

Biodiversity

Wild Mushrooms – Edible and Medicinal Species

Local Knowledge and Use



Pilot Survey

Bong, Mixay, Yai, Lethong, Gnordphe and Poua-Xai villages
Phoukhout District, Xieng Khouang Province, Lao PDR

Agro-biodiversity Project
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ສາທາລະນະລາດ ປະຊາທິປະໄຕ ສັງຄົມນິຍົມ
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Food and Agriculture
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1. Introduction

Due to the rich ecological landscape and biodiversity of Lao PDR, a great number of wild mushrooms are potentially available for domestic consumption and sales. Locally, some are known for their unique nutritious and medicinal properties, whereas a huge majority is of unknown value and use. A small number causes sickness or death, if mistakenly eaten.

The Phoukhout District covers an area of 3,069 square km with a density of 8 people per sq km. Arable land constitutes only some 15 percent, mainly allocated for upland (1,000-1,100m) paddy rice cultivation and extensive livestock grazing. The soils are generally infertile (acid with high content of iron) with stretches of flat and hilly savannah like landscape dominated by pine trees. On higher altitude broadleaved trees of particular the Fagaceae family are taking over in the disturbed forests. On the highest points of e.g. Phoukout Mountain (1,600 m) pine trees are reappearing together with Mai Hing hom (*Dacrydium elatum*) and other trees.



Typical savannah like Landscape in Phoukhout

In this report mushrooms¹ are referred to the group of fungi^{2,3} which produces fruiting bodies that can be seen by the naked eye and are also called macro-fungi. A mushroom consists of fine threads (hyphae) densely packed together in different structures such as the cap, the stem or stipe and the “root like” mycelium. The spores are released from gills, pores, pines, sacks, smooth surfaces, etc. Some mushrooms are disk shaped, some are trumpet shaped, some are ear shaped, some are coral shaped, some are rounded, etc. The shape, size, color, smell, and taste together with other macroscopic and microscopic characteristics define one species from another.



Het Yang - *Lactarius cf. volemus*

Apart from the unwritten local knowledge, very little information on mushrooms has so far been documented in Laos⁴. In comparison, China has recorded a total some 6,000 macro-fungal species (Liu, 2007), of which nearly 1,000 species are listed as edible mushrooms, some 470 species have medicinal use (Dai and Yang, 2008) and some 200 species are recorded as poisonous of which many are deadly (Yang et al. 2005).

Mycorrhiza mushrooms

Most of the collected mushrooms depend on a tree to produce their fruiting bodies by forming a non-visible symbiotic association (mycorrhiza) with the roots of the host tree. In the latter case, the two organisms mutually benefit from exchange of nutrients.

This fungal-host relationship is particular important in Phoukhout District due to the



Mycorrhiza – beneficial symbiosis between tree and mushroom

¹ Mushrooms cover larger agarics, brackets, puffballs, toadstools, corals, etc.

² Fungi include mushrooms, yeasts and moulds. Their cells walls contain chitin, unlike plants which contain cellulose.

³ Since 1969 fungi belong to its own (fifth) kingdom along with the plant, animal, “bacteria” and protista kingdoms.

⁴ Hyde et al, 2011 has provided a “tentative” checklist of which many of the macro-fungi species lack reference material, thus difficult to verify.

poor soils and high percentage of mycorrhiza depending trees such as the conifers (*Pinophyta*), the diptherocarps (*Diptherocarpaceae*) and the species belonging to the beech family (*Fagaceae*). Most trees will not survive without their mycorrhizal mushroom partners. Examples of mycorrhizal mushrooms are the boletes (*Boletus*, etc.), the milk-caps (*Lactarius*), the amanitas (*Amanita*) and the brittlegills (*Russula*).

Termite mushrooms



Comb made by termites

Yet, another group of edible mushrooms, the termite mushrooms (*Terminomyces*), can only live together with certain species of termites and will grow from their mounds. The termite mushrooms break down cellulose of the incomplete digested comb-like plant material, collected by the termites. In Thailand more than 10 different termite mushrooms have been recorded and the same amount of species is likely to appear in Laos. The termite mushrooms include the



Het tap – *Terminomyces* sp.

world's largest mushroom (*Terminomyces titanicus*) reaching up to one meter in diameter.

Parasitic and saprophytic mushrooms

Some edible and medicinal mushrooms are fruiting on living trees and insects - as parasites - causing the death of the host. However, this will normally only occur when the host is stressed and weakened by other causes. Examples include the chicken of the wood mushroom (*Laetiporus sulphureus*) and the *Cordyceps*, living on insects. The latter belongs to a very important group of medicinal mushrooms.



Het hing lueang - *Laetiporus sulphureus*

Some edible mushrooms are living on dead trees (saprophytes). Examples include the Split Gill (Het bee - *Schizophylla commune*) and species belonging to genus *Lentinus* (e.g. Het dong - *L. squarrosulus*), the genus *Ganoderma* (e.g. Het Lin jeu/Ling-zhi - *G. shishuanense*), the genus *Auricularia* (e.g. Het hou ling - *A. polystricha*) and Het Pek (*Neolentinus ponderosus*). These mushrooms peak over a longer period and can be seen year round. Other saprophytic edible mushrooms include a group obtaining their nutrients from decayed plant material and litter, such as the species belonging to genus *Agaricus* and straw mushroom (Het fueang/fang - *Volvariella volvacea*).



Het pek - *Neolentinus ponderosus*

Medicinal mushrooms

Apart from being important nutritional supplement, a great number of mushrooms also believed to have important medicinal properties e.g. for curing cancer and having calming effects. An example of a non-edible medicinal mushroom is the Het Lin jeu/Ling zheu (*Ganoderma* sp.⁵). Most any edible mushrooms also have medicinal properties such as the shiitake (Het hom – *Lentinus erodes*), cloud ear (Het Hou ling - *Auricularia* cf. *polytrichia*), and the “Cep” (Het Pheung – *Boletus* cf. *edulis*), and the Wood Blewit (*Lepista nuda*).



Het bee – *Schizophyllum commune*

⁵ According to Wang et al, 2009, and Wang et al, 2012 and Yamanaka et al 2014, the earlier species name of *G. lucidum* is only referred to a European species and Lin-chi/Ling-zheu is rather *G. sichuanense*, *G. multipilium* and *G. tropicum*.

Survey background and objective

Mushrooms are essential parts for the agro-ecological systems with diverse functions including decomposition of living and dead materials, nutrient cycling, symbiotic relationships with other organisms, stimulation of growth in a wide range of organisms, and for food and medicine. However, due to climate change and deforestation the fungal diversity is expected to change and some species are increasingly under threat whereas others may become more frequent including some for the villagers unknown poisonous species.



Het Na fuea - *Russula virescens*

The GEF/UNDP/FAO Agro-biodiversity Project (ABP) works with farmers and local government organizations, active in agro-biodiversity conservation and sustainable management. The overall goal of ABP encompasses provision of knowledge, information and awareness of conservation and sustainable use of local species and eco-systems contributing to the global/regional/national biodiversity, food security and quality of life. This intervention relates to ABP output 2.3: In situ conservation and output and output 1.4 Awareness and information.



Het Langok leuang/Mone Khai –
Amanita hemibupha ssp. javanica

The survey serves as important foundation for follow-up interventions by the ABP Project and collaborating partners with the aim to provide additional awareness, knowledge and sustainable harvest of wild mushrooms in different forest types and eco-systems.

2. Methodology

The field surveys were carried out from 13 August to 16 September 2013, which marks the second part of the rainy season that spans from beginning of May to mid of September. The six villagers (Bong, Mixai, Yai, Letong, Ngordphe and Boua-Xai) of Phoukhout District were selected for the survey due to their proximity to forest areas. Initial harvest information was gathered from village leaders followed by 1-2 rounds of pilot forays in the forest in order to obtain local names, photos and ecological data. The listing of scientific names were done by using literature from Japan, Thailand and China and to the extent possible verified through trusted internet sites and scientific publications available on internet.



Het Tip dam -
Craterellus cornucoprinoides

3. Results

The village size varied from 80-170 households (total 674) of which in average nearly 2/3 of the households collected wild mushroom varying to nearly all households in Gnordphe village (98%) to only 10% in Boua-Xai village (see table 1).

The number of recorded edible (50) and medical mushrooms (1) collected from the six villages was in range of 26-46 species, totaling 51 local names. A total of 21 Lao names were repeated in all villages and 12 names were unique for only one of the five villages. One species Het Kan chong/Lin jeu/Ling-zheu (*Ganoderm sp.*) was collected for

medicinal use, see table 1 and 2. So far, it has only been possible to identify a likely scientific species name on 22 locally named species, in addition to 14 local names assigned to genus level, see Annex 1.

In addition to the 51 local names of edible and medicinal mushroom species, seven local names of mushrooms (Het Euart, Het Khuem, Het Danghae, Het Namou, Het Dao, Het Khan Khaet, and Het Khan kha) were known as poisonous species of which one (Het Euart) was regarded as deadly, see table 3. However, no further information and photos were provided for these mushrooms and no fatalities from eating poisonous mushrooms were informed by the village leaders. Only few of the local names could be verified with a scientific name.

Table 1. Village and household income from collected mushrooms, year 2012

Village	Households	Portion of HH collecting	Village yearly income (mill. kip)	Average income per active HH	Main species for market
Bong	90	90%	130.5	1,611,000	Wai and Kor mong
Mixay	91	65%	28.5	482,000	Wai and Kor mong
Yai	86	45%	38.0	982,000	Wai and Kor mong
Lethong	80	95%	64.0	842,000	Wai and Kor mong
Gnordphe	156	98%	370.0	2,420,000	Wai and Kor mong
Boua-Xai	171	10%	50.9	2,978,000	Kor mong and Tap pouak
Total income	674	63%	681.9	1,605,000	

HH: Household

Table 2. Number of edible species recorded by six villages, year 2013

Village	Total	Sales	Insufficient info/photo
Bong	46	7	15
Mixay	37	4	23
Yai	26	10	15
Lethong	31	4	19
Gnordphe	29	4	19
Boua-Xai	31	8	12
Total species (Lao names)	51	14	25

The income from sales amounted to a total annual sum of 653.9 million kip (US\$85,000) or on average 1.6 million kip (US\$200) per active household. Two species were particular valuable and in high demand i.e. Het Wai (*Tricholoma matsuke sl.*) and Het Kor mong (*red Russula*) with a farm gate price of up to 70,000 kip/kg and these two species constituted to more than 80% of the total sales value. Minor income at price of 10,000-20,000 kip was generated from sales of e.g. Het Than/Pheung (*Boletus edulis*), Het Than (Crowded Brittlegill - *Russula cf. densifolia*), Het Na feua (Green-racked Brittlegill - *R. cf. virescens*), Het Yang (Fishy milkcap - *Lactarius cf.*



Het Kor daeng - *Russula sp.*



Het Pheung/Het Kahn lai
Boletus edulis

volemus), Het Tip dam (Horn of Plenty - *Craterellus cornucoprioides*), Het tip leuang (*C. odoratus*), Het Tip kan tan (*Cantherellus sp.*), Het dang (*Lentinus sp.*), and Het Bee (*Schizophyllum commune*). Sales are done at road side or through middlemen.

Table 3. Local names of poisonous mushroom species informed by six villages

Village	Poisonous	Deadly
Bong	Het Euart, Het Khuem, Het Danghae, Het Namou, and Het Khan khat	Het Euart
Mixay	Het Euart, Het Khuem, and Het Khan khat	Het Euart
Yai	Het Euart, and Het Khuem	Het Euart
Lethong	Het Euart, and Het Khuem	Het Euart
Gnordphe	Het Euart, Het Khuem, Het Khan ka, and Het Dao	Het Euart
Boua-Xai	Het Euart, and Het Khuem	Het Euart
Total	7	1

Twelve mushrooms were recorded to be harvested on dead wood including Het Dang Khao (*Lentinus squarrosulus*), Het Hou ling (*Auricularia polychrous*) and Het Bee (*Schizophyllum commune*). Five termite mushroom species were recorded, i.e. Het Tap kai noi (*Termitomyces microcarpus*), Het Tap mou (*T. clypeatus*), Het Tap khang, (*T. eurhizus*), Het Tap fan (*T. robustus*) and Het Pheuk (*T. sp.*). One species (Het Gnanh) was recorded to be growing on living bamboo.



Het Tip lueang - *Craterellus odoratus*

Table 4. Ecology of recorded edible mushrooms, by Lao names

Village	Total	Under trees		On Wood		On termite mounds
		Non mycorrhiza*	Mycorrhiza*	Living (Parasitic)	Dead (Saprophytic)	
Bong	48	7	24	1	11	5
Mixay	37	5	21	1	5	5
Yai	26	3	15	1	3	4
Lethong	31	7	15	1	4	4
Gnordphe	29	3	16	-	6	4
Boua-Xai	31	3	15	-	8	5
Total species (Lao names)	51	12	24	1	12	5

*: Initial estimation, due to uncertainty on scientific name of species

4. Discussion

The number of some 50 species of edible mushrooms must be regarded as indicative. In many cases one local name is probably covering several species. For example the local name Het Pheung includes several edible species belonging to the order *boletales* and the same goes for genus *Lentinus* (Het Bong), covering several species.



Het set - *Cantharellus cibarius*

Probably due to miscommunication, some edible species known to be growing in the area have not been included such as Chanterelle (*Cantharellus cibarius*), which is one of the most popular edible mushrooms in Europe. Another species, *Lactarius hatsudake* growing in the area, seemed to be missed. This species is highly priced edible mushroom in Japan and China (Mortimer et al, 2014).

On the other hand, in Laos as well as in neighbouring countries, there are also several local names covering one species, but it is unclear to what extent it is the case in this survey. It should be stressed that several villagers expressed uncertainties in naming many species and particular with regard to species belonging to the genus *Russula* and the order *Boletales*. Surveying over a longer period and with more photos and dried materials followed by careful identification including microscopic and DNA examinations will provide answers to this overriding challenge of correct naming.



Lactarius hatsudake

DNA examinations will

In Lao PDR, there is tradition to simply divide mushrooms into mushrooms growing from soil and on wood (NAFRI, 2009), with little emphasis on the importance of the mutual beneficial tree-fungal association (mycorrhiza). The highly valuable Het wai is by some believed to be the real matsutake mushroom, but this is very doubtful, due to its hosts. In the survey area it grows in association with the beech family, not pine as widely recorded from other countries. Further studies will tell if it is rather *Tricholoma bakamatsutake* or *T. fulvocastaneum*, two species closely related to *T. matsutake* (Yamanaka et al, 2014).



Het Wai

Tricholoma fulvocastanea

The survey provided limited knowledge on the ecology and there is a need to document more detailed growth requirements, including preference to specific host trees, soil conditions, etc.

Six poisonous species were recorded by the villagers, which is much lower than information from Thailand and China. So far, it has not been possible to provide a scientific name to any of the local poisonous mushrooms, but surely the species of the genus *Amanita* is likely to be included such as the Death Cap (*A. phalloides*), the Destroying Angel (*A. virosa*), the fool's mushroom (*A. verna*), Smith's Amanita (*A. smithiana*), *A. pseudoporphyria*, and *A. exitialis*, all potentially growing the area. Notably, none of the villages reported any occurrence of sickness from mistakenly consumed poisonous mushrooms, which may be due to special care in these villages. In any event, there seems to be room for providing more precise information, awareness and photos on poisonous species.

Annex 1. Edible and medicinal mushrooms, their ecology and recognitions, six villages Phoukhout District

No	Lao name*	Scientific name	V.1	V.2	V.3	V.4	V.5	V.6	Recognition by villager	Tree	Eco.
1	Het bee	<i>Schizophyllum commune</i>	x	x	x	x	x	x	Small white cap	Mix	Sapr
2	Het dang nguoa		x						Black	Mix	Sapr
3	Het dang khao/tin pok	<i>Lentinus squarrosulus</i>	x	x			x	x	White cap	Mix	Sapr
4	Het fai		x						Red cap	Mix	-
5	Het gnan		x	x					Yellow cap w. wh. scales	Bam	-
6	Het gnoum	<i>Amanita sp.?</i>	x	x	x	x	x	x	Volva	Mix	My
7	Het heua khoey		x			x			Large cap	NA	Sapr
8	Het Hou kouang	<i>Lentinus strigosus</i>	x	x					Cow ear	Mix	Sapr
9	Het hou ling	<i>Auricularia polystricha</i>	x						Red with hair	Mix	Sapr
10	Het hou nou	<i>Auricularia auricula-judae s.l.</i>	x						Earlike cap	Mix	Sapr
11	Het ka douk	<i>Catahtalesma ventricosa</i>	x	x	x	x			Large heavy white cap	Mix	My
12	Het kam khai	<i>Amanita princeps</i>	x	x					Egg albumen colour	Mix	My
13	Het kanh lai	<i>Boletus edulis</i>	x	x	x	x	x	x	Stem with white net	Mix	My
14	Het khan chong	<i>Ganoderma sp</i>	x						Like spoon	Mix	Sapr
15	Het khone kong		x	x		x			White cap & black top	Mix	-
16	Het konh xock leung	<i>Turbinellus floccococ</i>	x	x			x	x	Small white cap	Mix	My
17	Het kap ka		x						Hard black	-	Sapr
18	Het kham khao bak ling	<i>Ramaria sp.</i>	x	x					White round	Mix	Sapr
19	Het mone khai	<i>Amanita hemibapha</i>						x	Egg yolk color	Mix	My
20	Het kor dam	<i>Russula sp.</i>	x	x	x	x	x	x	Big red cap	Mix	My
21	Het kor mong	<i>Russula sp. (red)</i>	x	x	x	x	x	x	Black inside stem	Oak	My
22	Het Kor tane	<i>Russula sp. (red)</i>	x	x	x	x	x	x	Red cap	Mix	My
23	Het kor tong		x	x					Small Red cap	Mix	-
24	Het man		x	x	x	x	x	x	Oily white cap	-	-
25	Het mon khai	<i>Amanita hemibupha</i>						x	Egg yolk colour	Mix	My
26	Het Na feua	<i>Russula virescens</i>	x	x		x			Thick cap,like river weed	Mix	My
27	Het nok tha		x	x	x	x	x	x	Like tha bird	-	-
28	Het nuat	<i>Ramaria sp.</i>	x	x	x	x	x	x	Like beard	Mix	Sapr
29	Het pek	<i>Neolentinus ponderosus</i>	x				x	x	Large yellow cap	Pine	Sap
30	Het phao		x	x	x	x	x	x	Small slippery cap	-	-
31	Het pheung 1	<i>Boletus sp.</i>	x	x	x	X	x	x	Beehive under cap	Mix	My
32	Het pheung 2	<i>Heimioporus retisporus</i>	x	x	x	x	x	x		Mix	My
33	Het tanh	<i>Russula densifolia</i>		x	x	x	x	x	Black cap	Mix	My
34	Het tak heaung							x	Wh cap like scoop basket		Sapr.
35	Het tap kai noi	<i>Terminomyces microcarpus</i>	x	x	x	x			Small white cap	-	Term.
36	Het tap khang	<i>Terminomyces eurhizus</i>		x	x	x	x	x	Sharp top	-	Term.
37	Het tap fan	<i>Terminomyces robustus</i>	x	x			x	x	Sharp red cap	-	Term.
38	Het tap mou	<i>Terminomyces clypeatus</i>			x				Sharp top	-	Term.
39	Het tap pouak	<i>Terminomyces sp.</i>	x	x	x	x	x	x	On termite hill	-	Term.
40	Het tip dam	<i>Craterellus cornucopioides</i>	x	x	x	x	x	x	Straight black	Mix	My
41	Het tip leuang	<i>Craterellus odoratus</i>	x	x	x	x	x	x	Straight yellow	Mix	My
42	Het tip kan tan	<i>Cantharellus sp.</i>	x	x	x	x	x	x	Solid stipe	-	-
43	Het tip tan		x						Black stem	Mix	My
44	Het tong heo/hear	<i>Russula sp</i>	x	x	x	x	x	x	Thin white cap	Mix	My
45	Het yang	<i>Lactarius volemus</i>	x						White milk	Mix	My
46	Het yang daeng	<i>Lactarius sp.</i>	x	x	x	x	x	x	Red	Mix	My
47	Het yang leuang	<i>Lactarius sp.</i>		x	x		x	x	White cap	Mix	My
48	Het wai lao kang/wai kha	<i>Tricholoma ?</i>	x						Dark blue cap & stem	Oak	My
49	Het way noi	NA	x						Dark blue under cap	Mix	-
50	Het wai	<i>Tricholoma matsutake s.l.</i>	x	x	x	x	x	x	White gills	Oak	My
51	Het xa het wai	<i>Anamika sp</i>				x			Dark blue cap	Oak	My
	Total		44	39	26	29	28	30			

Note: V1: Bong, V2: Vixay, V3: Yai, V4: Letong, V5: Gnordphe, V6: Boua-Xai

*: In Lao language the classifier “Het” (mushroom) is used in front of the species

Literature

British Mycology Society, English Names for Fungi, 2014. <http://www.britmycolsoc.org.uk/library/english-names/>

Chandrasrikul A, Suwanarit P, Sangwanit U, Lumyong S, Payapanon A, Sanoamuang N, Pukahuta C, Petcharat V, Sardud U, Duengkae K, Klinhom U, Thongkantha S, Thongklam S, 2011. Checklist of Mushrooms (Basidiomycetes) in Thailand, Office of Natural Resources and Environmental Policy and Planning (ONEP), Thailand.

Dai Y, Zhou L-W, Yang Z-L, Wen H-A, Bau T, Li T. 2008. A revised checklist of medicinal fungi in China, *Mycosystema*, 27(6): 801-824, Institute of Microbiology, CAS.

Hyde, K. D. and Na, J. NAMC, Newsletter of the Asian Mycological Committee meeting, 2011. <http://www.msconfungi.org/upload/accessory/.../2012621030281577942.pdf>

NAFRI, 2009. Non-Timber Forest Products in the Lao PDR. A Manual of 100 Commercial and Traditional Products. The National Agriculture and Forestry Research Institute. Vientiane, Lao PDR: www.snv.org.la

Mortimer, P. E, Xu J, Kurunarathna, S. C. Hyde K.H. 2014. Mushrooms for trees and people. A field guide to useful mushrooms of the Mekong Region, humidtropics.cgiar.org/wp-content/plugins/download.../download.php?

Wang D-M., Wu S-H, Su C-H, Peng J-T, Shih Y-H, Che L-C. 2009. *Ganoderma multipileum*, the correct name for *G. lucidum* in tropical Asia, *Botanical Studies* 50: 451-458.

Wang, X-C, R-J Xi, Y. Li, D-M Wang, Y-J Yao, 2012. The Species Identity of the Widely Cultivated *Ganoderma*, 'G. lucidum' (Ling-zhi), in China. *PLoS One.*; 7(7): e40857. Published on-line Jul 20, 2012. doi: 10.1371/journal.pone.0040857 PMID: PMC3401198.

Yamanaka T, Ota Y, Konno M, Kawai M, Ohta A, Neda H, Terashima Y, Yamada A. 2014. The host ranges of conifer-associated *Tricholoma matsutake*, Fagaceae-associated *T. bakamatsutake* and *T. fulvocastaneum* are wider in vitro than in nature. *Mycologia*. May-Jun; 106 (3): 397-406.

Yang T-Z, Chen Z, Song B, Deng W. 2005. Poisonous Mushrooms Known from China - Species Resources and Distribution, Vol. 12, Supplement, Fifth International Conference on Mushroom Biology and Products. <http://wsmbmp.org/proceedings/5th%20international%20conference/pdf/chapter%202062.pdf>