and insects and their products.

Collection of NTFPs for subsistence use: NTFPs play an important role in the livelihood of villagers in Nong Sai Sub-district. Many species of NTFPs were harvested for daily use as food, medicine, and energy production. NTFPs for household consumption were classified as follows:

Mushrooms: Sixteen species in six families were collected, including Hed Ta Khai (*Russula delica*), Hed Ra Ngok (*Amanita princes*), Hed Kone (*Termitomyces spp.*), Hed Phek (*Lentinus strigosus*), Hed Nam Paeng (*Russula alboareolata*), and Hed Tan (*Russula densifolia*). A complete list of mushroom species is given in Table 1. Usually, villagers collected mushrooms during the rainy season from June to September; less often, mushrooms were collected 2-3 days after isolated rains throughout the hot season (April–October). The precise areas of mushroom collection varied according to the target species. Usually, villagers collected mushrooms, especially Hed Kone, in the same places each year. The average quantity of mushrooms collected is shown in Table 2.

Wild vegetables: Fifteen species from 12 families were collected, including Dog Din (*Hitcheniopsis parviflora*), Buk I Rok (*Pseudodracontium lacourii*), Phak wan (*Melientha suavis*), I Noon (*Adenia viridiflora*), and Krachiao (*Curcuma singularis*). A complete list of wild vegetable species is given in Table 1. Villagers collected wild vegetables all year, with some species, such as Dog Din and Krachiao, available only in the rainy season. The

average quantity of wild vegetables collected per household is shown in Table 2.

Table 1. NTFPs collected from Khao Angkhan National Forest Reserve and Khokyai community forest, Nong Sai Sub-district, Nang Rong District, Buriram Province.

| Type of NTFPs | Thai Name | Scientific Name | Family | Purpose of Collection | | Collecting Duration |
|-----------------|--|---|-----------------|-----------------------|------------|---------------------|
| | | | | Subsistence | Commercial | |
| Mushroom | Hed Ra Ngok | <i>Amanita princeps</i> Corner & Bas | AGARICACEAE | ☐ | ☐ | Apr-Sep |
| | Hed Kone | <i>Termitomyces</i> spp. | AGARICACEAE | ☐ | ☐ | Apr-Nov |
| | Hed Nang Hong | <i>Amanita caesarea</i> (Scop.) Per. | AGARICACEAE | ☐ | ☐ | Apr-Sep |
| | Hed Khai Han | <i>Amanita vaginata</i> (Bull.) Lam. | AGARICACEAE | ☐ | - | Apr-Sep |
| | Hed Saiduean | <i>Amanita</i> sp. | AGARICACEAE | ☐ | - | Apr-Sep |
| | Hed Chamuk wau | <i>Lactarius turpis</i> (Weinm.) Fr. | BOLETACEAE | ☐ | ☐ | Apr-Sep |
| | Hed Phueng | <i>Boletus colossus</i> Heim | BOLETACEAE | ☐ | - | Apr-Sep |
| | Hed Nam Manpu | <i>Cantharellus</i> sp. | CANTHARELLACEAE | ☐ | - | Apr-Sep |
| | Hed Pho | <i>Astreaus hygrometricus</i> (Pers.) Morgan | LYCOPERDACEAE | ☐ | ☐ | Apr-Jun |
| | Hed Bot | <i>Lentinus polychrous</i> Lev. | POLYPORACEAE | ☐ | - | All year |
| | Hed Phek | <i>Lentinus strigosus</i> (Schwin). Fr. | POLYPORACEAE | ☐ | - | Apr-Oct |
| | Hed Nam Paeng | <i>Russula alboareolata</i> Hongo | RUSSULACEAE | ☐ | - | Apr-Sep |
| | Hed Ta Khai | <i>Russula delica</i> Fr. | RUSSULACEAE | ☐ | ☐ | Apr-Oct |
| | Hed Tan | <i>Russula densifolia</i> (Sevr.) Gill | RUSSULACEAE | ☐ | - | Apr-Sep |
| | Hed Na Lae | <i>Russula cyanoxantha</i> Schaeff ex. Fr. | RUSSULACEAE | ☐ | - | Apr-Sep |
| Hed Nam Mak | <i>Russula emetica</i> (Schaeff. ex. Fr.) Pers. ex.S.F. Gray | RUSSULACEAE | ☐ | ☐ | Apr-Sep | |
| Wild vegetable | Buk I Rok | <i>Pseudodracontium lacourii</i> (Linden & Andre) N.E.Br. | ARACEAE | ☐ | ☐ | May-Jul |
| | Makok Pa | <i>Spondias pinnata</i> (L.F.) Kurz | ANACARDIACEAE | ☐ | - | All year |
| | Prong | <i>Cycas siamensis</i> Miq. | CYCADACEAE | ☐ | - | All year |
| | Chot | <i>Vietnamosasa ciliata</i> (A. Camus) T.Q.Nguyen | POACEAE | ☐ | ☐ | Jul-Oct |
| | Chamuang | <i>Garcinia cowa</i> Roxb. | CLUSIACEAE | ☐ | - | All year |
| | Tio | <i>Gratoxylum formosum</i> (Jack) Dyer | HYPERICACEAE | ☐ | - | All year |
| | Kradon | <i>Careya sphaerica</i> Roxb. | LECYTHIDACEAE | ☐ | - | All year |
| | Yanang | <i>Tiliacora triandra</i> (Colebr.) Diels | MENISPERMACEAE | ☐ | - | All year |
| | Phak wan | <i>Melientha suavis</i> Pierre | OPILIACEAE | ☐ | - | Apr-May |
| | Kra Thok Rok | <i>Olex psittacorum</i> (willd.) Vahl | OLACACEAE | ☐ | - | All year |
| | I Noon | <i>Adenia viridiflora</i> Craib. | PASSIFLORACEAE | ☐ | ☐ | May-Jul |
| | Thao Wan Yang | <i>Smilax ovalifolia</i> Roxb. | SMILACACEAE | ☐ | - | All year |
| | Krachiao | <i>Curcuma singularis</i> Gagnep. | ZINGIBERACEAE | ☐ | ☐ | May-Jun |
| Dog Din | <i>Hitcheniopsis parviflora</i> (Wall.) Loes. | ZINGIBERACEAE | ☐ | ☐ | May-Jun | |
| Prohom | <i>Kaempferia galanga</i> L. | ZINGIBERACEAE | ☐ | - | All year | |
| Wild fruit | Nom Maeo | <i>Uvaria rufa</i> Blume | ANNONACEAE | ☐ | - | Mar-May |
| | Nom Noi | <i>Polyalthai blumecta</i> (Pierre) finet&gagnep | ANNONACEAE | ☐ | - | All year |
| | Tab Tao | <i>Polyalthai debilis</i> (Pierre) finet&gagnep | ANNONACEAE | ☐ | - | All year |
| | Makok kluean | <i>Canarium subulatum</i> Guill. | BURSERACEAE | ☐ | - | Jun-Dec |
| | Samo Thai | <i>Terminalia chebula</i> Retz. | COMBRETACEAE | ☐ | - | Jan-Aug |
| | San Yai | <i>Dillenia obovata</i> (Blume) Hoogland | DILLENIACEAE | ☐ | - | Feb-Jun |
| | Makham Pom | <i>Phyllanthus emblica</i> L. | PHYLLANTHACEAE | ☐ | - | Jan-Aug |
| | Mao Khai Pla | <i>Antidesma ghaesembilla</i> Gaertn. | PHYLLANTHACEAE | ☐ | - | May-Aug |
| | Tako Na | <i>Diospyros rhodocalyx</i> Kurz | EBENACEAE | ☐ | - | Mar-Jul |
| | Takhop Pa | <i>Flacourtia indica</i> (Burm. F.) Merr. | SALICACEAE | ☐ | - | Jan-Jul |
| | Kra Bok | <i>Irvingia malayana</i> Oliv. Ex A.W. Benn. | IRVINGIACEAE | ☐ | - | Jan-Apr |
| | Makha Tae | <i>Sindora siamensis</i> Teysm. Ex.Miq. | FABACEAE | ☐ | - | Mar-Sep |
| | Wa | <i>Syzygium cumini</i> (L.) Skeels | MYRTACEAE | ☐ | - | Feb-Jun |
| | Mak Mo | <i>Rothmannia wittii</i> Bremek | RUBIACEAE | ☐ | - | Apr-Jul |
| | Ma Huat | <i>Lepisanthes rubiginosa</i> (Roxb.) Leenh. | SAPINDACEAE | ☐ | - | Oct-Apr |
| | Ta Khro | <i>Schleichera oleosa</i> (Lour.) Oken | SAPINDACEAE | ☐ | - | Jan-Aug |
| | Phlap Phla | <i>Microcos tomentosa</i> Sm. | TILIACEAE | ☐ | - | Apr-Oct |
| Kao Tak | <i>Grewia nisuta</i> Vahl | TILIACEAE | ☐ | - | All year | |
| Medicinal plant | Nom Maeo | <i>Uvaria rufa</i> Blume | ANNONACEAE | ☐ | - | All year |
| | Do Mai Ru Lom | <i>Elephantopus scaber</i> L | ASTERACEAE | ☐ | - | All year |
| | Pak Kad Dab | <i>Gynura pseudochina</i> (L.) DC. | ASTERACEAE | ☐ | - | All year |
| | Kham Rok | <i>Ellipanthus tomentosus</i> Kurz | CONNARACEAE | ☐ | - | All year |
| | Prong | <i>Cycas siamensis</i> Miq. | CYCADACEAE | ☐ | - | All year |
| | San Yai | <i>Dellania obovata</i> (Blume) Hoogland | DILLENIACEAE | ☐ | - | All year |
| | Ta Ko Na | <i>Diospyros rhodocalyx</i> Kurz | EBENACEAE | ☐ | - | All year |
| | Makham Pom | <i>Phyllanthus emblica</i> L. | PHYLLANTHACEAE | ☐ | - | All year |
| Mueat Lot | <i>Aporosa villosa</i> (Lindl.) Baill. | PHYLLANTHACEAE | ☐ | - | All year | |

| | | | | | | |
|----------------------------|---------------------------------|---|------------------|---|---|----------|
| | Mao Khai Pla | <i>Antidesma ghaesembilla</i> Gaertn. | PHYLLANTHACEAE | ☐ | - | All year |
| | Khan Thong Phayabat | <i>Suregada multiflorum</i> (A. Juss.) Baill. | EUPHORBIACEAE | ☐ | - | All year |
| Contd. | | | | | | |
| | Krai Thong | <i>Erythroxylum cuneatum</i> Kurz | ERYTHROXYLACEAE | ☐ | - | All year |
| | Takhop Pa | <i>Flacourtia indica</i> (Burm. F.) Merr. | SALICACEAE | ☐ | - | All year |
| | Tio Kliang | <i>Cratoxylum cochinchinensis</i> (Lour.) Blume | HYPERICACEAE | ☐ | - | All year |
| | Kret Plachon | <i>Phyllodium pulchellum</i> (L.) Desv. | FABACEAE | ☐ | - | All year |
| | Huad Seo kiew | <i>Orthosiphon rubicundus</i> (D.Don) Benth. | LAMIACEAE | ☐ | - | All year |
| | Kradon | <i>Careya sphareica</i> Roxb. | LECYTHIDACEAE | ☐ | - | All year |
| | Hatsakun | <i>Micromelum minutum</i> Wight & Arn | RUTACEAE | ☐ | - | All year |
| | Plalai Phueak | <i>Eurycoma longifolia</i> Jack. | SIMAROUBACEAE | ☐ | - | All year |
| | Popae | <i>Grewia hirsuta</i> Vahl | MALVACEAE | ☐ | - | All year |
| | Teng | <i>Shorea obtusa</i> Wall. Ex Blume | DIPTEROCARPACEAE | ☐ | - | All year |
| | Krat | <i>Dipterocarpus intricatus</i> Dyer. | DIPTEROCARPACEAE | ☐ | - | All year |
| Fuel-wood | Phluang | <i>Dipterocarpus tuberculatus</i> Taub. | DIPTEROCARPACEAE | ☐ | - | All year |
| | Daeng | <i>Xylia xylocarpa</i> (Roxb.) | FABACEAE | ☐ | - | All year |
| | Makha Tae | <i>Sindora siamensis</i> Teijsm. Ex.Miq. | FABACEAE | ☐ | - | All year |
| Insects and their products | I Noon | <i>Holotrichia</i> sp. | | ☐ | - | All year |
| | Khai Mot Daeng (Egg of Red Ant) | <i>Oecophylla smaragdina</i> | | ☐ | ☐ | Mar-May |
| | Phueng (Bees) | <i>Apis dorsata fabricius</i> | | ☐ | - | All year |

Wild fruit: Eighteen species in 13 families were collected (Table 1). The villagers tended to collect them indirectly as they collected other NTFPs or ran activities in agricultural land, favouring species such as Takhop Pa (*Flacourtia indica*), Makham Pom (*Phyllanthus emblica*) and Samo Thai (*Terminalia chebula*). Villagers collected many wild fruits all year long, especially in the dry season.

Medicinal plants: The villagers have established health centres, but traditional healing practices are still used, and medicinal plants are collected by the community. Most respondents collected medicinal plants for household use, usually for relieving general ailments such as colds, fevers, or stomach ache. Most plants were collected in the forests surrounding the villages. Common medicinal plants were Nom Maeo (*Uvaria rufa*), Hatsakun (*Micromelum minutum*), Kham Rok (*Ellipanthus tomentosus*), and Makham Pom (*Phyllanthus emblica*). A complete list of medicinal plant species is given in Table 1.

Fuel wood: Fuel wood was in demand in the study area as a source of energy. The main sources of fuel wood were villagers' cultivated land and the surrounding forest. Five species of fuel wood were collected, including Daeng (*Xylia xylocarpa*), Teng (*Shorea obtusa*), Makha Tae

(*Sindora siamensis*), Krat (*Dipterocarpus intricatus*), and Phluang (*Dipterocarpus tuberculatus*).

Wildlife: The respondents hunted wildlife for household consumption. The main species hunted were ground lizard, other lizards, and birds. Additionally, some respondents indicated that members of their household regularly caught aquatic animals such as fish, bullfrogs, and other frogs for household consumption.

Insects and their products: Respondents collected various insects and insect products, especially the eggs of the red ant (Khai Mot Daeng), which are used for several popular local dishes. Insect products were collected from January to March when ant nests are common on the leaves of *Shorea obtusa*, *Shorea siamensis* and other tree species in the dry dipterocarp forest. Other insects included bees and I Noon (*Holotrichia* sp.).

Collection of NTFPs for commercial use

Agriculture and wage labour are important sources of income, but NTFPs remain important to local livelihoods, especially for women. About 21.4% of NTFPs are consumed in the collectors' households, and the remaining 78.6% sold at market. Various mushrooms, wild vegetables, and insect species and their products were important NTFPs for commercial use (Tables 1 and 2).

Table 2. Average quantity per year and price of NTFPs collected from Khao Angkhan National Forest Reserve and Khokyai community forest, Nong Sai Sub-district, Nang Rong District, Buriram Province.

| Thai name | Average Quantity of NTFPs | | Average Price* (Baht/kg) | Percent of NTFPs collecting for Commercial/Household |
|----------------|-------------------------------|------------------------------|-----------------------------|--|
| | Subsistence (kg/Household) | Commercial (kg/Household) | | |
| Hed Ta Khai | 2.6 | 7.9 | 180 | 75.0 |
| Hed Ra Ngok | 0.9 | 3.6 | 160 | 80.6 |
| Hed Kone | 2.3 | 6.2 | 120 | 72.7 |
| Hed Nang Hong | 0.4 | 1.3 | 160 | 76.0 |
| Hed Nam Mak | 2.2 | 6.2 | 110 | 74.0 |
| Hed Pho | 2.9 | 3.7 | 250 | 56.7 |
| Hed Chamuk wau | 2.6 | 9.5 | 120 | 78.4 |
| Dog Din | 2.2 | 15.6 | 35 | 88.0 |
| Krachiao | 1.0 | 6.0 | 35 | 85.9 |
| Buk I Lok | 1.7 | 10.9 | 30 | 86.7 |
| I Noon | 3.0 | 15.2 | 30 | 83.5 |
| Chot | 2.8 | 3.9 | 100 | 58.4 |

| | | | | |
|----------------|------|------|-----|------|
| Khai Mot Daeng | 1.0 | 3.6 | 335 | 79.1 |
| Total | 25.4 | 93.6 | - | 78.6 |

* Price during the study period (June, 2009); currency exchange rate: 34.15 THB = 1US\$

Mushrooms: Seven species were collected, including Hed Ta Khai (*Russula delica*), Hed Ra Ngok (*Amanita princeps*), and Hed Kone (*Termitomyces spp.*). Most collectors sold their mushrooms to village middle-men at prices of 80-200 Baht per kilogram, depending on the species. Usually, mushrooms are collected between 4 and 8 AM, before their heads fully open.

Wild vegetables: Five species were collected, including Dog Din (*Curcuma parviflora*), Krachiao (*Curcuma singularis*), Buk I Lok (*Pseudodracontium lacourii*), I Noon (*Adenia viridiflora*), and Chot (*Vietnamosasa cililta*). Most collectors sold wild vegetables to a village middle-man, who took their products to the district market. The price was 30-35 Baht per kilogram, depending on the species. Usually, wild vegetables are collected between 6 and 8 AM, before the day's heat.

Insects and their products: Only eggs of the red ant were collected for commercial use. The price is about 335 Baht per kilogram. The tools to collect the eggs come from household materials such as bamboo handles, buckets, baskets, and tapioca flour.

The contribution of NTFPs to local livelihood: Our results indicate that the forest makes a positive contribution to local people living in and around the forest, for both subsistence and cash income. Most NTFPs in Khao Angkhan and Khokyai forests were collected for household consumption, and the rest (seven mushroom and five wild plant species, and the eggs of the red ant) were sold. The villagers' main income was derived from agriculture, supplemented by NTFP collection. The dry dipterocarp forest is an important source of expensive and popular NTFPs, including red ant eggs, Hed Pho, Hed Ta Khai, Hed Kone, and Phak Wan.

Phak Wan was not found on the list of commercial species, although it commanded high prices and had high demand. The fact that Phak Wan was only used in household consumption implies that it occurred in quantities insufficient for sale. In turn, this speaks to the forest's health: Phak Wan is normally common in dry deciduous forests, particularly those dominated by *Shorea siamensis* and *Shorea obtusa* (Kerr *et al.*, 1931). We did not focus on forest health, but interviews revealed that the species was formerly very popular, fetching high prices. The villagers scrambled to transplant the Phak Wan trees from the forest to their own properties, but in the process, they cut the roots, killing the trees - a 'tragedy of the commons' scenario (Hardin, 1968). That is, as the population and pressure on resources grew, users of resources held in common tend to overexploit and degrade those resources. Although regulations control forest use and management in the region, strict regulation is not possible as user groups in and outside the villages can easily and covertly access and exploit the forest. Participation in forest conservation was closely related to income generated from NTFP collection (Mianmit, 2003), but evidence suggests that NTFP collection has both positive and negative incentives, as unrestrained and unmanaged collection can have negative impacts on the structure and dynamics of

NTFP species populations (Murali *et al.*, 1996; Muraleedharan *et al.*, 2005). Therefore, for the sustainability of NTFP use and forest functions, user groups and community forest committees must work together for forest management.

Most of the respondents interviewed were farmers, with average land holdings of about 1.3 ha. The main income of the villagers was derived from agricultural products such as Thai jasmine rice and cassava. The average household income from agriculture was about 50,941 Baht (USD 1,491.7) per year. Other important sources of income came from wage labour and trading NTFPs, which amounted to an average of about 35,108 Baht (USD 1,028.1) per year per household. Agriculture and wage labour are important sources of income, but NTFPs are still important to local livelihood. From the viewpoint of income generation, NTFPs play complementary roles. Regarding the 51 km² of dry dipterocarp forest adjacent to the study villages, respondents perceived its value as a source of goods and services that greatly benefit their livelihood. Of the NTFPs collected from the forest for subsistence and trade, about 21.4% were consumed in the collectors' households, and 78.6% sold at market. Many wild products such as mushrooms (16 species), vegetables (15), fruits (18), medicinal plants (20), fuel wood (five), insects and their products (three), and animals (seven) were collected and hunted from the forest. Among these, seven species of mushroom, five of vegetables, one insect and its products were collected for trade. One exception was Phak Wan. Phak Wan is one of the most important species of NTFPs in dry dipterocarp forest because of its high price and demand in the domestic market, but it is used only locally and not sold at market. Phak Wan likely has high potential to provide income for local communities. Besides domestication, conservation of Phak Wan and its habitats in natural forests is also important for local livelihoods and can be an incentive for villagers to participate in forest conservation in Khao Angkhan and Khokyai forests.

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