Effective Implementation of Payments for Environmental Services in Lao PDR

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THE ENVIRONMENTAL, ECONOMIC AND SOCIAL CONDITION OF THE NAM MOUANE – NAM GNOUANG CATCHMENT

Research Report No. 5

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Abstract

The main objective of this Research Report is to overview the environmental, economic and social condition of the Nam Mouane – Nam Gnouang catchment. This Research Report identifies threats to forest wildlife and forest cover arising from current management practices and suggests possible management actions to achieve environmental improvements. These include reducing the expansion of shifting cultivation into undisturbed forests by improving agricultural productivity of slash-and-burned; reducing poaching/ hunting of forest wildlife through increased patrolling and the collection of snares.

Keywords: Nam Mouane -Nam Gnouang catchment, environmental threats, management actions, payments for environmental services

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Acronyms

CCN	Community Conservation Network
DoF	Department of Forestry
EPF	Environment Protection Fund
GoL	Government of Lao PDR
NAFRI	National Agriculture and Forestry Research Institute
NG	Nam Gnouang (river)
NMNG	Nam Mouane-Nam Gnouang (catchment)
NPA	National Protected Area
NTFP	Non-Timber Forest Product
PES	Payment for Environmental Services
PONRE	Provincial Department of Natural Resources and Environment (Bolikhamxay)
PPA	Provincial Protected Area
THPC	Theun-Hinboun Power Company
THPP	Theun-Hinboun Power Project
THXP	Theun-Hinboun Expansion Project
WCS	Wildlife Conservation Society

1. Introduction

This Research Reportprovides a baseline for the development of a bio-physical model of alternative environmental management options in the Nam Mouane-Nam Gnouang[1] (NMNG) catchment in the Bolikhamxay Province, Lao People's Democratic Republic (Lao PDR). The bio-physical model will be one element of a Payment for Environmental Services (PES) scheme designed as a pilot in the Lao PDR context. Detailed information on how a PES scheme would be designed, implemented and assessed step-by-step in the Lao context is presented in Research Report 3 'Development of a "virtual" PES scheme in the Nam Ngum River Basin' (Scheufele, Bennett, Kragt, & Renten, 2014), which establishes a draft set of guidelines for PES design, operation and assessment.

RR5 provides an overview of the biophysical environmental, economic and social conditions of the NMNG catchment and, in more detail, of the area to be involved in the pilot PES scheme. It provides information on the resource endowment, land use, administration, socio-economic situation and land tenure. Based on this information, RR5 identifies threats to the provision of environmental services and suggests possible management actions to achieve environmental improvements and/ or prevent environmental deterioration.

2. Overview

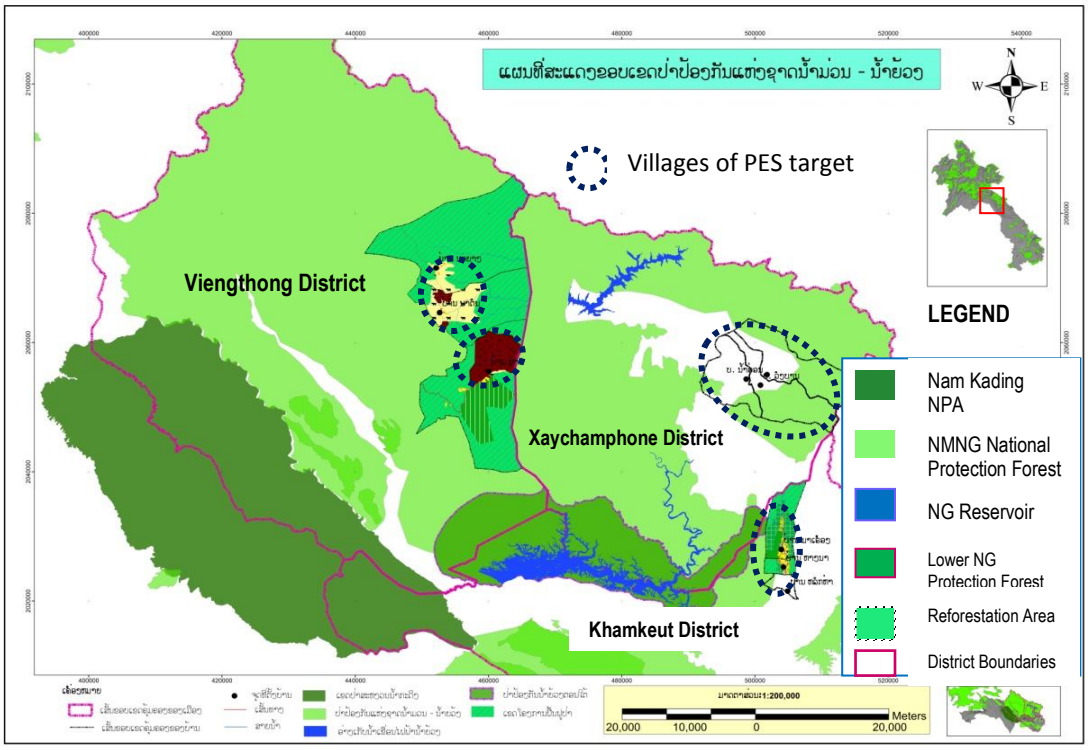
The NMNG catchment is located in the Bolikhamxay Province and extends over an area of about 524,406 hectares (Provincial Department of Natural Resources and Environment of Bolikhamxay, 2014). It encompasses the districts of Khamkeut, Xaychamphone and Viengthong (see Figure 1). The NMNG is rich in natural resources providing a variety of environmental services such as supply of biodiversity, provision of recreational and tourist opportunities, flood protection and soil erosion control. These environmental

[1]Also spelled *Ngouang*.

services contribute to the socio-economic development of the Bolikhamxay Province and the Lao PDR as a whole.

Topographically the area is predominately mountainous interspersed with karst landscapes. The elevation ranges from about 140 meters on the Mekong flood plain up to 2,300 meters along the Annamite Mountain Range bordering on Vietnam (Norplan A.S., 2008b). Especially the upper catchment is characterized by a lack of flat land traditionally used for rice paddy cultivation.

The NMNG catchment consists of two major river systems - the Nam Mouane and Nam Gnouang- and numerous streams. The Nam Mouane originates in the highlands of the northern region of Viengthong District with a catchment area of 236,868 hectares. The Nam Gnouang[2] originates in the Annamite mountain range with a catchment area of about 287,538 hectares (Provincial Department of Natural Resources and Environment of Bolikhamxay, 2014). Both rivers drain into the Nam Kading[3], which eventually confluents with the Mekong River.



[2] In fact the headwater of this river composes of two smaller rivers named the Nam Heuang and Nam Chat.
[3] The downstream section of the Nam Theun is called Nam Kading.

Figure 1: Location of PES target villages within the NMNG catchment area

Source: Bolikhamxay PONRE

One of the main features of the catchment is the Nam Gnouang reservoir. For the purpose and focus of this research the NMNG catchment is divided into an 'upper' and a 'lower' catchment (Figure 1). The dark green shaded area encompassing the reservoir is the lower catchment. The rest – north of the reservoir - makes up the 'upper' catchment. The Nam Gnouang reservoir was built in 2012 by damming the Nam Gnouang. At its full supply level the reservoir covers about 105 square kilometers, extending about 100 kilometers upstream (Social and Environmental Division, 2011). The Theun-Hinboun Power Company (THPC) undertook this development with the aim of increasing and maintaining a stable power generation capacity, especially during the dry season. This is achieved by diverting additional water from the Nam Gnouang - Nam Theun catchment into the Nam Hai - Hinboun catchment where the powerhouse is located. The Theun-Hinboun Expansion Project headpond is located at an elevation of 400 meters above mean sea level with the powerhouse being at 170 meters above mean sea level (Norplan A.S., 2008b).

The mountainous topography influences air temperature and rainfall within the NMNG catchment (Tables2). The average maximum temperature (measured from 1990 to 2013) ranges from 28.5°C in December/ January to 34.1°C in April. The average minimum temperature (measured from 1990 to 2013) ranges from 16.19°C in December to 25.68°C in June. The average monthly rainfall (measured from 1982 to 2013) ranges from 4.6mm in December to 712.8 mm in July. The average total annual rainfall for the period is 3,191 mm. Figure 4 below shows the relative monthly humidity averaged for the period 1990 to 2013.

The NMNG catchment holds deposits of gold, lead, graphite. Some small-scale commercial mining is currently taking place (Souriya & Pangkham, 2014)[4]. Additionally, villagers, mainly from Kengbit village, get involved in alluvial panning for gold at the Nam Gnouang and Nam Kading before the start of the wet season, taking advantage of low water levels (Norplan A.S., 2008b).

[4] One mining company operating in the catchment is the Phonesack Mining Company.

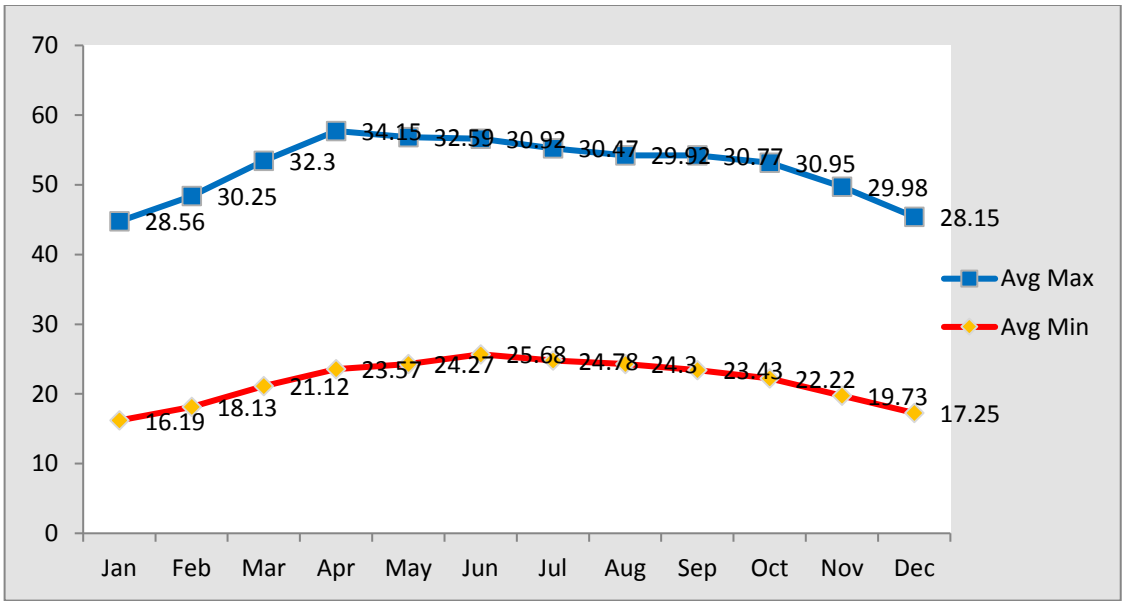


Figure 2: Average minimum and maximum temperature 1990-2013 (˚C), Pakxan Weather Station

Source: Bolikhamxay PONRE, Division of Meteorology and Hydrology, 2014.

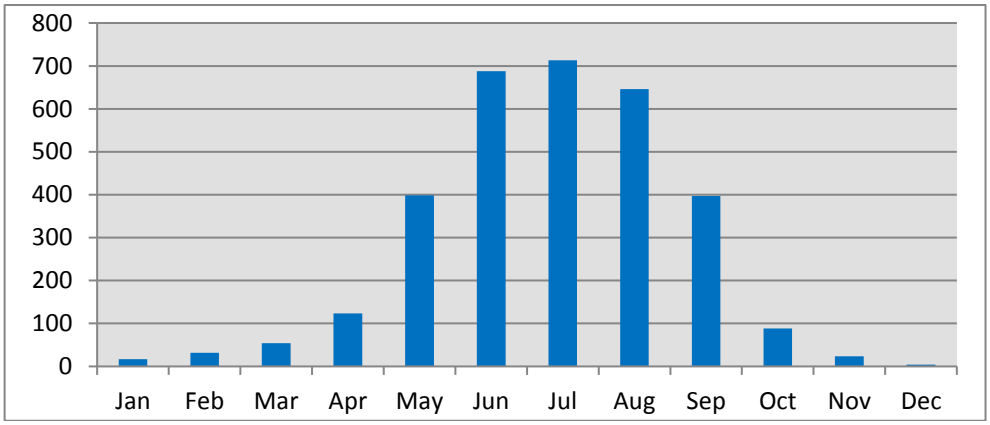


Figure 3: Average Monthly Rainfall 1984-2013 (mm), Pakxan Hydromet Station

Source: Bolikhamxay PONRE, Division of Meteorology and Hydrology, 2014

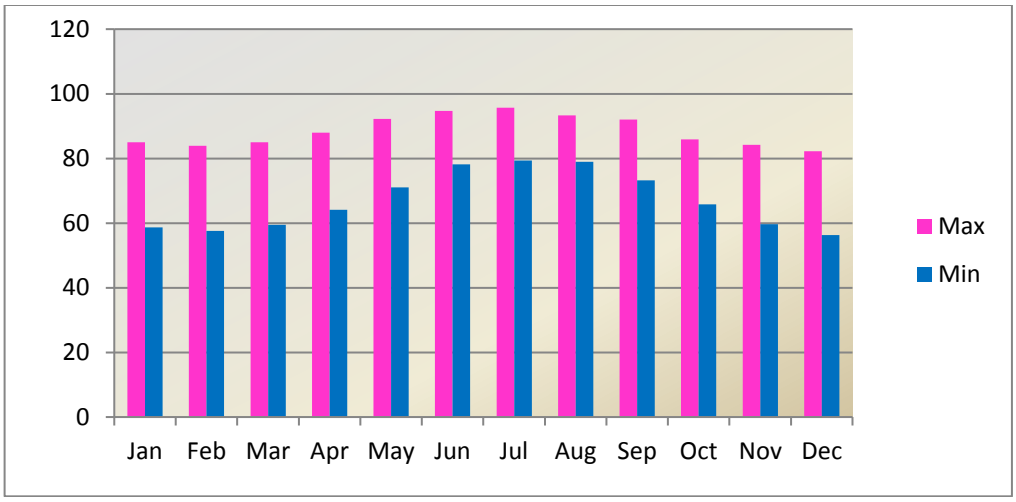


Figure 4: Average relative monthly maximum and minimum humidity, 1990-2013 (%)

Source: Bolikhamxay PONRE, Division of Meteorology and Hydrology, 2014

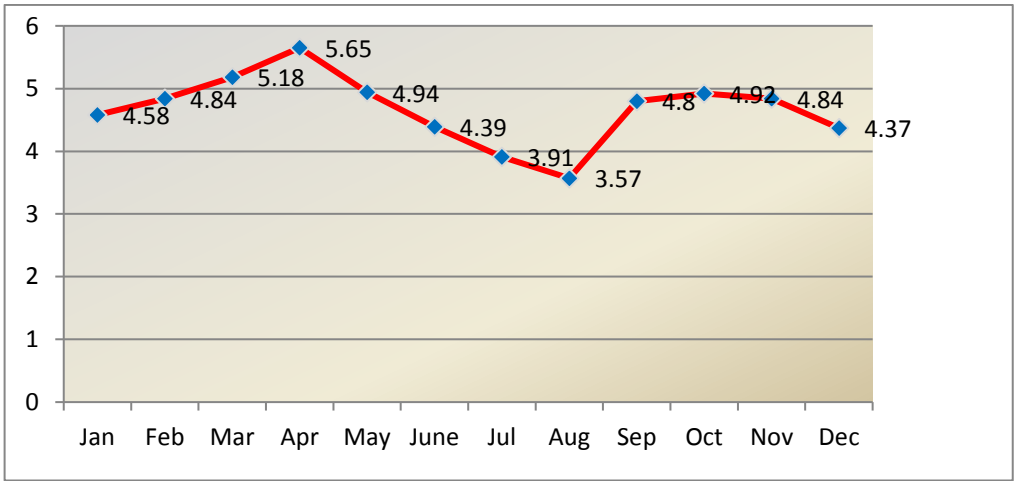


Figure 5: Average evaporation 2000-2013 (mm)

Source: Bolikhamxay PONRE, Division of Meteorology and Hydrology, 2014.

The area to be involved in the PES scheme consists of land allocated to nine villages with a total land area of 100,631 hectares in three districts as follows[5]:

- Khamkeut District (Hang Na Village; Lak 5 Village; Na Heuang Village),
- Xaychamphone District (Nam On Village; Phon Kham Village; Vangban Village), and,

[5] Maps of the village land use are provided in the Annex.

- Viengthong District (Na Tan Village; Na Yang Village; Pha Bo Village).

These villages are located within the NMNG National Protection Forest.Pha Bo Village is located immediate to the edge of the Phou Sithon Endangered Species Conservation Area; Vangban Village is located inside the Nam Chat/Nam Pan PPA while Nam On and Phon Kham Villages are located close to its boundaries. The three PES pilot villages of Khamkeut District are located in proximity to the Phou Chomvoy Provincial Protected Area (PPA) that covers an area of 25,040 hectares (Travers, Clements, & Hedemark, 2010), adjoining the area to the east. The livelihoods of all villages are based on subsistence agriculture, but the economic, social and environmental conditions of the areas in which they are located vary across the three districts. For example, the three villages in Khamkeut District are better connected to infrastructure and have higher education levels than the villages in the Xaychamphone and Viengthong Districts.

3. Agriculture

The main crops cultivated in the NMNG catchment are rice, maize, cassava, peanut and taro (Pangxang, Phoyduangsy, & Tsechalicha, 2014; Souriya & Pangkham, 2014). The use of chemical fertilizers, pesticides and herbicides has become popular among farmer groups to increase agricultural productivity. As a consequence, water resources are increasingly polluted with chemicals causing problems such as fish kill (Pangkham, 2014).

Farmers in the NMNG catchment mainly grow upland rice since flat areas required for paddy cultivation are limited. The yield of traditional upland rice farming is, in general, lower than the yield of the lowland paddy rice production[6]. Thus, many farmers frequently experience a shortage in rice supply. As a result, farmers supplement their food supply through the harvest of non-timber forest products (NTFP) from their surrounding environment for sale to buy rice. Farmers in most villages expand their

[6] Based on the provincial figures of rice production area and yield for the 2010-11 production season, the average upland rice yield of Bolikhamxay Province is estimated to be 1.7 tons/ha versus 3.7 tons/ha of lowland paddy yield (Department of Planning and Investment in Bolikhamxay, 2012).

agricultural land within a respective village land use area every year. In general, the area used for shifting cultivation through slash and burn is expanding, on average, one hectare per family per year (Souriya & Pangkham, 2014). For example, in the three target PES villages of the Khamkeut District(Lak 5 Village, Hang Na and Na Heuang)the percentage of households that have sufficient rice paddy land to produce sufficient rice for their own consumption is 80%, 95% and 79%,respectively. In these villages dependency on slash and burn farming is generally low even though the size of slash and burn fields in Lak 5 and Hang Na is estimated at five hectares and two hectares per household, respectively (Pangxang et al., 2014). Nevertheless these slash and burn fields are not located in old growth forest, rather they are cleared in fallow areas adjacent to the paddy fields. As for the six other PES villages[7] in Viengthong and Xaychamphone Districts, slash and burn fields are cleared within the protection forest (Provincial Department of Natural Resources and Environment of Bolikhamxay, 2014). Based on local information regarding land use for upland agriculture of approximately one hectare per family each season (Norplan A.S., 2008a) has put an estimate of the land use 'in any one rotation of crops' at 736 ha in the NG area. However given that not all households of the nine villages to be involved in the PES scheme in the NMNG catchment would expand their agricultural land, this estimate may be a crude indication of agricultural land expansion in the area in any cropping season and may not be generalized for the 758 households under the PES pilot scheme.

The areas that are currently used for agriculture are effectively bereft of vegetation aside from whatever crop that is planted there. The continuous expansion of shifting cultivation into undisturbed forests destroys and fragments habitats, reducing biodiversity levels.

Shifting cultivation has been practiced for many years in the NMNG catchment. Due to varying fallow periods (3-10 years) the disturbed landscape is a mixture of re-growth at various stages (Norplan A.S., 2008a). As the report states,

> '… areas that have been fallow for1-3 years are dominated by grasses and herbaceous perennial plants such as *Erianthus arundinaceus*, *Ageratum conyzoides*, *Eupatorium odoratum*, *Themeda triandra*, and *Imperata Cylindrica*. In areas that have been in fallow for approximately 3-6 years it is evident that

[7]Pha Bo villagers reported that they only practice slash and burn on *Imperata cylindrica* grassland.

> pioneer tree species have begun to regenerate and previously dominant grasses and herbaceous plants have declined. In areas that had been fallow for 8-10 years trees have started to form an open canopy, although bamboo species are prominent.'(Ibid)

Some areas that have not been used for shifting cultivation for decades, such as the area North of the Nam Khamang (close to the Nam Gnouang reservoir), have been affected by uncontrolled fires in adjacent areas that have repeatedly scorched vast hillsides (Norplan A.S., 2008a). As a result, tree species have been unable to gain a foothold, instead grasses and herbaceous perennial species dominate the land (Ibid.).

Gardening by local people is a common livelihood activity. For instance, about 20 households out of 123 households in Lak 5 Village do gardening on an average of one rai[8] of land per household. Almost every household in Hang Na Village does gardening, although the production of the latter is still mainly for household consumption(Pangxang et al., 2014).

Industrial plantations (e.g., rubber) are limited in the NMNG catchment except for some cultivation of cassava and maize as cash crops for sale to buyers in Vietnam (Souriya & Pangkham, 2014). The prices given for these crops in Lak 5 Village are 1300 Kip/kg and 2000 Kip/kg respectively; in Hang Na Village these are1100 Kip/kg and 1500 Kip/kg respectively (Pangxang et al., 2014). The two villages experience shortages of rice supply for four and three months respectively, during which time they secure their supply of rice by selling cassava, maize, as well as livestock. Overall, these villages rely fully on agriculture for their income, including on non-rice crops. Pha Bo villagers in Viengthong District, on the other hand, grow crops such as vegetables, taro, sweet potato, cucumber and cabbage, among others, on the upland fields. This produce is mainly for self-consumption, and only a little is sold to the market at the district administrative town. Hence the principal income source of the village is from the sale of livestock, mainly cattle and buffaloes. The main problem faced by the village is a shortage of water supply, especially during the dry season. While the Phou Thai and Tai Daeng living in Lak 5 Village have had enough rice paddy land, the Hmong did not have paddy land until a few years ago. Yet they have recently acquired rice paddy land In contrast, the Hmong in Pha

[8] A surface measurement unit, 1 rai = 1,600 m^2.

Bo do not have any paddy land[9] (given the village's high altitude) and have been practicing slash-and-burn cultivation on fallow areas near the village. However their principle livelihood activity is animal husbandry, mainly cattle, on the grassland surrounding their village.

4. Forestry

Forest Cover

The level of forest cover for Bolikhamxay Province was estimated at 54.9% in 2010 compared to 61.4% in 2002. The reduction in forest cover was attributed to forestland conversion for agriculture and industrial plantation (Department of Forestry, 2012). The upper NMNG catchment is covered predominately with secondary growth as the land has been used extensively for shifting cultivation for at least three generations (Social and Environmental Division, 2011). The remaining original forests are generally concentrated in the mountainous area along the Lao-Vietnam border region. Areas of original forest cover of mixed deciduous forest are found along streams and on hillsides while patches of Evergreen Forest persist in gullies at higher elevations where stands of deciduous forest and bamboo are found (Norplan A.S., 2008a). Tizard (1996) reports that all areas along the Nam Gnouang are heavily utilized by humans and only the higher peaks and ridge tops still retain forest with Evergreen Forest only remains in 'five widely separated patches' on the larger hills and mountains in the area. By the team's observation in Viengthong and Khamkeut Districts, remnant of some undisturbed forests exists along mountain ridges, on karsts and on steep slopes. However, since no surveys have been conducted on the undisturbed forest areas in the NMNG catchment, there are no data available on the extent of undisturbed forests.

Forest cover of the whole Lao PDR is shown in figure 6 below, with area targeted for PES scheme indicated. According to Norplan A.S. (2008a), 'areas close to the villages

[9]This can partly be explained by the fact that many Hmong families live in the lowland where their paddy lands are located; their presence in Pha Bo is mainly for raising livestock chiefly cattle.

that are located along the Nam Gnouang could be regarded as unstocked forest[10] or upland re-growth.' The report notes further that 'these are previously forested areas where crown density has been reduced to less than 20% (or in some cases 0%) as a result of heavy disturbance through shifting cultivation practices'. This has led to a loss of forest structure, a disturbance of ecological processes and a decline in biodiversity.

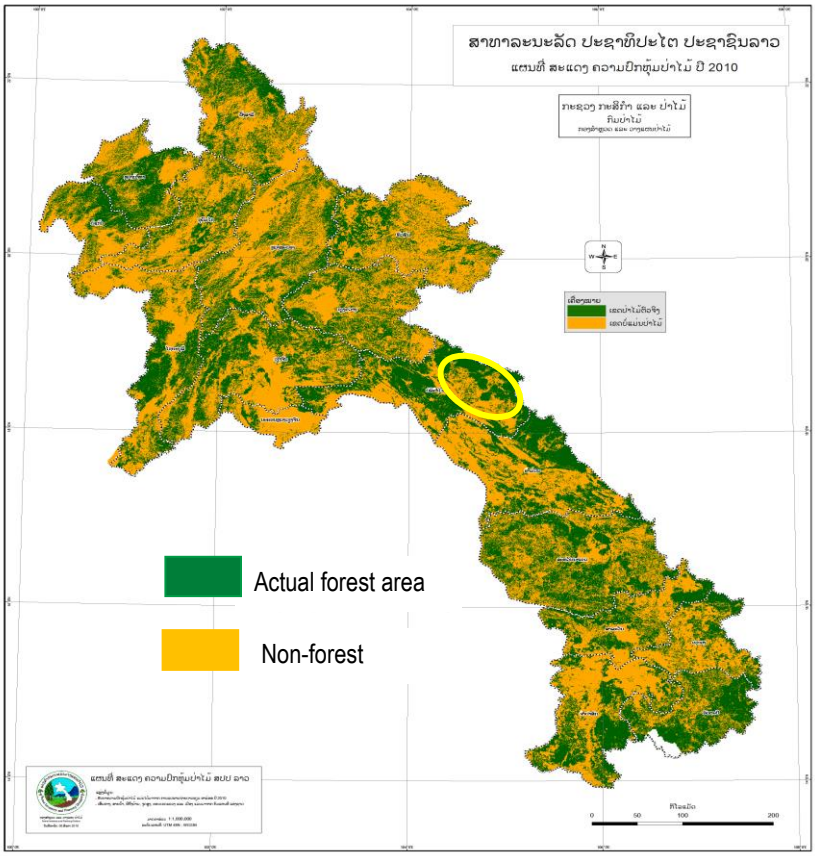


Figure 6: Forest Cover of Lao PDR in 2010

Source: Department of Forestry (2012), English legends added.

[10]Unstocked forest areas are defined as 'previously forested areas in which the crown density has been reduced to less than 20% because of logging, shifting cultivation or other heavy disturbance. If the area is left to grow undisturbed it becomes forest again'(Department of Forestry, 2012).

Biodiversity

While information on wildlife in the Nam Mouane sub-catchment is relatively scarce/inaccessible, the Nam Gnouang sub-catchment is home to a great diversity of wildlife species (International Centre for Environmental Management, 2010)[11], including the relatively recent discovered new species of mammals such as the Large-antlered Muntjac (*Muntiacus vuguangensis*), a distinctive species of rabbit – the Annamite Striped Rabbit (*Nesolagus timminsi*) (Tizard, 1996)[12] and the iconic Saola (*Pseudoryx nghetinhensis*). According to a preliminary survey by Tizard (1996) in the Northern Extension area of the Nakai-Nam Theun NPA, presently the Nam Pan/Nam Chat Provincial Protected Area which is within the NG catchment, twenty-four Key Species of bird, as well as an additional four Key Species in the Nam Gnouang Area (NGA) of Globally Threatened or Near Threatened birds have been documented. These include: Crested Argus (*Rheinartia ocellata*), Yellow-vented Pigeon (*Treron seimundii*), Gray Laughingthrush (*Garrulax maesi*), and Short-tailed Scimitar Babbler (*Jabouillei adanjoui*). Two additional Key Species, the Malayan Night-Heron (*Gorsachius melanolophus*) and the Blyth's Kingfisher (*Alcedo hercules*) have been found. Mammals include, in addition to the Saola, Rhesus Macaque (*Macaca mulatta*), Stump-tailed Macaque (*Macaca arctoides*), Douc Langur (*Pygathrix nemaeus*), Gibbon sp., Black Giant Squirrel (*Ratufa bicolor*), Muntjac sp., Southern Serow (*Naemorhedus sumatraensis*) among other birds and mammals. However, no recorded information on plant diversity is available in the NMMG catchment but logging of valuable tree species is also reported (see Section on Forest Use). Table 1 presents the key wildlife species of conservation concern in the Nam Gnouang catchment.

[11]Tizard (1996) surveys in the area suggests however that these areas seem to support a lower density of many mammals found elsewhere in Lao especially primates, *Ratufa* squirrels and large mammals (*i.e.* big cats, bears, wild cattle, etc.).

[12]Tizard (1996) reports on the two species of wildlife as unnamed then. Names are added by verifying the information in Duckworth et al. (1999) and IUCN Red List data - see http://www.iucnredlist.org.

Table 1: Key wildlife species of conservation concern in the Nam Gnouang catchment

Species	**Conservation status**
Birds	
Crested Argus *(Rheinardia ocellata)*	At Risk in Lao PDR*
Crested Kingfisher *(Megaceryle lugubris)*	Regionally At Risk
Great Hornbill *(Buceros bicornis)*	At Risk in Lao PDR*
River Lapwing *(Vanellus duvaucelii)*	National Long-term Decline
Large-billed Crow *(Corvus macrorhynchos)*	Unknown?
Mammals	
Macaques	Regionally At Risk
Douc Langur *(Pygathrix namaeus)*	At Risk in Lao PDR*
Phayre'sLangur *(Semnopithecus phayrei)*	At Risk in Lao PDR*
Gibbons	At Risk in Lao PDR*
Bears	At Risk in Lao PDR*
Otters	Regionally At Risk /Globally Threatened
Asian Golden Cat (*Catopuma temminckii*)	Globally Near-Threatened; Little Known in Lao PDR*
Tiger (*Panthera tigris*)	At Risk in Lao PDR*
Asian Elephant (*Elephas maximus*)	Globally Threatened
Heude's Pig (*Sus bucculentus*)	Little Known in Lao PDR*
Saola (*Pseudoryx nghetinhensis*)	Critically Endangered**
Muntjac sp.	Depending on species: Little Known or Potentially At Risk in Lao PDR*
Sambar (*Cervus unicolor*)	Potentially At Risk in Lao PDR*
Gaur (*Bos gaurus*)	Globally Threatened; At Risk in Lao PDR*
Banteng (*Bos javanicus*)	At Risk in Lao PDR*
Serow(*Naemorhedus sumatraensis*)	At Risk in Lao PDR*
Black Giant Squirrel (*Ratufa bicolor*)	Potentially At Risk in Lao PDR*

Source: Adapted from (International Centre for Environmental Management, 2010) based on (W. Robichaud, 2003) and (Wildlife Conservation Society, 2007) surveys. *Based on Duckworth et al (1999); **Assessed as 'At Risk in Lao PDR' by Duckworth et al (Duckworth et al., 1999).

Discovered in 1992 by science, the Saola is classified as Critically Endangered on the IUCN Red List. It is a flagship species occurring only in Lao PDR and Vietnam along this section of the Annamite Mountain Range, which is considered its main habitat (Tizard, 1996)[13]. Saola is the key species to protect in the Bolikhamxay Province (Integrated Ecosystem and Wildlife Management Project, 2006), given its undetermined small population and limited habitat range in the area as well as threats it faces. Other wildlife species present in the NMNG catchment area which are of potential focus for the PES pilot scheme are Large-antlered Muntjac (*Muntiacus vuquangensis*) and White-cheeked Gibbon (*Hylobates leucogenys*) (Vongkhamheng, 2014), listed by the IUCN Red List as Endangered and Critically Endangered, respectively. Both animals, whose status is Potentially at Risk in Lao PDR, are listed as Lao PDR Category I Protected Species. Additionally other large bird species may be suitable for potential monitoring, especially as forest protection and reduced hunting through patrolling may logically result in species population increase.

Forest categories

Almost the entire upper NMNG catchment (524,406 ha) is broadly categorised as National Protection Forest (Provincial Department of Natural Resources and Environment of Bolikhamxay, 2014). In addition, Bolikhamxay Province has established the Nam Gnouang South Protected Forest Area[14] covering over 50 square kilometres, whose management is being supported by the Wildlife Conservation Society (WCS). The area includes much of the former village shifting cultivation areas that are no longer used in the catchment area(Social and Environmental Division, 2012).

[13]Saolas are confined to a small range in the Annamite Mountains of central Laos and Vietnam. Saolas are not known to occur in large numbers outside of the Northern Extension, presently the Nam Pan/Nam Chat Provincial Conservation Forest, or the Nam Gnouang Area (Tizard, 1996).
[14] It is unclear whether Conservation Forest Areas have the status of a National Protected Area, Provincial Protected Area or District Protected Areas.

The villages in the NMNG catchment also have reforestation, production, conservation, and protection forests allocated[15] in varying degrees; logging and timber harvesting is prohibited in reforestation and conservation forests and most likely in protection forest. The extent of these forests in the three PES target scheme villages of Khamkeut District and one village in Viengthong District is provided in Table 2.

Table 2: Extent of village level forest categories, Khamkeut District

Village	Reforestation forest, ha	Production forest, ha	Conservation forest, ha	Protection forest, ha	Agriculture land, ha	Plantation land, ha
Lak 5	380.7	300.8	40		265.87	
Hang Na	40 (79.3)	10 (241.9)	100 (382.8)	30	231	32 (12 ha planted)
Na Heuang	-	201	896	-	348	-
Pha Bo	12,369	4,355			1,042.75	

Source:(Pangxang et al., 2014). Numbers in brackets columns 2-4 for Hang Na are based on information provided by Bolikhamxay PONRE (2014).

Protected Areas

The forest in the Bolikhamxay Province is of significant environmental value. The National Protected Areas are shown in Figure 7. The province contains the NamKading National Protected Area (NPA) with an area of 169,000 hectares (Southammakoth, 1999) located to the southwest of the NMNG catchment. To the southeast of the NMNG catchment, the Nakai-Nam Theun NPA stretches across the Bolikhamxay and Khammouane Provinces. The Khammouane Province additionally contains the Phou Hin Poun, also known as Khammouane Limestone, NPA. The Nakai-Nam Theun – Phou Hin Poun Corridor links the Nakai-Nam Theun NPA with the Phou Hin Poun NPA.

The upper NMNG catchment contains the Pha Kouan Chan Provincial Protected Area (PPA)[16], the Nam Chat/Nam Pan Provincial Conservation Forest of 650 Km^2[17] (W.

[15]Practically these allocated forest areas are found/ embedded inside the designated national protection forest area, which effectively means that there is a degree of overlap between village land use allocation and national protection forest area.

[16]According to the Forestry Law 06/ NA 2007 (under review) National, Provincial and District Protected Areas are comprised of conservation forests. Yet, almost the entire NMNG catchment is categorized Protection Forest. The land demarcation seems to be overlapping.

[17] Norplan A.S. (2008a) puts this area figure at 45,000 ha.

Robichaud, 2003) and Nam Chouan Provincial Conservation Forest located at the border to Vietnam. These two Provincial Conservation Forest areas are of high biodiversity importance and have been suggested to be considered first if a decision is to be made to add areas to the NPA system (W. Robichaud, Marsh, Southammakoth, & Khounthikoummane, 2001). Table3 lists the protected area network encompassing the NMNG catchment and the surrounding region.

The NMNG catchment additionally contains two provincial endangered species conservation areas, PhouSithon and Phou Chomvoy. These areas have been designated for the protection of endangered species, primarily the Saola *(Pseudoryx nghetinhensis)* (Souriya & Pangkham, 2014).

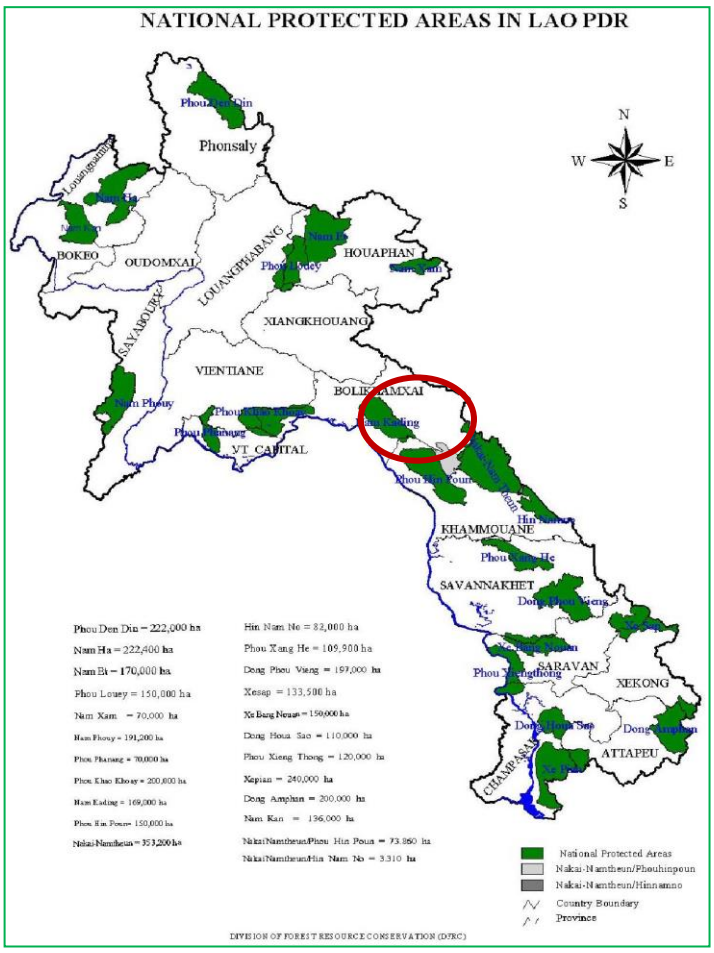


Figure 7: Location of National Protected Areas of Lao PDR in 2010

Source: Department of Forestry

Table 3: Protected areas in the Bolikhamxay Province and surrounding areas

NPA and local level PA*	Area, ha	Location
Nakai-Nam Theun NPA	353,200	Bolikhamxay, Khammouane Provinces
Phou HinPoun or Khammouane NPA	150, 000	Khammouane Provinceof the southern and eastern catchment of Nam Hinboun, to the south of the existing Theun Hinboun Power Station
Nam Kading NPA	169,000	Nam Kading valley downstream of the existing Theun Hinboun dam, Bolikhamxay Province
The Nam Chat/Nam Pan Provincial Conservation Forest *(northeast of the Phou Chomvoy PPA)*	65,000 [45,000]	Bolikhamxay Province, east of the NMNG catchment bordering Viet Nam consists mostly of undisturbed forest and habitat for rare and highly endangered wildlife species such as the Saola (*Pseudoryx nghetinhensis*).
Pha Kouan Chan Provincial Protected Area (PPA)	Small area	Bolikhamxay Province covering most of the inaccessible limestone ridge separating the Nam Gnouang reservoir area and the Nam Theun catchment. The key species include the recently described Lao rock rat or *kha-nyou* (*Laonastes aenigmamus*), new to science.
Nakai-Nam Theun – Phou Hin Poun Corridor **	73,860	Bolikhamxay, Khammouane Provinces, forest corridor linking the Nakai-Nam Theun NPA with the Phou Hin Poun NPA, which covers the forests on each side of Nam Theun River downstream of the NT2 dam site and has been set up as a compensation measure of the barrier effect of the Nam Theun 2 reservoir on the Nakai Plateau (ICEM, 2010).

Source: Adapted from the International Centre for Environmental Management (2010) with some adjustments. (**) based on Ministry of Agriculture and Forestry & Water Resources and Environment Administration (2010).

Forest use

In the NMNG catchment, large-scale commercial timber harvesting is carried out by a logging company contracted by the government, while small-scale timber harvesting by villagers for domestic use is commonly practiced (with restrictions) in forest areas under each village jurisdiction (Souriya & Pangkham, 2014). In the past, sporadic small-scale timber harvesting, targeting the highly sought-after timber species Fokienia cypress (*Fokienia hoginsii*), or Mai longleng along the border between Laos and Viet Nam (Tizard, 1996), which occurred in the upper Nam Gnouang sub-catchment formerly known as the Northern Extension of the Nakai-Nam Theun NPA, were taking place.

*This report concerns the Provincial Protected Areas in Bolikhamxay Province within the upper NMNG catchment.

Current logging in the NMNG catchment area has targeted the Mai Tae Hoh tree (*Sindora cochinchinensis*), another most valuable hardwood species (Pangkham, 2014), 2014).While the threat of logging has been reduced for Fokienia cypress in the Nam Gnouang catchment area due to the remoteness and difficult access, the threat for Mai Tae Hoh is still imminent. Other valuable tree species in the NMNG catchment are: Mai Ham, Mai Champapa (*Michelia champaca*), Mai Hinghom (*Fokinia chinensis*), Mai Khaen (*Shorea sp.*), Mai Mihom and Mai Dou (*Pterocarpus macrocarpus*). The threat of logging for these timber species is also present, especially for Mai Dou.

Harvesting of Non-Timber Forest Products

Generally collection of Non-Timber Forest Products (NTFPs) is an important activity in rural areas where a variety of forest products are harvested. These include food items (such as edible leaf, bamboo shoot, plant stem, flower, and fruit), fiber, building materials, fire wood and medicinal products. For poor families, it has been estimated generally that NTFPs can sometimes account for more than 50% of the family diet (The National Agriculture and Forestry Research Institute, National University of Laos, & Stichting Nederlandse Vrijwilligers, 2007). Collection sites vary from village to village with some villages having areas of forest specifically set aside for NTFP harvesting; while in others collection is mainly focused on forests in and around upland fields (Travers et al., 2010), commonly also in abandoned fields of regenerating forest. The sites of NTFP collection, however, are not so clearly determined in the target villages of the PES pilot scheme visited by the project team. For example, within the Nam Chat-Nam Pan PPA (which is defined in the village land use maps of Phon Kham and Nam On[18] villages of Xaychamphone District) agricultural activities, hunting, or timber cutting are not permitted, whereas villagers are allowed to collect NTFPs from the area (W. Robichaud, 2003) [19]. Thus, NTFP collection sites can vary. For example, Pha Bo villagers in Viengthong District reported limited availability of NTFP species nearby their village areas, hence collection is limited mainly to bamboo shoots and wild fruit in the village

[18] Also spelled Phonekham and Namone.
[19] It is common practice that collection of NTFPs is carried out in protected areas as well as protection forests. The rule is that, at least in theory, collection is permitted only in the so called controlled use zones.

surroundings, which are mostly for self-consumption. By contrast, Hang Na villagers in Khamkeut District collect cardamom and barberine vine or kheua haem, for trade and use in medicine. Na Heung villagers collect phakvarn leave (*Melientha suavis*), nhot tao (*Arenga westerhoutii*) and rattan tips for food (Pangxang et al., 2014). In addition, collection of cinnamon tree (*Cinnamomum iners*) is widespread. This seriously threatens the survival of the tree while the berberine vine stock has practically disappeared from the area due to overharvest (Pangkham, 2014).

5. Other land uses

In addition to agricultural land use mainly for shifting cultivation in the NMNG catchment, infrastructure and development projects (primarily dams and roads), urban development and timber harvesting are land use types which cause forest destruction (Souriya & Pangkham, 2014). Conventional mining has not yet been a concern. The vast area of scattered limestone outcrops, often with spectacular scenery, renders the NMNG catchment a great potential for ecotourism and scientific research. Yet, this potential has not been fully explored and their direct use is still limited[20].

Other land uses in the target villages that have been allocated to villages include Waterland, Communication Land, Construction Land and Cultural Land and some others. Table 4 below shows the village land allocation by categories[21] of the nine villages.

[20] The NMNG catchment area does not seem to be of priority for international ecotourism at this point or in the foreseeable future.

[21] For a detailed discussion of the different land categories and their general use restrictions as defined in the Land Law (Land Law 88/ PM 2008) and the Forestry Law 06/ NA 2007 (under review) see Research Report 4 'Payments for environmental services: the legality in the Lao PDR' (Scheufele, Smith, Tsechalicha, & Bennett, 2014).

Table 4: Land and forest allocation in the target villages of the PES scheme

Village	Total village area (ha)	Agricultural Land (ha)	Land for National Defense (ha)	Concession Land (ha)	Construction Land (ha)	Cultural Land (ha)	Conservation Forest (ha)	Production/ utilization Forest (ha)	National Protection Forest (ha)	District Protection Forest (ha)	Village Protection Forest (ha)	Reforestation Forest (ha)	Plantation Land (ha)	Industrial Land (ha)	Communication Land (ha)	Wetlands (ha)	Total households	Total population
Hang Na	1,047.816	231.085			27.781	4.425	382.803	241.998				79.300	32.669		12.983	34.772	69	420
Lak 5	1,048.471	265.873			33.041	2.158		300.800				380.747			21.44	44.412	123	876
Na Heuang	4,483.127	442.503			38.681	2.197	1,556.96	528.447				1,779.009			10.667	124.668	134	991
Na Tan	16,311.31	3,308.10	468.79		10.53	3.88			9,891.29	2,410.70					12.45	205.5	37	223
Na Yang	33,268.503	1,234.87			12.22	0.65			28,717.114			3,170.446			26.48	106.72	35	298
Pha Bo	21,257.13	4,366.30			25.71	2.91		4355.01				12,368.93			124.91	13.5	50	309
Nam On	6,258.460	968.74		605.33	77.33	13.94		526.580	3,021.110			800.750			90.28	154.40	168	1128
Phon Kham	9,199.760	902.12			14.84	2.19	2034.47	22.950	5,986.610			58.680			37.53	140.37	74	518
Vangban	7,756.450	264.34			59.79	20.16	410.76		5,591.990		925.940	376.100		0.810	28.45	78.11	68	549
Total area	**100,631.03**	**11,983.93**	**468.79**	**605.33**	**299.923**	**52.51**	**4,384.99**	**5,975.79**	**53,208.11**	**2,410.70**	**925.94**	**19,013.96**	**32.67**	**0.81**	**365.19**	**902.45**	**758**	**5,312**

Source: Bolikhamxay PONRE, 2014

Each of the village land use categories are explained as follows:

- Agricultural land (Land Law 04/ NA 2003) is the second largest land use allocated in the nine target villages, totaling 11,984 hectares and accounting for 11.9% of total village land. This land use type includes paddy land, land for slash and burn farming and possibly garden areas.
- Construction land (Land Law 04/ NA 2003)[22] is land designated and allocated for housing, and infrastructure. All target villages have been allocated construction land (300 hectares), which has been used mostly for housing.
- Concession land (Land Law 04/ NA 2003) is a land category (state land) authorized through the concession process for individuals or juridical entities to 'operate businesses' in accordance with the conditions and time limit specified legally in the terms of contract (Decree 135/ PM 2009). In the target villages there are 605.3 hectares of concession land recorded in Nam On Village.
- Cultural land (Land Law 04/ NA 2003)[23] is defined as land that contains cultural heritage and is related to the historical routes, traditional objects, archaeological sites, temples, natural landscape, cultural buildings, and other places which are determined by the State to be cultural and tourist land. Each of the target villages has cultural land, totaling together 52.5 hectares for the nine villages.
- Conservation Forests are defined in the Forestry Law 06/ NA 2007. Sustainable resource use (such as NTFP collection) is permitted provided the use does not cause irreversible resource loss or exhaustion. In the NMNG catchment, Village Conservation Forests, Village Protection Forests and Village Production Forests are 'embedded' the National Protection Forest (Pangkham, 2014).
- Reforestation land comprises the largest area of land use allocated to the target villages, totaling 19,013.96 hectares and accounting for almost 19% of village land. There is, however, an issue pertaining to the definition of this land type in relevant legislation what reforestation land actually means in a strict legal context. While it is open to interpretation it could mean that this is a disturbed or degraded

[22] From village consultations 'cconstructed land' is mentioned as the land on which construction has already taken place. It is not reflected and defined in the Land Law as a separate category rather it is embedded in the construction land.

[23] Sacred sites, spiritual and religious sites, cemetery land would fall under this land category.

forestland area which is left for regeneration, either through a natural process or through enrichment planting, or both.

- Communication land (Land Law 04/ NA 2003) is reserved for infrastructure such as the construction of roads has been allocated to all target villages.
- Wetlands[24] have been allocated to all target villages. Industrial land has only been allocated to one target village.

6. Administration

The administration of Lao PDR is organized hierarchically into the central government (Prime Minister's Office), provincial, district and village administrations. The intermediate administrative level between the village and district administrations is called '*kumban'* or village cluster which effectively makes up of villages located in a close geographical area[25]. Such an administrative structure is applied in the villages of the PES pilot scheme in the NMNG catchment.

At the village level, the role and functions of the village administration are to implement and manage the socio-economic development plans for the village, to protect and maintain security and public order, and to protect and preserve natural resources and the environment within the village (Law on Local Administration No 47/ NA 2003, Article 47). A village is divided into units, each composed of households that are normally located physically close to one another, where a unit head is selected and designated. Typically a village administration consists of the party organization, village Lao Front for National Construction (including village elders), mass organizations such as the village Lao Women's Union and Youth Union, as well as a village security unit/militia and other thematic units such as forestry, culture, etc.

[24] In the Land Law (2003) English version, this is translated as "Water Area Land" which seems to be technically imprecise while wording in the original Lao version clearly means a wetland.
[25] Due to the lack of substantive information on the rationale and objectives of cluster establishment including its role and responsibilities, it is not possible to provide a sufficient cluster description here.

The roles and functions of district administrations are defined by Article 20 of the Law on Local Administration (2003) as to manage political, economic, socio-cultural affairs and human resources; to protect, preserve and utilize natural resources, the environment and other resources; and to manage national and local defense and security, and foreign affairs as assigned by the province or capital city. The creation, abolition, division, merger or definition of the land area of a district is approved by the government, based on the recommendation of the governor or mayor (Article 24). Among other criteria, a district can be created where there is a population of at least 30,000 people for lowland area or 20,000 people for the mountainous area although exceptions to this criterion can be made by the government (Article 25).

Provincial and city administrations have the roles, functions and operational procedures to manage political, economic, socio-cultural affairs and human resources; to protect, preserve and utilize natural resources, the environment and other resources; and to manage national and local defense and security, and foreign affairs as assigned by the Government (Article 7).

7. Population

There are over 70 villages[26] in the NMNG catchment with a total population of about 52,000 people. The current pilot PES scheme involves 9 villages with 758 households and a population of about 5,300 people, accounting for 10.2% of the total NMMG catchment population. These are potential sellers of environmental services. The ethnicities of the population in the villages include Lao, Phouthai, Thai Daeng, Hmong, Laotheung (Khmu) and Toum[27]. Major occupations, income level and literacy level of the population of the target villages are among the important aspects for consideration in designing the pilot PES scheme, these are briefly described below.

[26] Note that the number of villages in the NMNG catchment is frequently assumed to be almost 100.
[27]Five out of the 9 target villages of the PES scheme have not been visited by the project team at the time of this report preparation.

The overall literacy rate of Bolikhamxay Province was 77% in 2005-86% among men and 68% among women. In the districts of the PES pilot scheme, literacy level varies among different ethnic groups and genders. Generally the male literacy rate is higher. For example, among the 15 year and above age group, the literacy rate for men was 78.3% and 51.6% for women in Khamkeut District compared with 73.8% and 47.6 % in Viengthong District[28] respectively. However the rate of the population to have completed lower secondary school was below 10% for both Viengthong and Khamkeut Districts in the 2005 Population Census (National Statistical Centre, 2007).

In terms of district-wide job types, about 5% of Khamkeut District's working population was engaged in non-agricultural work compared with about 20% of the Viengthong District working population who had non-agricultural work (Ibid.). To facilitate the PES scheme design, interviews in the target villages were carried out with the results presented in Table 5. Overall, the average annual income per person of the three PES target districts of Viengthong, Khamkeut and Xaychamphone is US$376, US$684 and US$237 respectively (Provincial Department of Natural Resources and Environment of Bolikhamxay, 2014).

[28]Xaychamphone District did not exist at the time of the 2005 Census.

Table 5: Selected socio-economic characteristics* of the project area

Village	Ethnic composition	Major occupation	Average HH income/year	Literacy level	Road Access	Access to electricity
Lak 5	Phu Thai, Tai Daeng, Hmong	Rice farming (>80%)		>90%	100%	90%
Hang Na	Phou Thai	Rice farming (>95%)		100%	Not easy in wet season	100%
Na Heuang	Hmong, Lao Loum, Lao Theung, Phou Thai	Rice farming		100%		100%
Pha Bo	Hmong, Lao Loum	Rice farming (by slash and burn), livestock raising		Majority illiterate	100%, landslide risk	under installation

Source:(Pangxang et al., 2014). (*) Accuracy of the primary figures in the table on literacy rate may be questionable, however these could be true for the current situation compared to, e.g., survey figures almost a decade ago.

Table 6: Income sources of the PES villages

Village	# Household*	Sources of household income/year, million Kip								
		Rice	Livestock	Agr. crops	Handicraft	Salary/ wages	Trade business	Asset sale	NTFP sale	From other sources
Viengthong District										
Pha Bo	50	0	10	15	0	43	0	0	3	0
Na Tan	37	0	1.173	5	0	18.8	0	38	30	5
Na Yang	35	0	3	11	0	0	0	0	749	67
Khamkeut District										
Lak 5	123	435	869	1.8	580	507	3.62	1	362	507
Hang Na	69	3.57	1.28	2.57	571	741	3	133	143	23
Na Heuang	134	32	1.326	1.577	67	210	5	76	330	8
Xaychamphone District										
Nam On	168	0	3.67	0	0	521	1.295	885	0	0
Vangban	68	0	200	667	0	88	32	0	854	0
Phonkham	74	0	698	116	0	33	2	0	15	0

Source: PONRE, 2014. (*) No. households are based on the PONRE dataset for 2013.

8. Land tenure

Land allocation was completed in all villages of the NMNG catchment, including all the villages targeted for PES scheme (Provincial Department of Natural Resources and Environment of Bolikhamxay, 2014). Nevertheless the land allocation is only completed for temporary land use and no villages of the 9 villages targeted for the PES scheme have been issued permanent tenure right for long term land use ownership(Pangxang et al., 2014).

9. Threats to the environment

Biodiversity degradation

According to officials of the Bolikhamxay PONRE, 'the main threats to the forest animals (wildlife) in the catchment of the Nam Gnouang Reservoir, namely the Nam Mouane-Nam Gnouang National Protection Forest, are hunting, illegal and legal logging, shifting cultivation, industrial developments, and dam and road developments'(Souriya & Pangkham, 2014). Of these, according to the PONRE officials, the biggest threats to wildlife are hunting for trade, road development and shifting cultivation. As reported by the International Centre for Environmental Management (2010), 'in the Bolikhamxay and Khammouan Provinces, Protected Areas and biodiversity are under threat from illegal logging and deforestation. Currently there is almost no control of logging and hunting in the protected areas. Additionally, the pressure on timber, wild animals and NTFP including medicinal plants is expected to increase from Vietnam and China'. Poaching is especially damaging if motivated by wildlife trade (Duckworth et al., 1999; Government of Lao PDR, 2005; International Centre for Environmental Management, 2010; Wildlife Conservation Society, 1995). Tizard (1996) attributes shifting cultivation, hunting, logging and habitat fragmentation/degradation as threats to wildlife (birds and mammals) in the surveyed areas of the NG catchment along the Annamite Chain in Bolikhamxay

Province. More generally (Kyophilavong & Tsechalicha, 2011) found through a survey on NPAs in Lao PDR that hunting is the highest threat to NPAs.

Widespread hunting is largely attributed to the trade in wildlife across the border between Lao PDR and Vietnam with a wildlife trading point located in Vietnam just a few kilometers away from the border. Given the high demand for wildlife coupled with insufficient and ineffective patrolling, Vietnamese hunters and poachers have incentives to cross the border to poach forest animals on the Lao side, namely in the Nam Mouane-Nam Gnouang National Protection Forest area. The most heavily poached area is located along the border with Xieng Khouang Province (Souriya & Pangkham, 2014). The situation is aggravated by similarly high demand inside the Lao PDR providing incentives for local hunting and poaching of wildlife for food namely Muntjac sp., Wild boar, Civet sp., Bush-tailed Porcupine and birds (Pangkham, 2014). Thus, it is not uncommon to find wildlife on sale in the local shops in towns and villages inside the Nam Mouane – Nam Gnouang National Protection Forest near the Nam Kading NPA (Souriya & Pangkham, 2014).

Threats to wildlife can become more critical through having improved access to forest areas and wildlife habitats. Norplan A.S. (2008a) notes at the time that the THXP development would provide greater access and opportunities for the wildlife trade and collection of NTFP through allowing greater access via vehicle and boat to Nam Heung, Nam Chat/Nam Pan, Nam Khou, Nam Pon, Nam Khamang, Nam Thong and other smaller streams in the catchment that may have significant biodiversity value. Of particular concern is the iconic extremely rare and endangered Saola (*Pseudoryx nghetinhensis*), which is endemic to Laos and Vietnam and has the highest conservation status in the Lao PDR (International Centre for Environmental Management, 2010). In addition to the direct hunting threat, various hunting techniques employed by poachers such as hunting with dogs, snaring and trapping of wildlife are detrimental to the Saola (W. Robichaud, 2014) even if the animal may not be the targeted species[29].

[29] On how critical snare collection is in the area considered to be Saola habitat, see the 2013 *Annual Report of the Saola Working Group* at:
http://www.asianwildcattle.org/documents/2013%20SWG%20Annual%20Report.pdf.

In summary, the biodiversity in the area has declined due to increased hunting and poaching of forest animals and a continuing loss and fragmentation of habitat through deforestation. The following are the main environmental problems identified in the nine target villages (Provincial Department of Natural Resources and Environment of Bolikhamxay, 2014):

- Slash and burn cultivation in the watershed areas;
- Uncontrolled forest burning;
- Illegal logging for sale; and
- Hunting and poaching of wild animals by using modern firearms and destructive fishing.

PONRE aims to address the above problems as they are viewed as creating negative impacts on the environment and people's livelihood. It has been found that biodiversity decline has been correlated with the increasing number of development projects in the Province. These include hydroelectricity power plants and road constructions. However, management of the natural resources has been largely ineffective. This is despite strict laws and regulations that are in place but are poorly implemented and enforced (Souriya & Pangkham, 2014).

Soil erosion

As described above, the topography of the NMNG catchment is predominately mountainous, where most lands are steep slope. Given the soil types present, the soil seems to be susceptible to erosion if bare land is left exposed to rain and runoff. On examination of the soil type map of Bolikhamxay Province produced by the Agricultural Land Management and Development Department of the National Agriculture and Forestry Research Institute (NAFRI), four soil types can be identified in the area, which are: *Haplic Alisols, Haplic Luvisols, Eutric Cambisols and Haplic Acrisols* (Figure 8).

By a physical observation, the soil present along the road and around Pha Bo Village area is mixed coarse yellowish soil with rock content which easily disintegrates as it gets

saturated and appears to be easily erodible[30] though the actual erosion rate is unknown. The villagers of the target PES pilot scheme in Khamkeut District, for example, reported severe soil erosion and flooding along the Phao and Maheuang rivers in 1996 and 2002. No subsequent management action has been taken(Pangxang et al., 2014).

In terms of the topographical gradient (Figure 9), the land areas of the villages identified for the PES pilot scheme, except in the target villages of Khamkeut District, fall predominately under Watershed Class I-III described by Heinimann (2003)[31] in relation to the Lao PDR Watershed Classification Map[32]. These correlate well with the NAFRI Gradient Map for Bolikhamxay Province where the gradients of the topography concerned appear to have fallen within the range of 16%-30%, 30%-55% and above 55% (Figure 9).

Reduction of forest cover

The areas targeted for the PES pilot scheme have been under reduced natural forest cover through slash and burn farming and are dominated by secondary growth at various stages. As mentioned above, Bolikhamxay Province as a whole has experienced reduced forest cover from 61.4% in 2002 to 54.9% in 2010 (Department of Forestry, 2012). As has been observed, abandoned upland fields in this area, if left undisturbed, have a high potential to become re-vegetated although the rate of recovery varies (see Section 3).

[30] The villagers interviewed did not mention erosion as a big problem in their lands, largely fallow areas are covered with vegetation/ grass.

[31] 'Class I: *Protection Forest* - Areas with very steep slopes and rugged landforms, commonly uplands and headwater areas. Critical areas for water and soil resources management […].Class II: *Commercial Forest* - Areas with steep slopes, usually at higher elevation. Landforms are in general less susceptible to water and soil degradation than under WSC Class 1. Recommended land use: forest (conservation and production forests), agro-forestry and grazing, if accompanied by strict conservation measures. Class III: *Agro-Forestry* - Areas with moderate to steep slopes and less erosive landforms. Includes uplands and foot zones of slopes. Wider range of land use tolerable than in WSC Classes 1 and 2 from the point of view of water and soil conservation. May be used for commercial forest, grazing and combinations of trees and agricultural crops, if appropriate conservation measures are applied (Heinimann, 2003).

[32]Prepared as part of the Lower Mekong Basin Watershed Classification Project of the Mekong River Commission (MRC).

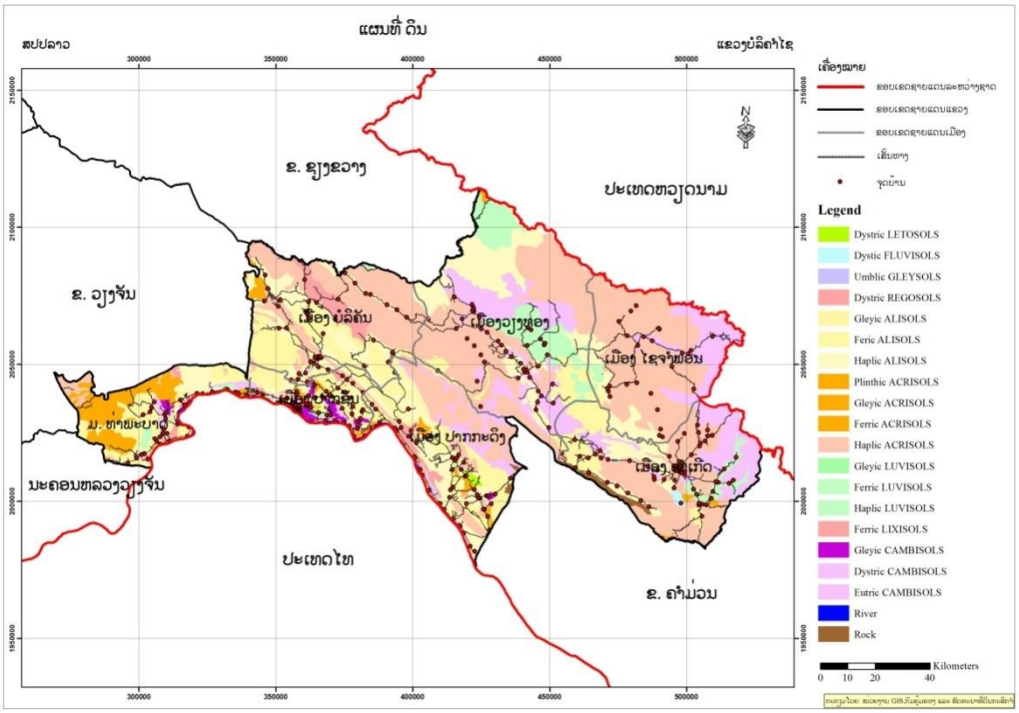


Figure 8: Soil Map of Bolikhamxay Province

Source: National Agriculture and Forestry Research Institute

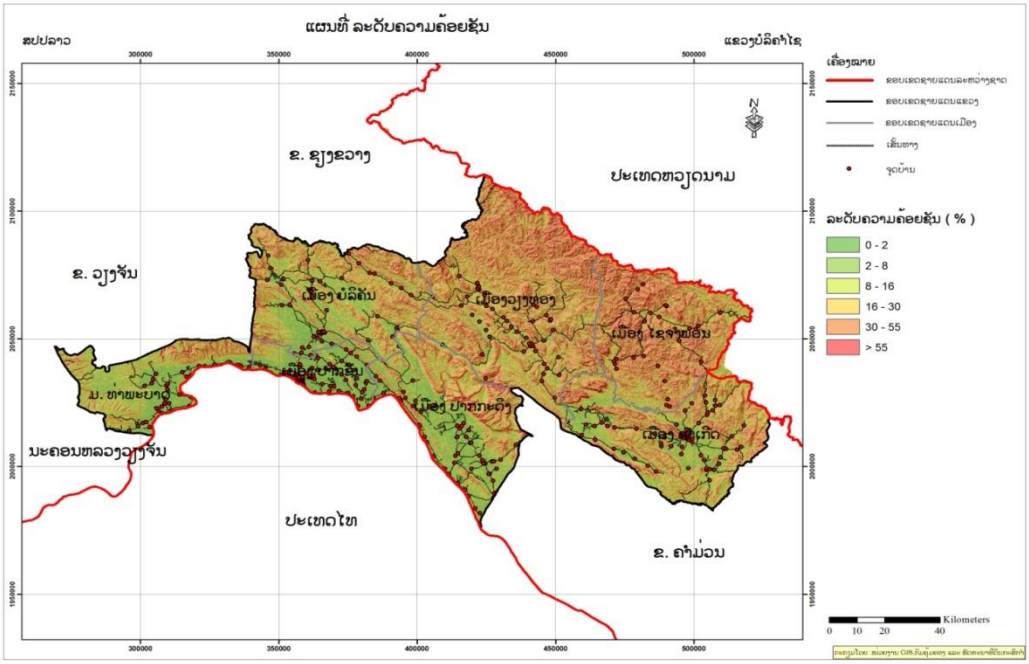


Figure 9: Slope (Gradient) Map of Bolikhamxay Province

Source: National Agriculture and Forestry Research Institute.

10. Existing management strategies and actions

The Government of Lao PDR (GoL) aims to increase forest cover in the Lao PDR to 70% in 2020 (Government of Lao PDR, 2005; Order 17/PM 2008 on Strengthening the Forest Management, Protection and the Coordination of Management Forest and Forestry Business). For the Bolikhamxay Province, about 14% of the 194.4 hectares of Production Forest, 21 % of the 617,000 hectares of Protection Forest and about 13 % of the 58,400 hectares of Conservation Forest have been identified as having potential for reforestation (Table 7).

In the local context, as part of its environmental conservation, the THPC has proposed a catchment protection program aimed at reducing erosion and silt in the reservoir, and improving water quality for fisheries. The company considers 'planting trees and rehabilitation of selected areas will more than offset the losses [of forest areas] due to flooding and [dam] construction'(Social and Environmental Division, 2011). Thus THPC's strategy for forest regeneration is through assisted natural regeneration in areas considered to be at high risk of erosion or severely degraded (Norplan A.S., 2008b).

THPC has started a reforestation program along the edges of the reservoir, planting more than 111 hectares with local tree species with the aim to 'rehabilitate the protected area so that local flora and fauna can repopulate it, making the PFA [Nam Gnouang South Protected Forest Area] a wildlife corridor between nearby National Protected Areas'(Social and Environmental Division, 2012).

THPC has worked closely with government agencies and WCS to create a catchment management plan for the long-term rehabilitation of the area above the NG Reservoir (Ibid.). WCS has been active in natural resources management in Bolikhamxay Province for many years, focusing largely on wildlife surveys and NPA management. Current WCS engagement in the Nam Gnouang catchment includes support of the protection and restoration of the forest area (50 sq. km described above) of the Nam Gnouang watershed.

Table 7: Areas of the three forest types in five provinces of Central Laos

No.	Province	Production Forests				Protection Forests				Conservation/Protected Forests			
		Forested area(%)	Area potential for reforestation (%)	Other area(%)	Total area (ha)	Forested area (%)	Area potential for reforestation (%)	Other area(%)	Total area (ha)	Forested area(%)	Area potential for reforestation (%)	Other area(%)	Total area (ha)
1	Vientiane Capital	-	-	-	-	27.37	53.58	19.05	9,400	24.55	42.94	32.51	169,600
2	Xieng Khouang	39.60	44.48	15.91	307,700	34.18	39.91	25.91	642,000	43.14	43.33	13.54	366,600
3	Vientiane	66.16	28.86	4.97	295,900	52.61	38.80	8.59	658,900	59.67	33.74	6.58	126,800
4	*Bolikhamxay*	*78.32*	*14.26*	*7.42*	*194,400*	*63.79*	*20.91*	*15.30*	*617,000*	*65.85*	*13.30*	*20.84*	*58,400*
5	Khammouane	46.19	22.17	31.64	258,600	39.65	18.19	42.17	127,900	59.46	8.72	31.82	862,800
	Central Laos overall	**55.78**	**29.09**	**15.14**	**1,056,600**	**49.29**	**32.56**	**18.15**	**2,055,200**	**52.20**	**22.56**	**25.24**	**1,584,200**

Source: Department of Forestry (Extract), 2012.

It is reported that this new conservation area has the potential to form a biodiversity corridor linking the Sai PhouLuang mountain chain with Nam Kading NPA (Travers, et al. 2010), with a high diversity of wildlife, including many species of regional or global conservation concern (McWilliam, 2007; cited in Travers et al., 2010).

The Community Conservation Network (CCN) Project (implemented 2010-2012) was funded by the World Bank through the Environment Protection Fund (EPF) with the aim of integrating forest conservation with livelihood improvement through community participation in protected area management in the Nam Theun-Nam Kading Basin. It was designed 'to enhance knowledge and understanding of local communities on the need to protect the watershed, to conserve natural resources and biodiversity, and to provide knowledge and opportunities on various livelihood development options' (Environment Protection Fund, 2013). The villages involved in the project were those located adjacent to the Nam Kading and Nakai-Nam Theun NPAs. Six villages from each of the two districts, Pak Kading and Khamkeut, were involved in this project. The main achievements included land use planning, forest rehabilitation, zoning for the sustainable

use of NTFPs, zoning for the management of endangered wildlife species, livelihood development activities and capacity building for village personnel. The CCN also dealt with preventing forest encroachment and hunting wildlife, including patrolling and regular monitoring activities[33]. For instance, under the sub-project activities in the Nam Kading River Basin, village conservation networks were established in 12 villages. Village patrolling was regularly conducted 2-4 times per month but later was reduced to monthly as a result of reduced threats (Ibid.).

The villages that will be involved in the pilot PES scheme are currently involved in a forest protection project supported by the EPF. The EPF has been working with these villages to support the management of the Upper Nam Gnouang National Protection Forest in close cooperation with Bolikhamxay PONRE. The objectives of the three year project are to enhance the institutional capacity, increase the forest coverage in the area by 1% in 2015, as well as increase villagers' participation in conservation activities[34].

11. Possible new management actions

While a range of management actions will be required to enhance and maintain environmental conditions and the associated environmental services in the NMNG catchment, protecting forest habitats and the wildlife they contain are of key importance. Generally based on initial local consultations, actions that can potentially be adopted by villagers in the pilot PES project sites include reforestation and forest protection both for increased forest cover and biodiversity benefit, wildlife monitoring, snare collection and anti-poaching patrolling.

Complementarily zoning of the National Protection Forest on the ground in concerned villages may be necessary to restrict unsustainable resource use/ extraction impacting biodiversity and ecosystem functions. Additionally, the provision of incentives to

[33] According to a CCN End-of-Project Report (in Lao, undated draft), patrolling was conducted in conservation forest, protected areas, NTFP management zones, Endangered Species Conservation Zones and in fishery conservation pools.
[34]See the Lao EPF website at: http://www.laoepf.org.la

enhance forest regrowth from fallow to more mature forest (which can be measured according to the growth age) may support forest protection.

Slash-and-burn agriculture is still the dominant type of agriculture in the THXP watershed. One problem with this farming practice in the NMNG catchment is that it has encroached onto forest areas beyond the land allocated to villages, in addition to the impact of fire associated with the burning of slash and burn fields as it often spreads into other surrounding areas. Slash and burn agriculture is also characterized by low productivity, therefore the pressure on the remaining undisturbed forests could be reduced by improving agricultural productivity of slash-and-burn plots. Or, replacing rice with more profitable crops (for example, fruit trees) and introducing sustainable agricultural practices would also be an option. For these actions, small-scale farmers would have to be paid to enable the transition to make the necessary investments. Training would be necessary as well for this option to work. In addition, small-scale farmers could be offered compensation payments to reduce their agricultural activity, and thus reduce the area they would otherwise slash- and-burn.

12. Conclusion

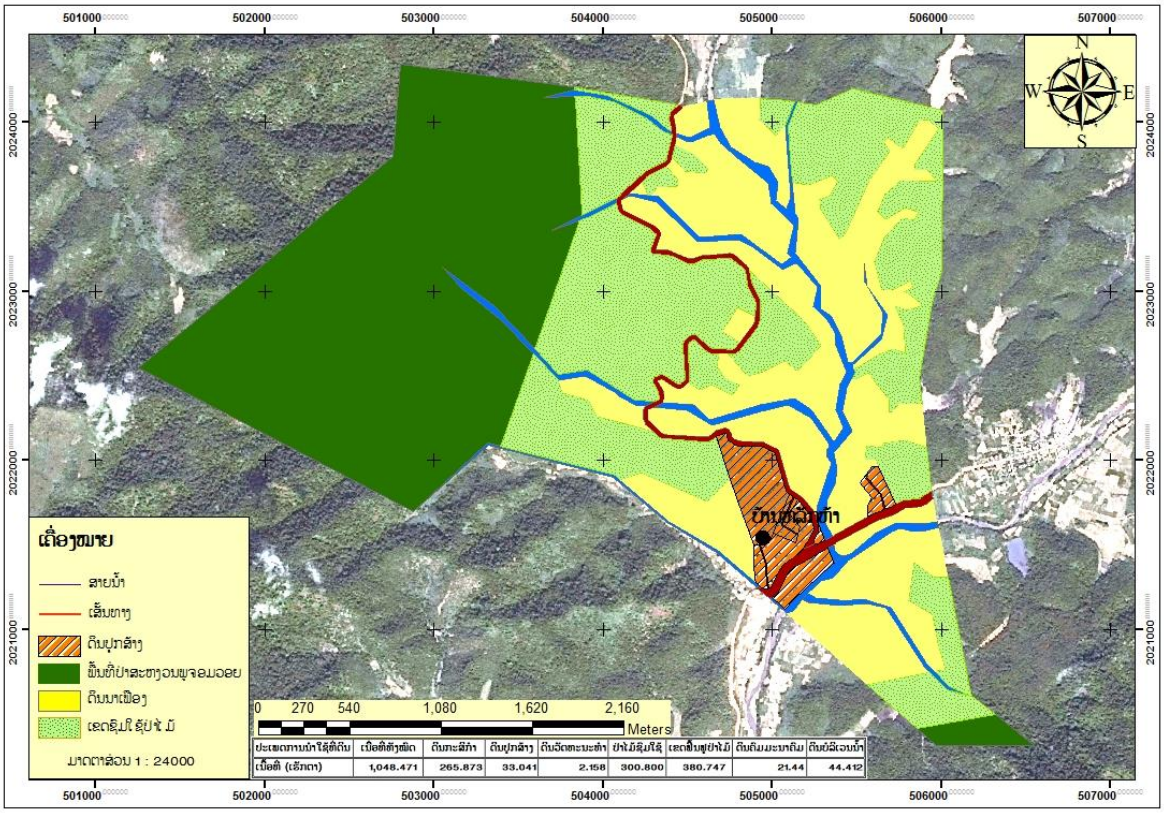
The objective of this Research Report has been to overview the environmental, social and economic condition of the NMNG catchment to identify the issues and impacts on the environment of the current land uses. It has been shown that current land uses have negative impacts on forest cover and biodiversity. Protection of the natural resources could improve the livelihoods of small-scale farmers and can ultimately lead to long-term maintenance of ecosystem services in the NMNG catchment. Reducing the pressure on undisturbed forests by improving agricultural productivity of slash-and-burn plots as well improving law enforcement at the provincial and district levels could support the protection of forest cover and forest wildlife.

Acknowledgments

We acknowledge Michael Renton, Marit Kragt, Gabriela Scheufele, and Jeff Bennett for valuable comments and exchange of ideas.

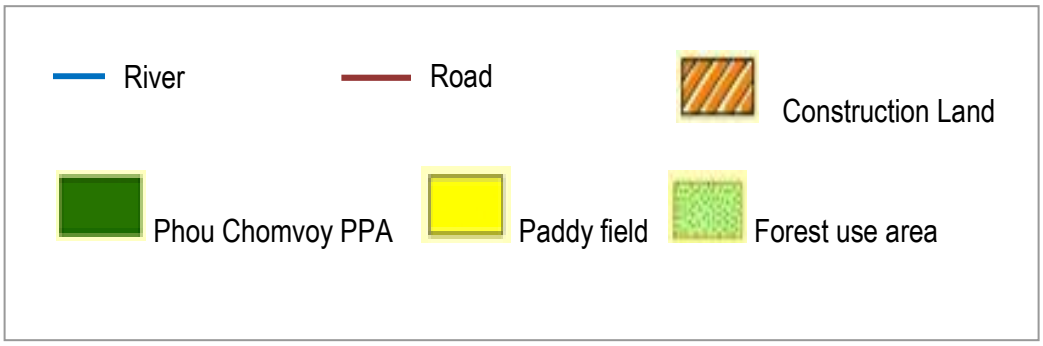
Annex: Village Land Use Maps

Annex A: Lak 5 Village Land Use Map, Khamkeut District

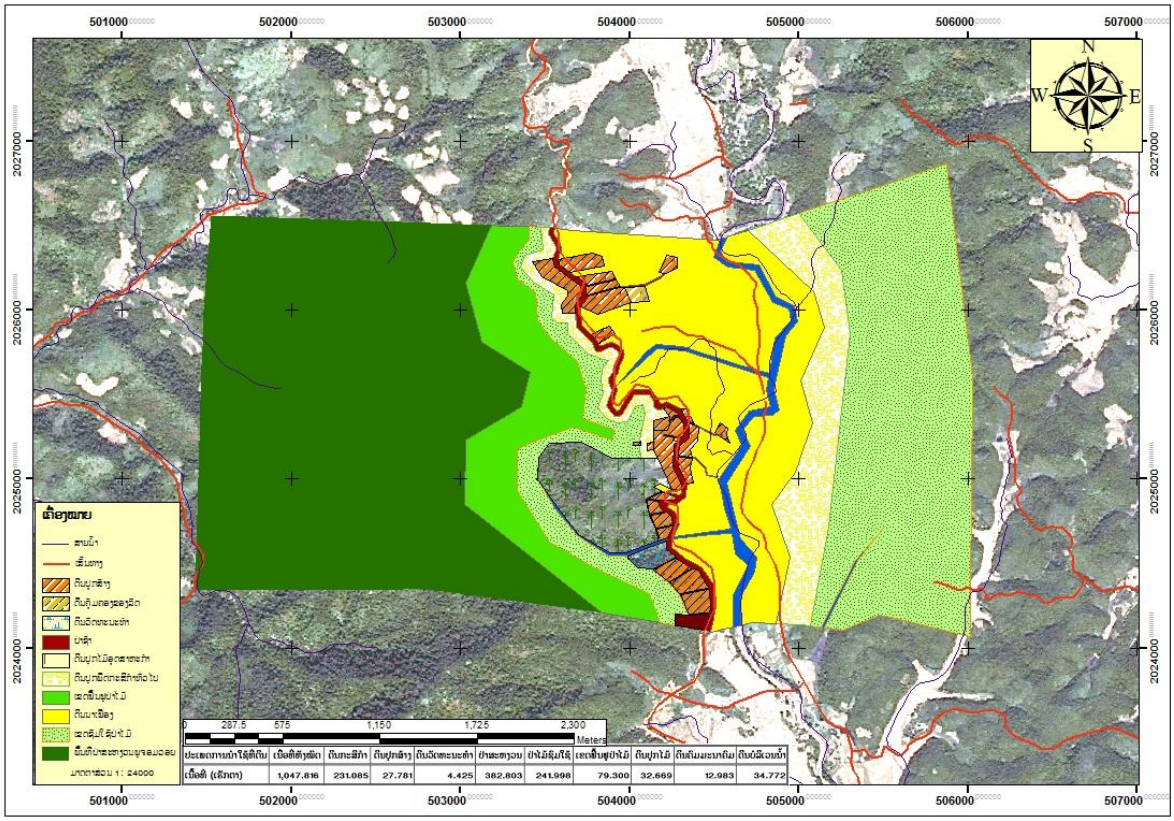


Source: Bolikhamxay PONRE.

Legend:

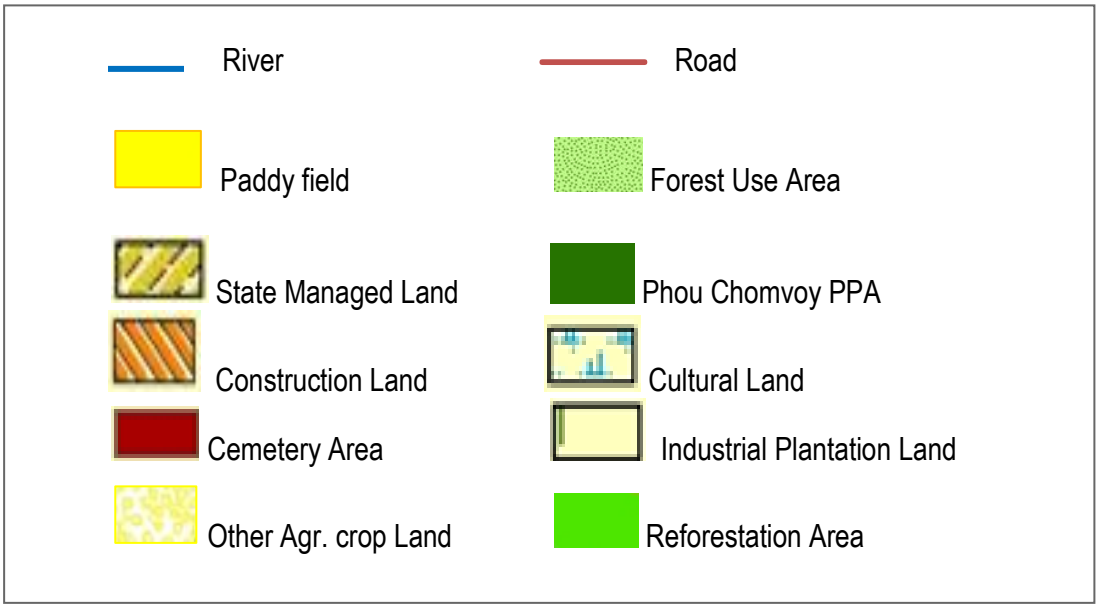


Annex B: Hang Na Village Land Use Map, Khamkeut District

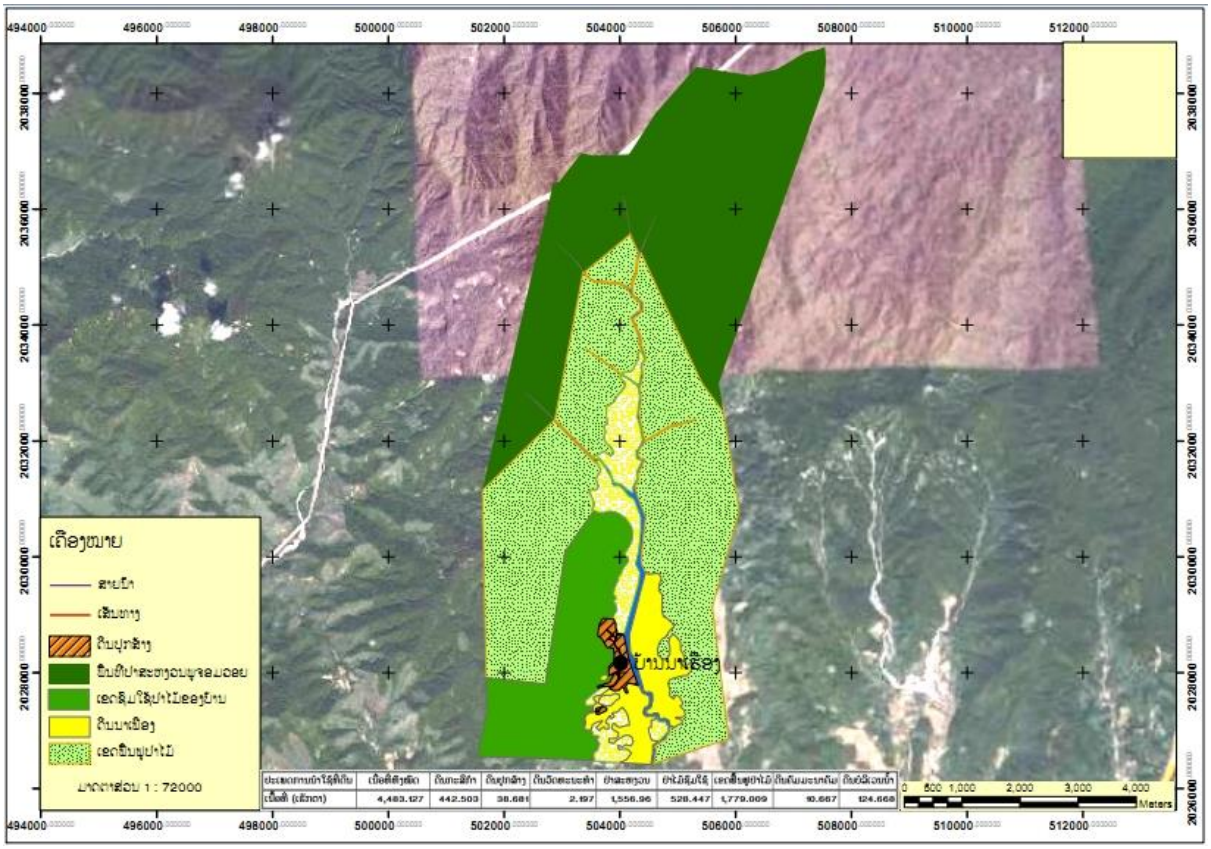


Source: Bolikhamxay PONRE

Legend:



Annex C: Na Heuang Village Land Use Map, Khamkeut District



Source: Bolikhamxay PONRE

Legend:

River

Road

Construction Land

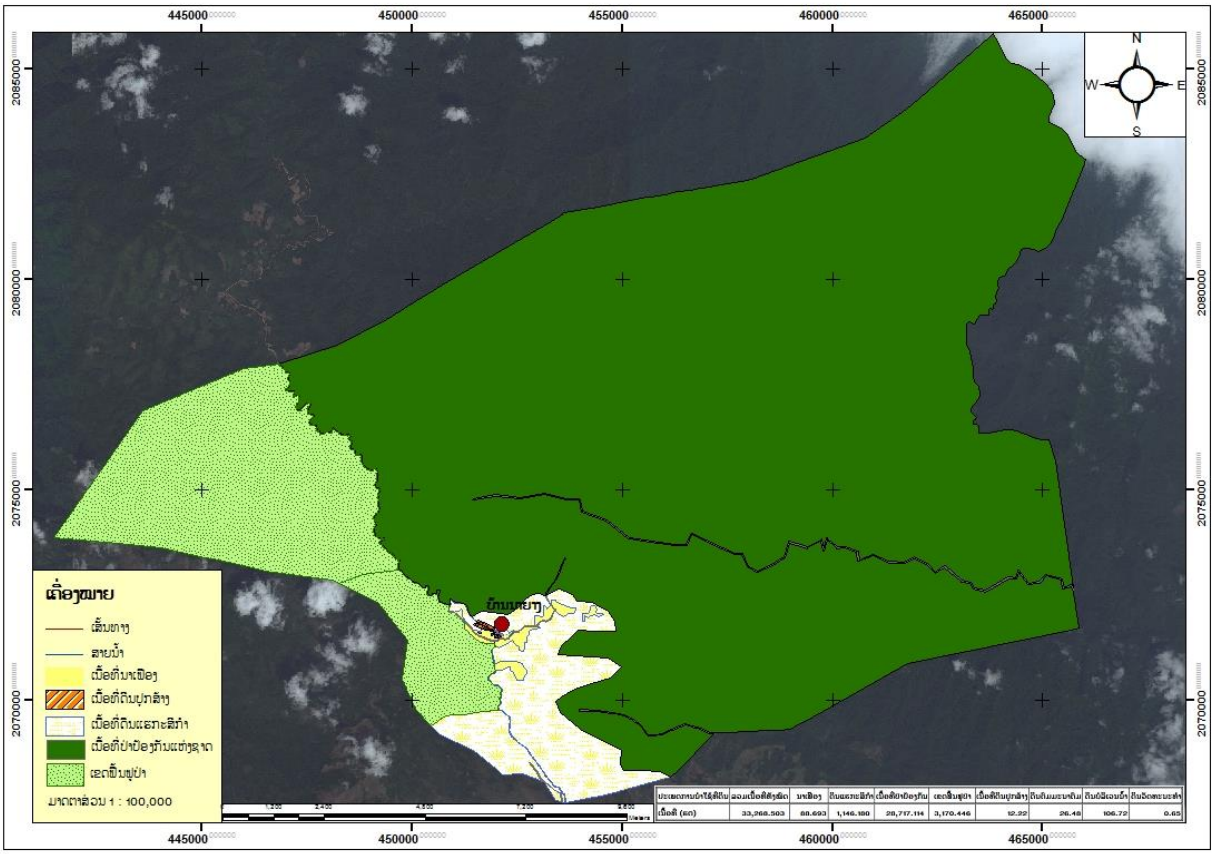
Forest Use Area

Reforestation Area

Phou Chomvoy PPA

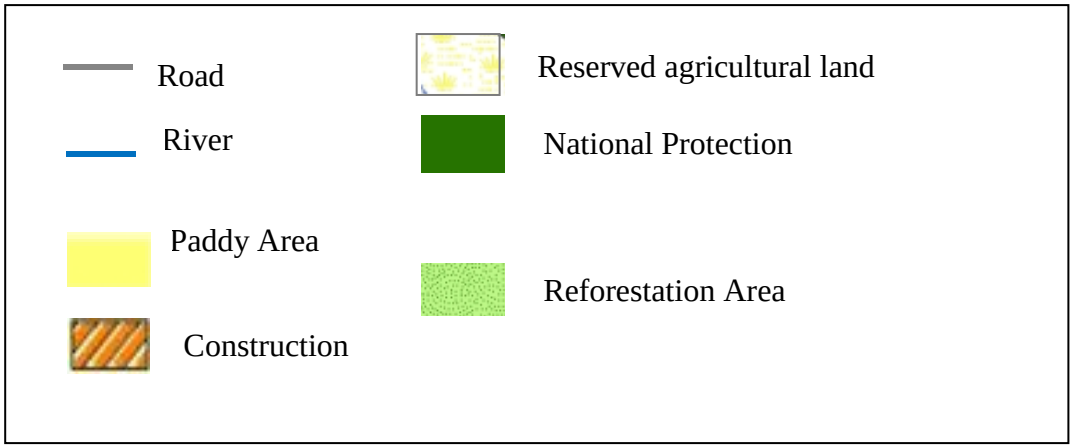
Paddy Land

Annex D: Na Yang Land Use Map, Viengthong District

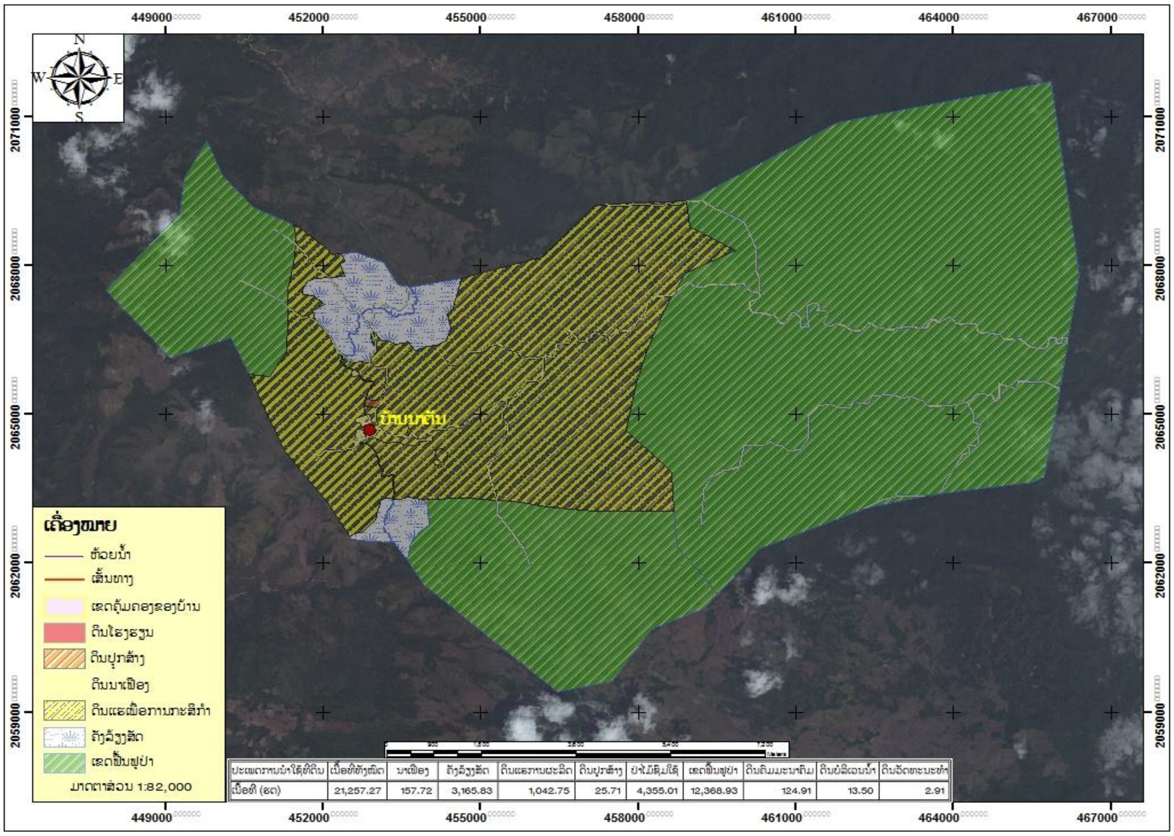


Source: Bolikhamxay PONRE

Legend:



Annex E: Na Tan Village Land Use Map, Viengthong District



Source: Bolikhamxay PONRE.

Legend:

River

Road

School Area

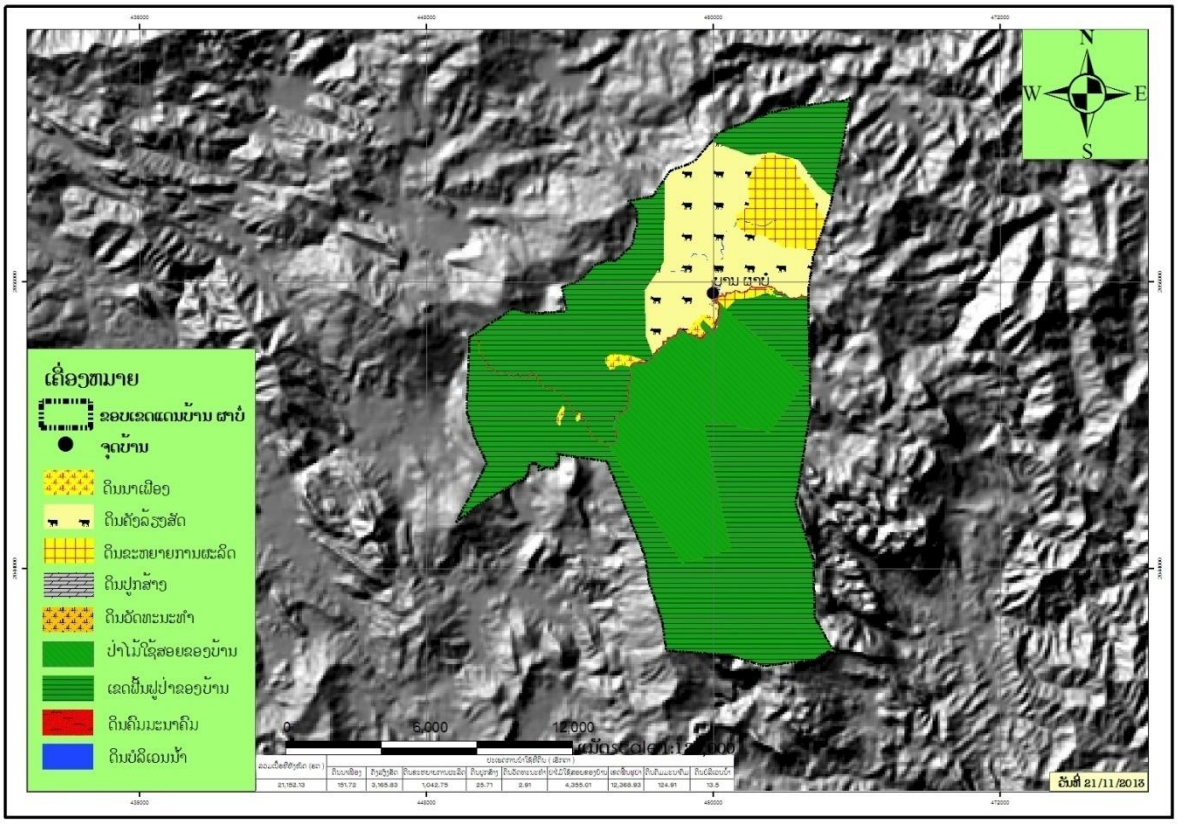
Construction

Reserved for agriculture

Livestock grazing land

Reforestation area

Annex F: Pha Bo Village Land Use Map, Viengthong District

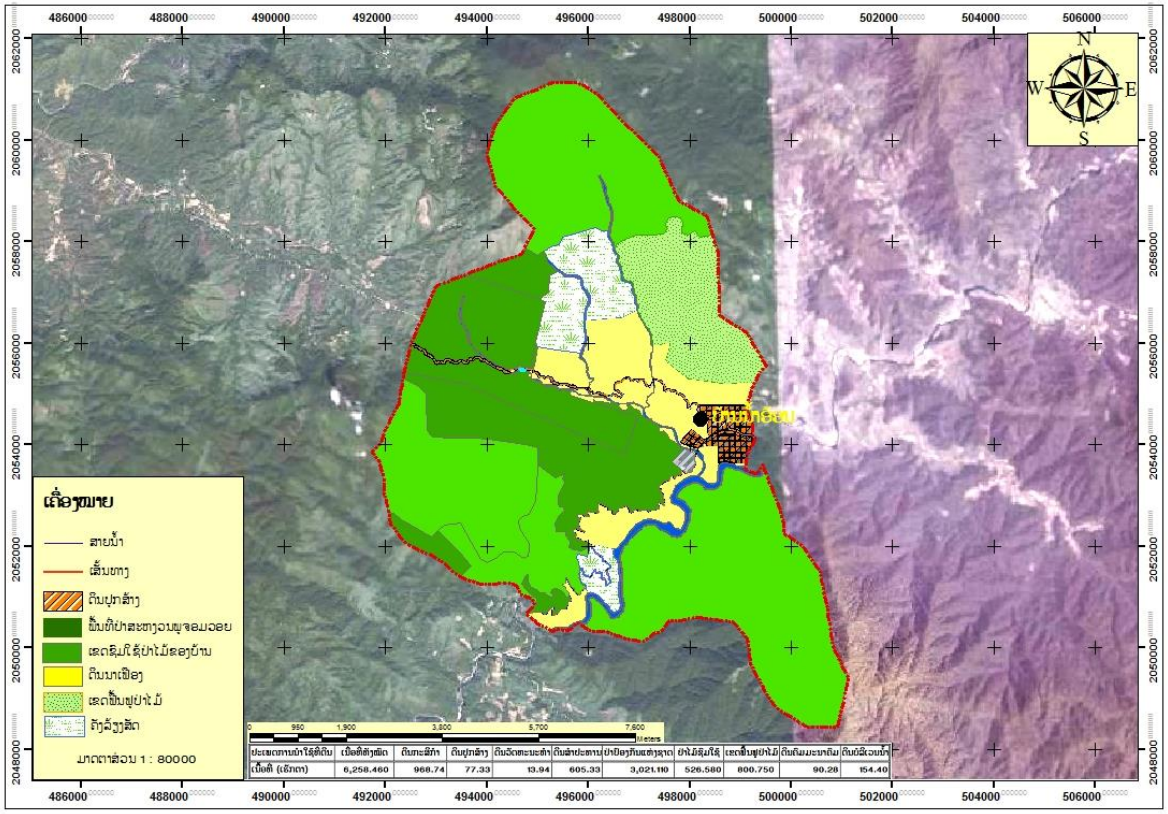


Source: Bolikhamxay PONRE

Legend:

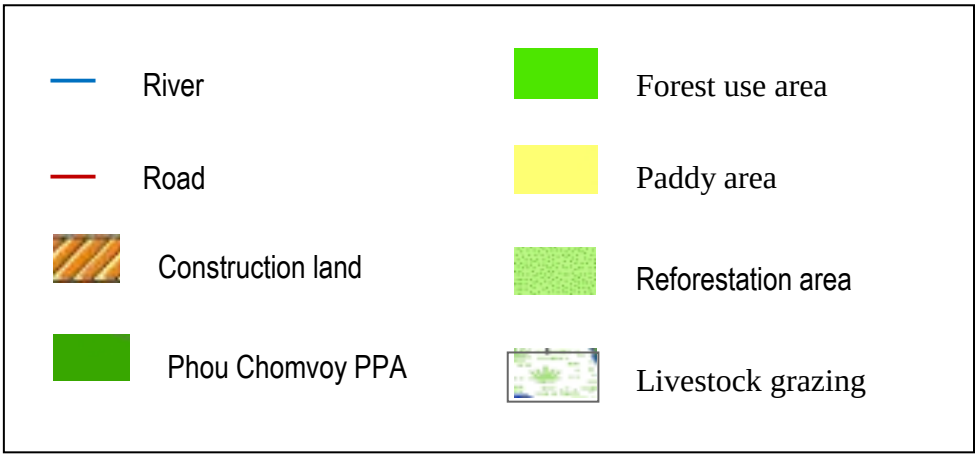
Village	Livestock grazing
Village	Production expansion
Paddy land	Reforestation area

Annex G: Nam On Village Land Use Map, Xaychamphone District

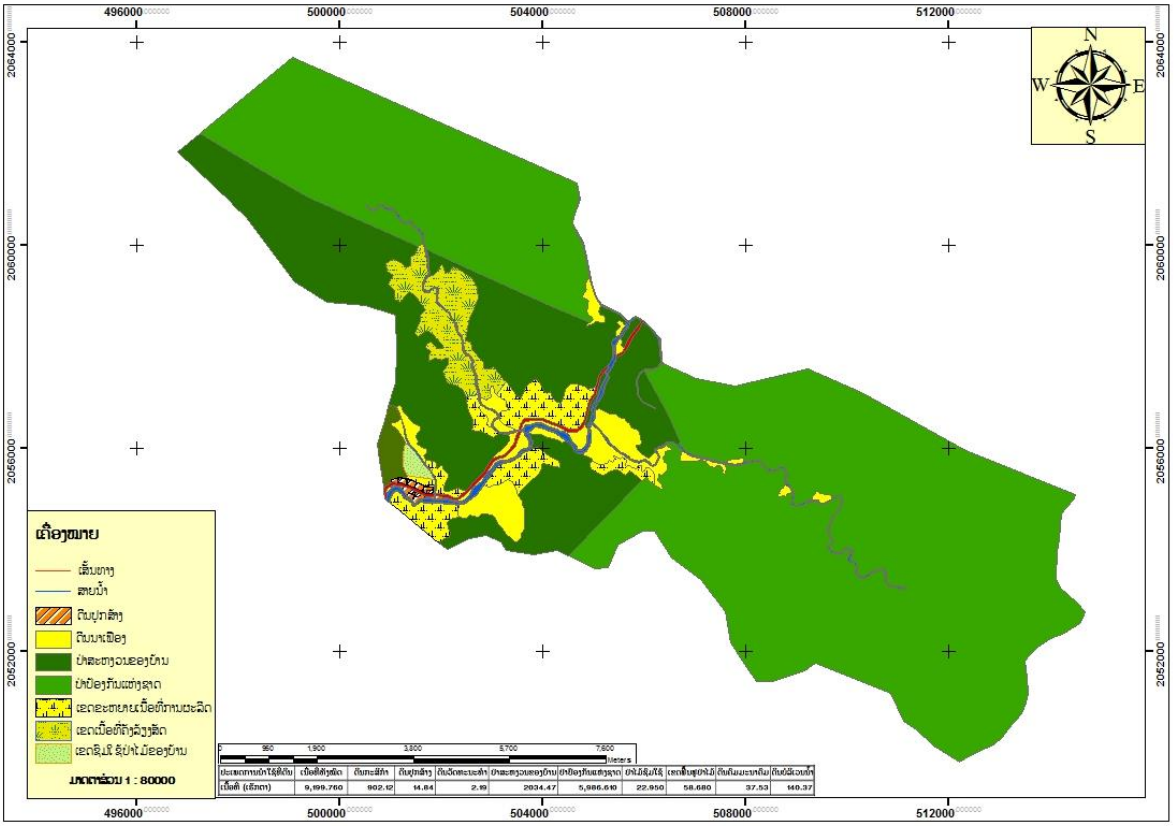


Source: Bolikhamxay PONRE.

Legend:

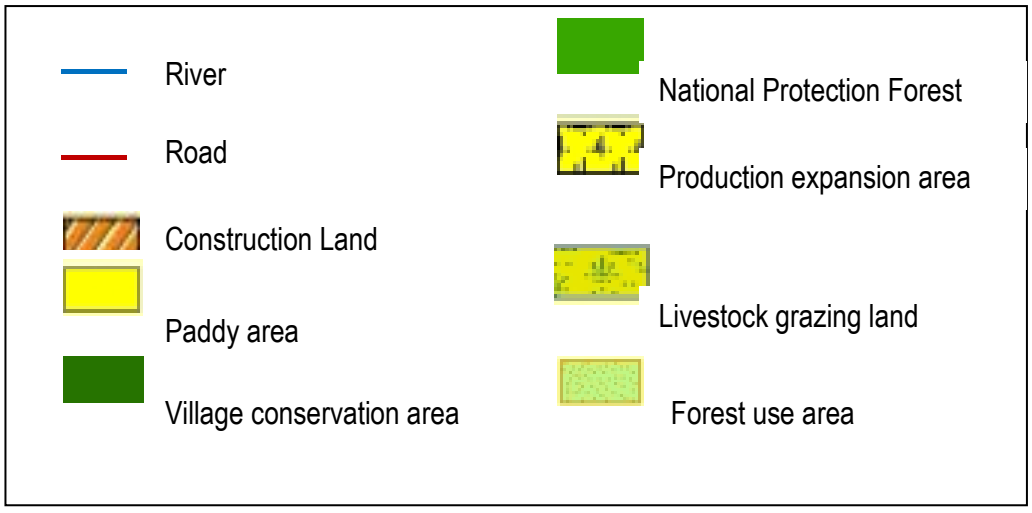


Annex H: Phonkham Village Land Use Map, Xaychamphone District

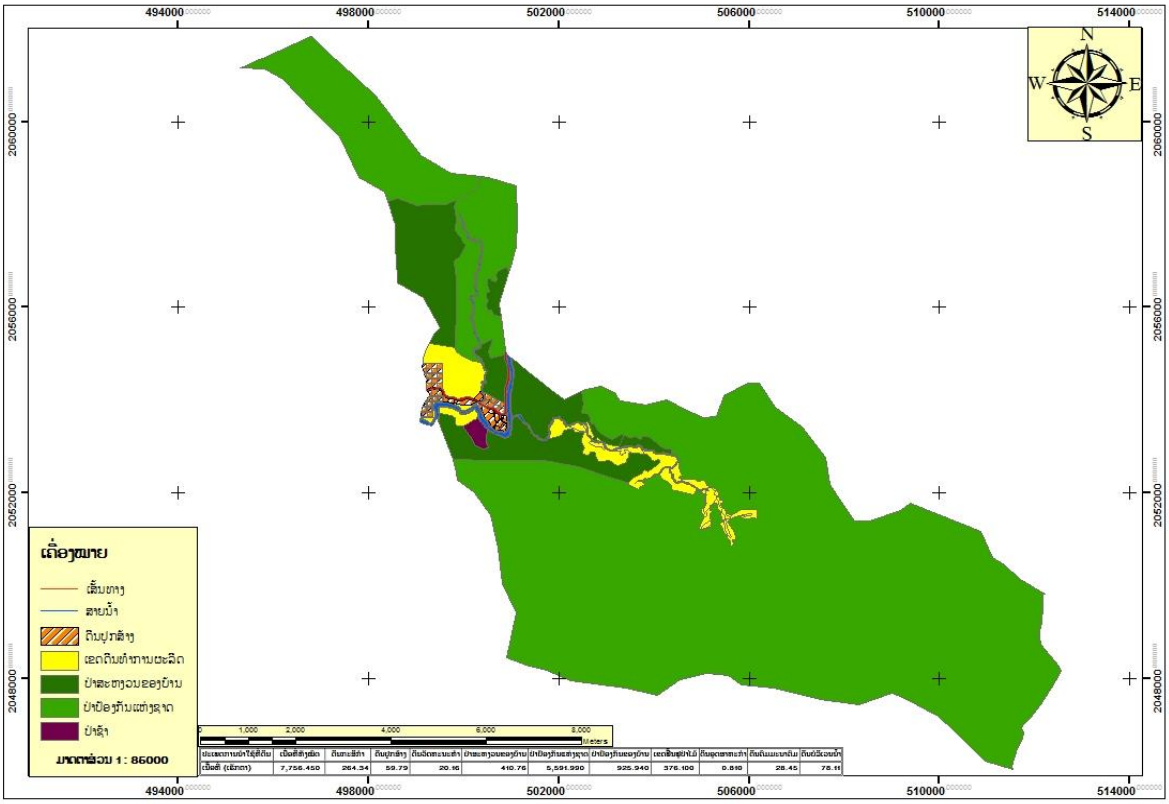


Source: Bolikhamxay PONRE.

Legend:



Annex I: Vangban Village Land Use Map, Xaychamphone District



Source: Bolikhamxay PONRE

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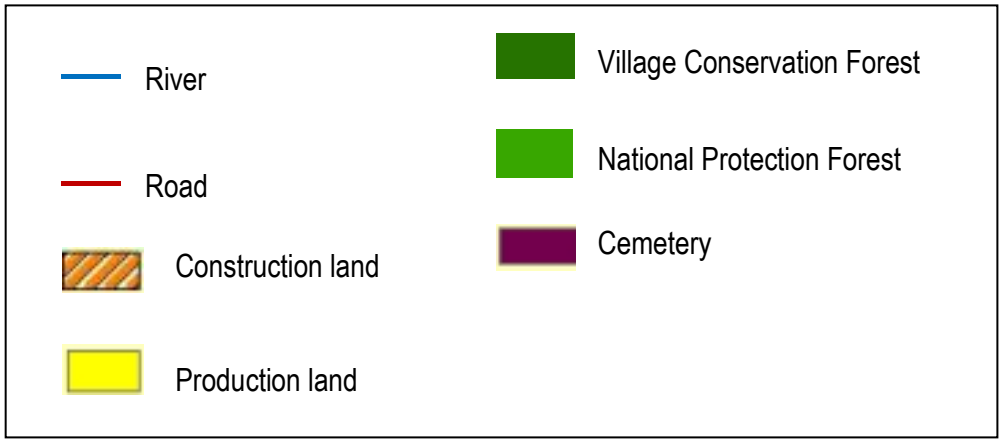

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