

Economic Value and Utilization of Biodiversity in Local Communities at Nam Nao National Park, Phetchabun Province

Suppanit Jarernsuk¹, Kecha Dadookain², and Touchkanin Jongjitvimol^{1*}

¹ Faculty of Science and Technology, Pibulsongkram Rajabhat University, Phitsanulok 65000, Thailand.

² Faculty of Management Sciences, Pibulsongkram Rajabhat University, Phitsanulok 65000, Thailand.

*Corresponding author, E-mail: touchkanin@psru.ac.th

ABSTRACT

Nam Nao National Park, Phetchabun Province is home to thousands of wildlife, flora and fauna, and indigenous people for a long period of time. It is also known as one of the most visited national parks during the tourist season from October to February every year. However, not until recently has the knowledge about the Park's non-timber forest products (NTFPs) been examined and revealed. This paper, therefore, aims at studying the biodiversity and assessing the economic value of the forest products utilized in Nam Nao National Park between 2012 and 2014. Using interviews and questionnaires, the study showed that 8 categories of NTFPs were prominently used by a large number of residents. The mean gross annual value was THB 23,196.49 per household. Moreover, herbs and spices were recorded as the most popularly used either for commercial or medicinal purposes. The results also showed that the transfer of local wisdom and the sharing of knowledge for herbal treatment play an important role in conserving the NTFPs in this area.

Key words: economic value, utilization, biodiversity resources

INTRODUCTION

It can be seen that forest is a significant source of biodiversity. People who live in and around the forest use both timber and non-timber forest products (NTFPs) for their subsistence. They benefit significantly from the consumption of edible fruits, mushrooms, and bamboo shoots (Choopan, 2007). People use forest products as building materials, medicines, and clothing. They also use these products in their religious ceremonies and traditional rituals (Bookaew *et al.*, 2009). Nowadays, as population growth and technological advancement have been increasing, it is more convenient for local people to exploit their natural resources for personal purposes (Petchsri and Jongjitvimol, 2013), which leads to deforestation as well as forest encroachment for farming and agricultural land.

Nam Nao National Park, Phetchabun Province is located in the lower northern part of Thailand. It is known for its richness in biodiversity and natural beauty. It attracts thousands of tourists both Thais and foreigners each year, generating a favorable income to its residents (DNP, 2010).

From our preliminary investigation, people who settled around the area obtained many benefits from the forest commercially and personally. Several forest products were crafted and vended in local markets and souvenir shops whereas several others were extracted to use as illness treatments. It is, therefore, the purposes of this paper to firstly study the biodiversity in this area and, secondly, to assess the economic value of its forest products. The results of this study may raise people's awareness of biodiversity and its conservation.

MATERIALS AND METHODS

This qualitative research was conducted with its objectives to collect primary data on NTFPs using interviews and questionnaires, and to assess the economic value of NTFPs. Heads of villages and representatives who had experiences in utilizing and consuming these products were asked to participate in this process between 2012 and 2014.

Population and sample size

The respondents of this interview-questionnaire survey were people from 4 sub-districts in Nam Nao District, Phetchabun Province; namely Nam Nao, Kok Mon, Lak Dan and Wang Kwang (Figure 1). The sample size was 375 out of 5,780 households by using the Taro Yamane formula at 95% confident level (Yamane, 1973). The population size, and sample size of each sub-district were shown in Table 1.

Research Instrument

Formal interview-questionnaire survey was used as a main instrument to collect data. This tool was improved and approved by Professor Dr. Visut Baimai of Mahidol University, Thailand. Most samples were identified as experienced park staffs and taxonomy of literature reviews in the field (Monkolprasit *et al.*, 1997; Nabhitabhata *et al.*, 2000; Pauwels *et al.*, 2003; Nabhitabhata and Chan-ard, 2005; Jongjitvimol, 2008; Duengkae, 2011) and were confirmed by comparing them with specimens at Chiang Mai University Herbarium, Forest Herbarium, and Chulalongkorn University Herbarium.

Research Process

The process of the proposed research consists of 3 stages. Each stage is described as follows:

1) The preliminary stage

In this stage civil servants of 4 sub-district offices as well as Nam Nao District office, and staffs of Nam Nao National Park were contacted and coordinated to decide and define the areas studied. After that, the finalized studied areas were surveyed. Villagers were then informed and described about the research, and were asked to collaborate voluntarily. Finally, the interview-questionnaire survey was designed and reviewed by renowned experts in the field.

2) Data collection stage

The collection of data in this research was divided into 2 main parts as follows:

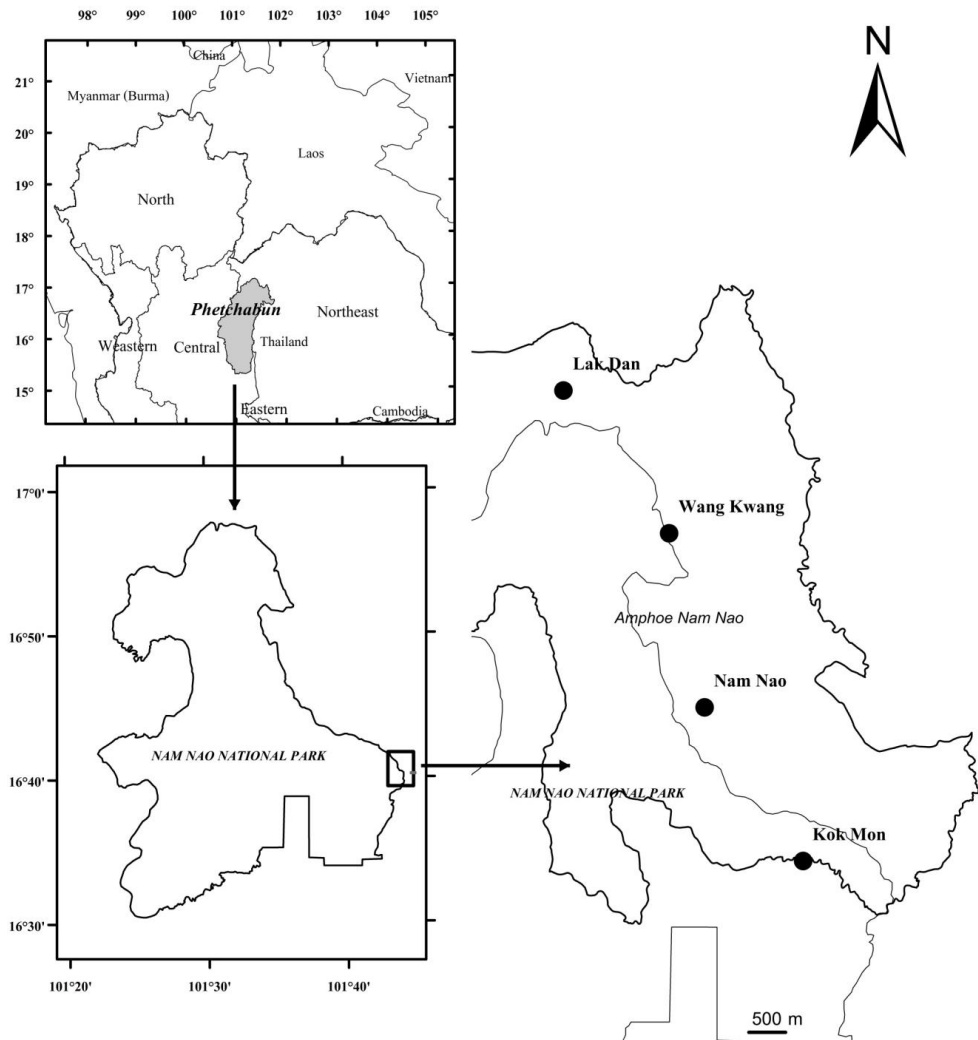


Figure 1 Represents a map of Nam Nao communities located in Nam Nao National Park, lower northern Thailand.

Table 1 Population and sample size.

Sub-districts	Population size (Household)	Sample size (Household)
1. Nam Nao	1,880	122
2. Kok Mon	1,079	70
3. Lak Dan	1,077	70
4. Wang Kwang	1,744	113
Total	5,780	375

(Community Development Plan, 2012)

2.1) Primary data collection

At the initial part the collection consisted of observation, interview, and questionnaire. The contents of the questionnaire aimed at collecting demographic profile of the respondents, and targeting the utilization of the forest products in the studied areas. On-site data collection was conducted through heads of villages and representatives to gather samples of utilized plants.

2.2) Secondary data collection

In this part the interview-questionnaire surveys were carried out. The market price method was used to analyze the economic benefits from the NTFPs. The annual calendar of forest products was then created to evaluate their values, using 2 formulas as follows:

2.2.1) The calculation of volume of the log:

$$V = [(B + b) / 2] L \quad (1)$$

where:

V is the volume of the log in m^3 .

B is the area of the small end of the log in m^2 .

b is the area of the large end of the log in m^2 .

L is the length of the log in m.

From Smalien's formula (Husch *et al.*, 1972), the volume of a log can be closely estimated by multiplying the average of the areas of the 2 log ends by the log's length.

2.2.2) The economic valuation:

$$EV = AV_{\text{forest}} \times AVP \quad (2)$$

where:

EV is the economic valuation.

AV_{forest} is the average quantity used per household.

AVP is the average price in local markets between 2012 and

2014.

3) Assessment of data

The assessment of data was categorized according to biodiversity, the utilization, and seasonal calendar of forest products.

RESULTS

The results of this interview-questionnaire survey, which aimed at (1) studying the biodiversity in Nam Nao National Park; and (2) assessing the economic values of the forest products utilized in the park. The survey which was collected from a sample of 375 out of 5,780 households, showed that the majority of the sample populations were male (51.73%), aged between 40 and 49 years old (23.47%). Of all the respondents, 47.73% obtained primary education diplomas. In addition to this, 47.20% were engaged in agricultural and farming careers where

46.13% of the participants were either company employees or self-employed. Most of the sample populations were married (57.80%). Of all the family sizes, a nuclear family seemed to be dominant (60.00%) with a monthly income between THB 6,000 and 8,000 (28.00%).

From table 2, it is apparent that the biodiversity resources of utilized forests can be classified into 8 categories, 113 items. They are woods (2 items, 1.77%), herbs and spices (28 items, 24.78%), wild crops (24 items, 21.24%), wild fruits (14 items, 13.28%), mushrooms (15 items, 13.27%), wild animals (15 items, 12.39%), insect and their products (11 items, 9.73%), and ornamental plants (4 items, 3.54%). Not only are the majority of these NTFPs used in households, 32 items were also sold in local markets. About 81 items or 74.43% were forest products. It is also obvious that the economic average net value of 113 items equals to THB 23,196.49 or THB 8,698,683.70 per sub-district (375 households).

Table 2 Category items, seasonal calendar and economic value of biodiversity in the studied areas.

Categories and Scientific Names (Items)	Seasonal Calendar	Total Used/Year	Used/Year/ Household	Count Units	Average Price (THB/Count Unit)	Economic Value (THB/Year)
1. Woods						
1.1 <i>Bambusa</i> sp.	All years	12,970.52	34.59	m ³	250.00	8,647.50
1.2 Unknown (Firewood)	All years	957.40	2.55	m ³	480.00	1,224.00
Total		13,927.92	37.14	m³	730.00	9,871.50
2. Herbs and spices						
2.1 <i>Acacia catechu</i> (L.f.) Willd.*	All years	255.00	0.68	kg	35.00	23.80
2.2 <i>Acacia concinna</i> (Willd.) DC.	All years	105.00	0.28	kg	20.00	5.60
2.3 <i>Amomum verum</i> Blackw.	All years	144.00	0.38	kg	150.00	57.00
2.4 <i>Andrographis paniculata</i> (Burm.f.) Nees.	All years	68.00	0.18	kg	50.00	9.00
2.5 <i>Artocarpus lacucha</i> Buch.-Ham.	All years	72.00	0.19	kg	50.00	9.50
2.6 <i>Asparagus racemosus</i> Willd.	All years	58.00	0.15	kg	60.00	9.00
2.7 <i>Betula alnoides</i> Buch.-Ham. ex G.Don	All years	273.00	0.73	kg	50.00	36.50
2.8 <i>Boesenbergia</i> sp.	All years	527.00	1.41	kg	40.00	56.40
2.9 <i>Caesalpinia sappan</i> L.	All years	184.00	0.49	kg	50.00	24.50
2.10 <i>Curcuma longa</i> L.	All years	517.00	1.38	kg	30.00	41.40
2.11 <i>Curcuma zanthorrhiza</i> Roxb.	All years	307.00	0.82	kg	40.00	32.80
2.12 <i>Cymbopogon citrates</i> (DC.) Stapf	All years	729.00	1.94	kg	40.00	77.60
2.13 <i>Derris elliptica</i> (Wall.) Benth.	All years	274.00	0.73	kg	30.00	21.90
2.14 <i>Ficus sarmentosa</i> Buch.-Ham. ex Sm.	All years	294.70	0.79	kg	130.00	102.70
2.15 <i>Houttuynia cordata</i> Thunb.	All years	94.50	0.25	kg	50.00	12.50
2.16 <i>Knema globularia</i> (Lam.) Warb.	All years	92.00	0.25	kg	50.00	12.50
2.17 <i>Phoenix acaulis</i> Roxb.	All years	85.00	0.23	kg	40.00	9.20
2.18 <i>Piper retrofractum</i> Vahl	All years	270.00	0.72	kg	60.00	43.20
2.19 <i>Piper wallichii</i> (Miq.) Hand.-Mazz.	All years	395.00	1.05	kg	50.00	52.50
2.20 <i>Pithecellobium tenue</i> Craib	All years	104.00	0.28	kg	50.00	14.00

Table 2 Category items, seasonal calendar and economic value of biodiversity in the studied areas (Cont.).

Categories and Scientific Names (Items)	Seasonal Calendar	Total Used/Year	Used/Year/ Household	Count Units	Average Price (THB/Count Unit)	Economic Value (THB/Year)
2.21 <i>Prunus cerasoides</i> Buch.-Ham. ex D.Don	All years	172.50	0.46	kg	60.00	27.60
2.22 <i>Salacia chinensis</i> L.	All years	201.00	0.54	kg	70.00	37.80
2.23 <i>Smilax corbularia</i> Kunth	All years	187.00	0.50	kg	100.00	50.00
2.24 <i>Smilax glabra</i> Roxb.	All years	174.00	0.46	kg	100.00	46.00
2.25 <i>Tetragium obovatum</i> Gagnep.	All years	253.00	0.67	kg	30.00	20.10
2.26 <i>Thunbergia laurifolia</i> Lindl.	All years	152.00	0.41	kg	40.00	16.40
2.27 <i>Tinospora crispa</i> (L.) Hook.f. & Thomson	All years	251.00	0.67	kg	60.00	40.20
2.28 <i>Zingiber officinale</i> Roscoe	All years	648.00	1.73	kg	50.00	86.50
Total		6,886.70	18.36	kg	1,585.00	976.20
3. Wild crops						
3.1 <i>Amaranthus blitum</i> subsp. <i>oleraceus</i> (L.) Costea*	All years	402.00	1.07	kg	50.00	53.50
3.2 <i>Amorphophallus brevispathus</i> Gagnep.	All years	85.80	0.23	kg	20.00	4.60
3.3 <i>Bambosa</i> sp.*	All years	2,841.00	7.58	kg	40.00	303.20
3.4 <i>Barleria strigosa</i> Willd.	All years	59.00	0.16	kg	20.00	3.20
3.5 <i>Calamus viminalis</i> Willd.*	All years	739.00	1.97	kg	30.00	59.10
3.6 <i>Cleome gynandra</i> L.	All years	669.00	1.78	kg	30.00	53.40
3.7 <i>Clinacanthus nutans</i> (Burm.f.) Lindau	All years	189.00	0.50	kg	30.00	15.00
3.8 <i>Cratogeomys formosum</i> (Jack) Benth. & Hook.f. ex Dyer	All years	248.00	0.66	kg	20.00	13.20
3.9 <i>Dioscorea bulbifera</i> L.*	All years	2,063.00	5.50	kg	30.00	165.00
3.10 <i>Diplazium esculentum</i> (Retz.) Sw.*	Feb.-Mar.	291.00	0.75	kg	32.50	24.38
3.11 <i>Entada glandulosa</i> Pierre ex Gagnep.	All years	104.00	0.28	kg	50.00	14.00
3.12 <i>Eryngium foetidum</i> L.	Nov.–Feb.	81.00	0.22	kg	50.00	11.00
3.13 <i>Lasia spinosa</i> (L.) Thwaites.*	May-Aug.	68.00	0.18	kg	25.00	4.50
3.14 <i>Limnorchis flava</i> (L.) Buchenau*	All years	83.00	0.22	kg	50.00	11.00
3.15 <i>Limnophila aromatica</i> (Lam.) Merr.	Jan.-May	52.00	0.14	kg	25.00	3.50
3.16 <i>Melientha suavis</i> Pierre*	All years	847.00	2.26	kg	200.00	452.00
3.17 <i>Momordica charantia</i> L.*	All years	184.00	0.49	kg	25.00	12.25
3.18 <i>Moringa oleifera</i> Lam.*	All years	224.00	0.60	kg	50.00	30.00
3.19 <i>Musa</i> sp. (blossom)	All years	389.00	1.04	kg	6.00	6.24
3.20 <i>Musa</i> sp. (psuedostem)	All years	1,067.00	2.85	kg	20.00	57.00
3.21 <i>Piper betle</i> L.*	All years	83.00	0.22	kg	35.00	7.70
3.22 <i>Plantago major</i> L.	All years	82.00	0.22	kg	40.00	8.80
3.23 <i>Sechium edule</i> (Jacq.) Sm.*	May-Aug.	381.00	1.02	kg	40.00	40.80
3.24 <i>Senna siamea</i> (Lam.) Irwin & Barneby*	All years	46.00	0.12	kg	30.00	3.60
Total		11,269.30	30.06	kg	948.50	1,356.97
4. Wild Fruits						
4.1 <i>Baccaurea ramiflora</i> Lour.	Jun.-Aug.	578.00	1.54	kg	20.00	30.80
4.2 <i>Calamus viminalis</i> Willd.*	All years	211.00	0.56	kg	50.00	28.00
4.3 <i>Castanopsis inermis</i> (Lindl.) Benth. & Hook.f.	All years	572.00	1.53	kg	30.00	45.90
4.4 <i>Flacourtia indica</i> (Burm.f.) Merr.	Nov.-Feb.	84.00	0.22	kg	20.00	4.40

Table 2 Category items, seasonal calendar and economic value of biodiversity in the studied areas (Cont.).

Categories and Scientific Names (Items)	Seasonal Calendar	Total Used/Year	Used/Year/ Household	Count Units	Average Price (THB/Count Unit)	Economic Value (THB/Year)
4.5 <i>Lepisanthes rubiginosa</i> (Roxb.) Leenh.	May-Jun.	95.00	0.25	kg	15.00	3.75
4.6 <i>Malpighia glabra</i> L.	Jan.-May	219.00	0.58	kg	20.00	11.60
4.7 <i>Mangifera caloneura</i> Kurz	Jun.-Aug.	492.00	1.31	kg	20.00	26.20
4.8 <i>Musa</i> sp.	Apr.-Jun.	528.00	1.41	kg	10.00	14.10
4.9 <i>Nephelium hypoleucum</i> Kurz	All years	283.00	0.75	kg	35.00	26.25
4.10 <i>Passiflora foetida</i> L.	Jun.-Aug.	284.00	0.76	kg	15.00	11.40
4.11 <i>Phyllanthus emblica</i> L.	Jun.-Aug.	163.00	0.43	kg	30.00	12.90
4.12 <i>Prunus cerasoides</i> Buch.-Ham. ex D.Don	Apr.-Jun.	120.50	0.32	kg	10.00	3.20
4.13 <i>Schleichera oleosa</i> (Lour.) Merr.	Feb.-Mar.	89.00	0.24	kg	25.00	6.00
4.14 <i>Spondias mombin</i> L.*	Apr.-Jun.	284.00	0.76	kg	30.00	22.80
Total		4,002.50	10.67	kg	330.00	247.30
5. Mushrooms						
5.1 <i>Amanita princeps</i> Corner & Bas.	May-Aug.	291.00	0.78	kg	100.00	78.00
5.2 <i>Amanita hemibapha</i> (Berk. & Br.) Sacc.	May-Aug.	103.00	0.27	kg	70.00	18.90
5.3 <i>Astraeus hygrometricus</i> (Pers.) Morgan*	May-Aug.	957.00	2.55	kg	200.00	510.00
5.4 <i>Auricularia auricula-judae</i> (Bull.) Wettst.*	May-Aug.	833.00	2.22	kg	50.00	111.00
5.5 <i>Heimiell retispora</i> (Pat & Bak.) Boedijn.*	May-Aug.	376.00	1.00	kg	100.00	100.00
5.6 <i>Lactarius piperratus</i> (L.) Pers.	May-Aug.	179.00	0.48	kg	40.00	19.20
5.7 <i>Lactarius turpis</i> (Weinm.) Fr.	May-Aug.	86.00	0.23	kg	100.00	23.00
5.8 <i>Lenzites polychrous</i> Lev.*	May-Aug.	211.00	0.56	kg	150.00	84.00
5.9 <i>Russula delicata</i> Fr.	May-Aug.	172.00	0.46	kg	50.00	23.00
5.10 <i>Russula densifolia</i> Secr. ex Gillet	May-Aug.	93.00	0.25	kg	50.00	12.50
5.11 <i>Russula eburneureolata</i> Hongo.	May-Aug.	195.00	0.52	kg	100.00	52.00
5.12 <i>Russula emetica</i> (Schaeff.) Pers.	May-Aug.	82.00	0.22	kg	50.00	11.00
5.13 <i>Russula lepida</i> Fr.	May-Aug.	180.50	0.48	kg	100.00	48.00
5.14 <i>Russula nigricans</i> (Bull.) Fr.*	May-Aug.	201.00	0.54	kg	100.00	54.00
5.15 <i>Termitomyces striatus</i> (Beeli) R. Heim*	May-Aug.	582.00	1.55	kg	200.00	310.00
Total		4,541.50	12.11	kg	1,460.00	1,454.60
6. Wild animals						
6.1 <i>Amyda cartilaginea</i> (Boddaert, 1770)	All years	593.40	1.58	kg	300.00	474.00
6.2 <i>Demanieta manii</i> (Rathbun, 1904) *	All years	1,081.00	2.88	kg	150.00	432.00
6.3 <i>Gallus gallus</i> (Linnaeus, 1758)	Jul. - Nov.	1,638.00	4.37	kg	130.00	568.10
6.4 <i>Glyphoglossus molossus</i> (Gunther, 1869)*	All years	482.20	1.29	kg	130.00	167.70
6.5 <i>Hoplobatrachus rugulosus</i> (Wiegmann, 1835)*	Jun.-Aug.	973.00	2.59	kg	150.00	388.50
6.6 <i>Naja kaouthai</i> Lesson, 1831	All years	137.00	0.37	kg	120.00	44.40
6.7 <i>Occidozyga lima</i> (Gravenhorst, 1829)*	All years	691.40	1.84	kg	180.00	331.20
6.8 <i>Paradoxurus</i> sp.	All years	405.00	1.08	kg	200.00	216.00
6.9 <i>Pila scutata</i> (Mousson, 1848)*	All years	903.00	2.41	kg	50.00	120.50
6.10 <i>Ptyas korros</i> (Schlegel, 1837)	All years	422.00	1.12	kg	120.00	134.40
6.11 <i>Rattus argentiventer</i> (Robinson & Kloss, 1916)*	All years	2,679.00	7.14	kg	200.00	1,428.00

Table 2 Category items, seasonal calendar and economic value of biodiversity in the studied areas (Cont.).

Categories and Scientific Names (Items)	Seasonal Calendar	Total Used/Year	Used/Year/ Household	Count Units	Average Price (THB/Count Unit)	Economic Value (THB/Year)
6.12 <i>Ratufa</i> sp.	Jun.-Aug.	640.00	1.71	kg	150.00	256.50
6.13 <i>Sus scrofa</i> (Linnaeus, 1758)*	All years	5,927.50	15.81	kg	190.00	3,003.90
6.14 <i>Trachypithecus</i> sp.	All years	266.30	0.71	kg	400.00	284.00
6.15 <i>Tupaia glis</i> (Diard, 1820)	Jun.-Aug.	790.00	2.11	kg	170.00	358.70
Total		17,628.80	47.01	kg	2,520.00	8,207.90
7. Insect and their products						
7.1 <i>Apis dorsata</i> Fabricius, 1793	All years	302.00	0.81	kg	200.00	162.00
7.2 <i>Apis florea</i> Fabricius, 1787	All years	47.00	0.13	kg	100.00	13.00
7.3 <i>Apis florea</i> Fabricius, 1787	Jun.-Dec.	198.00	0.53	kg	100.00	53.00
7.4 <i>Carebara castanea</i> Smith, 1858	All years	382.00	1.02	kg	150.00	153.00
7.5 <i>Gryllus bimaculatus</i> De Geer, 1773	Nov.-Mar.	183.00	0.49	kg	150.00	73.50
7.6 <i>Lethocerus indicus</i> (Lepeletier & Serville, 1825)	All years	217.40	0.58	kg	180.00	104.40
7.7 <i>Melolontha melolontha</i> (Linnaeus, 1758)	Apr.-Jun.	477.00	1.27	kg	100.00	127.00
7.8 <i>Oecophylla smaragdina</i> (Fabricius, 1775)*	Jan.-May	388.00	1.03	kg	150.00	154.50
7.9 <i>Omphisa fuscidentalis</i> (Hampson, 1896)*	Nov.-Mar.	415.00	1.11	kg	180.00	199.80
7.10 <i>Vespa affinis</i> (Linnaeus, 1764)	Nov.-Jan.	57.8.00	0.15	kg	80.00	12.00
7.11 <i>Xylotrupes Gideon</i> (Linnaeus, 1767)*	Nov.-Mar.	205.00	0.55	kg	50.00	27.50
Total		2,872.20	7.66	kg	1,440.00	1,079.70
8. Ornamental plants						
8.1 <i>Aeginetia indica</i> L.	All years	5.00	0.01	kg	12.00	0.12
8.2 <i>Clitoria ternatea</i> L.	All years	13.10	0.03	kg	10.00	0.30
8.3 <i>Hibiscus sabdariffa</i> L.	May-Nov.	6.50	0.02	kg	15.00	0.30
8.4 <i>Pandanus amaryllifolius</i> Roxb.	Oct.-Feb.	59.00	0.16	kg	10.00	1.60
Total		83.60	0.22	kg	47.00	2.32
Net value		THB 23,196.49 per household per year				
		THB 8,698,683.70 per community per year				

Note: * traded to the community market; 32 THB can be exchanged for approximately 1 US dollar.

The results also revealed that each sub-district could harvest forest products throughout the year resulting in the favorable distribution of economic benefits as shown in Figure 2. The majority of items were harvested during the monsoon season (between May and August), whereas the minority of items were harvested during trans-seasonal period (between September and October).

DISCUSSION AND CONCLUSION

Forest products are an important source of food and income for people around the world (Ticktin, 2004; Yadav and Dugaya, 2013). Those who live in Southeast Asia such as Cambodia, Vietnam, and Laos and whose habitats are at the edge of the forest gain benefits from the forest products (Diokno, 2008; IUCN,

2005). In addition to this area, those who are found in the upland community also take advantages from the forests (Foppes and Phommasane, 2005). In some counties products from the forest are also exported as goods in order to increase their total national incomes (Phounvisouk *et al.*, 2013).

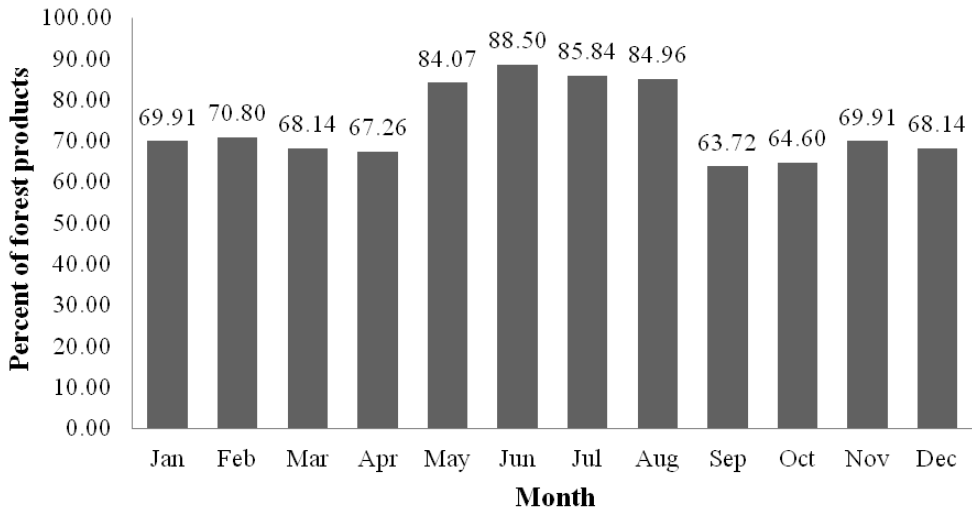


Figure 2 The quantity of forest products (percent) within a year.

Thailand is one of the several countries where remote communities still depend largely on direct benefits from the biodiversity and forest. The aims of this research were to study biodiversity in Nam Nao National Park, Phetchabun Province and to assess the economic value and the utilization of the biodiversity.

Four sub-districts around Nam Nao National Park, Phetchabun Province; namely, Nam Nao, Kok Mon, Lak Dan and Wang Kwang, were selected as the population of this study. The preliminary observation results were classified into 8 categories including woods, herbs and spices, wild crops, wild fruits, mushrooms, wild animals, insects and their products, and ornamental plants. These wild products were economically valuable with their values of around THB 23,196.49 baht per household per year or THB 8,698,683.70 per community.

Most of the NTFPs were used for household consumption (81 items or 71.68%), where 32 items or 28.32% were sold in local markets. It is quite obvious that people in the studied communities were not likely to focus on commercial aspect of the harvest. They rather used these products for subsistence purposes. This is consistent with some prior research (Petchsri and Jongjitvimol, 2013) conducted in a Rong Kla village, Phu Hin Rong Kla National Park, Phitsanulok Province. Their study showed that there were 111 biodiversity items, which were beneficially taken by people in this community. One hundred items (90.09%) were used for household consumption whereas only eleven items (9.91%) were traded in the local markets. In addition, Jarernsuk *et al.* (2015), whose research was in Khek Noi Community,

Phetchabun Province located closely to Thung Salaeng Luang National Park, reported that 107 forest products (90.68%) were harvested for existence purposes. Only 11 items or about 9.32% were traded commercially.

In light of each biodiversity item, the results revealed that herbs and spices were found to be used most frequently (28 items, 24.78%). This could be understandable that residents in this area especially denizens of the forest still have a strong belief in herbal treatment. This correlates with a vast majority of the respondents (88.00%) holding a degree lower than undergraduate level.

The results also showed that 28% of the respondents had an average income between THB 6,000 and THB 8,000 per year. This amount is comparatively low and may lead to the use of alternative medicines. In contrast, with comparison to the value of herbs and spices (THB 8,207.90), 2 items (1.77%) of woods priced at THB 976.20, while 15 items (12.39%) of wild animals valued THB 9,871.50 per household. The less use of herbs and spices may result in less value, but high volume compared with those of woods and wild animals. In accordance with a study by Petchsri and Jongjitvimol (2013), they found that people in Phu Hin Rong Kla community, in the vicinity of Phu Hin Rong Kla National Park, Phitsanulok Province used herbs and spices most prominently (30 items or 27.30%). However, the economic values of woods (7 items or 6.31%), wild animals (15 items or 13.52%) were THB 41,635.50, and THB 2,927.70, compared to THB 594.50 of herbs and spices per household.

Moreover, in consideration of the first top 3 biodiversity items, bamboo was found to possess the most economic value with an average of THB 8,647.50 annually. Of all NTFPs, bamboo is the most outstanding product. It is widely known that bamboo is advantageous to local people in many aspects. Upphapon *et al.* (2013) studied the utilization of biodiversity in Thai Yo, living in the northeastern part of Thailand. Their study revealed that villagers of Thai Yo used bamboo stems in their basketry, equipment, and furniture.

This is consistent with Soodsang (2015), whose research demonstrated that in 1 community of Wat Bot district, Phitsanulok Province, people initiated the bamboo basketry group to conserve the use of bamboo, which consequently led to an increase in family incomes. The second most utilized item was boars with the volume of 5,927.50 kilograms valuing approximately THB 3,003.90 per year. The third most popularly used item was rice field rats. Their estimated volume was 2,679.00 kilograms with the economic value of around THB 1,428.00 per year. Jarernsuk *et al.* (2015) confirmed in their study at a Kek Noi community with in Nam Nao National Park that boars were the second most popularly used item with their volume of 2,867.00 kg. Rice field rats were the third most frequently utilized item with the volume of 2,679.00 kg., valuing approximately THB 1,428.00 per year.

It is quite apparent that communities around Nam Nao National Park have benefited from biodiversity existing in the area. However, the economic values in this area seem to be less than that in other study (Petchsri and Jongjitvimol, 2013; Jarernsuk *et al.*, 2015). This resulted from less amount use of biodiversity, leading to less economic values yielded. The main purpose of the utilization of biodiversity in

this area seemed to be for household consumption. Nevertheless, wasteful consumption was apparent in some items; for instance, wild animals. Such consumption, if not controlled, might pose the detrimental effects to the nature, ecological system, as well as the existence of wildlife species. Slash-and-burn farming might also threaten natural habitats for wildlife, and might degrade natural resources, which could trigger the loss of biodiversity. This study, therefore, suggests that people with direct authority find ways to educate residents the detrimental effects of destroying biodiversity, and to raise people's awareness of conserving biodiversity.

ACKNOWLEDGEMENTS

This work was supported by a grant from Pibulsongkram Rajabhat University and the Higher Education Research Promotion - National Research Universities (HERP-NRU) budget under the biodiversity project (2556A14262002).

REFERENCES

- Bookaew, S., P. Thamsenanuphap and T. Thane. (2009). Plant diversity and utilization of forest products in Khok Yai community forest, Wapi Pathum District, Maha Sarakham Province. *Environment and Natural Resources Journal*, 7(1), 36-50. (in Thai).
- Choopan, T. (2007). Plant diversity and ethnobotany in Khok-rai forest, Chiang Yuen District, Maha Sarakham Province. *Journal of science and Technology Mahasarakham University*, 26(2), 150-157. (in Thai).
- Community Development Plan. (2012). *Three-year Development Plan of Nam Nao District Administrative Organization, Phetchabun*. Khek Noi Sub-District Administration Organization Office, Phetchabun, Thailand. (in Thai).
- Diokno, M. (2008). *The Importance of Community: Issues and Perceptions of Land Ownership and Future Options in 5 Communes in Monduliri Province, Cambodia*. Phnom Penh, Cambodia: NTFP-Exchange Programme and NGO Forum on Cambodia. 51 pp.
- DNP (Department of National Parks, Wildlife and Plant Conservation). (2010). *National Parks in Thailand*. 2nd ed. Department of National Parks, Wildlife and Plant Conservation. Bangkok. 280 pp.
- Duengkae, P. (2011). A check list of the wild mammals in Thailand. *Journal of Wildlife in Thailand*, 18(1), 82-151. (in Thai).
- Foppes, J. and S. Phommasane (2005). *Experiences with Market Development of Non-Timber Forest Products in Lao PDR*. Paper presented at the international workshop on market development for improving upland poor's livelihood security, 30 August to 2 September, Kunming, China. 11 pp.
- Husch, B., C.I. Miller and T.W. Beers (1972). *Forest Mensuration*. New York: Ronald Press. 410 pp.
- IUCN. (2005). *The Focusing on Wildlife Trade in Lao PDR and Vietnam*. Malaysia: Traffic Southeast Asia.
- Jarernsuk, S., S. Petchsri, P. Poolprasert, B. Wattanadumrong and T. Jongjitvimol. (2015). Economic value of non-timber forest products used by the largest Hmong community in Thailand. *NU. International Journal of Science*, 12(1), 38-51.

- Jongjitvimol, T. (2008). *Species Diversity and Taxonomy of Infraorder Aculeata (Hymenoptera: Apocrita) in the North of Thailand*. Ph.D thesis, Naresuan University. Phitsanulok. 280 p.
- Monkolprasit, S., S. Sontirat, S. Vimollohakarn and T. Songsirikul. (1997). *Checklist of fishes in Thailand*. Bangkok: Office of Environmental Policy and Planning. 353 pp.
- Nabhitabhata, J. and T. Chan-ard. (2005). *Status of Mammals, Reptiles and Amphibians in Thailand*. Office of Environmental Policy and Planning. Bangkok. 234 pp.
- Nabhitabhata, J., T. Chan-ard and Y. Chuaynkern. (2000). *Checklist of Amphibians and Reptiles in Thailand*. Bangkok: Office of Environmental Policy and Planning. 152 pp.
- Pauwels, O.S.G., P. David, C. Chimsunchart and K. Thirakhupt. (2003). Reptiles of Phetchaburi Province, Western Thailand: A list of species, with natural history notes, and a discussion on the biogeography at the Isthmus of Kra. *The Natural History Journal of Chulalongkorn University*, 3(1), 23-53.
- Petchsri, S., and T. Jongjitvimol. (2013). Economic value of biodiversity resources used by Hmong tribe in RongKla village, Phu Hin Rong Kla National Park, Phitsanulok. *Rajabhat Journal of Sciences, Humanities and Social Sciences*, 14(1), 13-24. (in Thai).
- Phounvisouk, L., T. Zuo and C.N. Kiat. (2013). Non-timber forest products marketing: Trading network of trader and market chain in Luang Namtha Province, Lao PDR. *IOSR Journal of Humanities and Social Science*, 18(4), 48-57.
- Soodsang, N. (2015). Bamboo basketry design development based on Thai wisdom preservation. *International Journal of Business and Social Science*, 6(7), 139-148.
- Ticktin, T. (2004). The ecological implications of harvesting non-timber forest products. *Journal of Applied Ecology*, 41(1), 11-21.
- Upphapong, B., S. Champadaeng and S. Sookna. (2013). The development of bamboo basketry according to the base of creative economy of the Thai Yo Ethnic group in Northeast Thailand. *Asian Social Science*, 9(10), 231-236.
- Yadav, M. and D. Dugaya. (2013). Non-timber forest products certification in India: Opportunities and challenges. *Environment, Development and Sustainability*, 15(3), 567-586.
- Yamane, T. (1973). *Statistics: An Introductory Analysis*. 3rd ed. New York: Harper and Row. 919 pp.