My Ly - Nam Mo Hydropower JSC

Environmental and Social Impact Assessment

MY LY HYDROPOWER PROJECT

Volume I
Environmental and Social Impact Assessment
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Volume I

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International Consultant:	Input from National Consultant:
ENVIRO-DEV	**Power Engineering Consulting Joint Stock Company I (PECC1)**
Contact: Olsbergsveien, N-2510 Tylldalen Norway env-dev@online.no www.enviro-dev-no.com +47 90267958	Contact: Km 9+200 Nguyen Trai Street, Thanh Xuan Nam Ward, Thanh Xuan District, Ha Noi, Vietnam caothuyen@yahoo.com +84 3 8542270; +84 904230082

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ABBREVIATIONS AND ACRONYMS

Abbreviation/Acronym	
ACBP	Awareness and Capacity Building Plan
Project AI	Project Area of Influence
AP	Affected Person
CLO	Community Liaison Officer
CSR	Corporate Social Responsibility
CVC (crushing facility)	Conventional Concrete
dBA	Decibel A-weighting
DARD	Department of Agriculture and Rural Development
DIA	Direct Impact Area
DPC	District People's Committee
DONRE	Department of Natural Resources and Environment
E	East
E&S	Environmental and Social
ECC	Environmental Compliance Certificate
EHS	Environment, Health and Safety
EHSP	Environment, Health and Safety Plan
EIA	Environmental Impact Assessment
EMDF	Ethnic Minority Development Framework
EMS	Environmental Management System
ESAP	Environmental and Social Action Plan
ESIA	Environmental and Social Impact Assessment
ESMMP	Environmental and Social Management and Monitoring Plan
ESMP	Environmental and Social Management Plan
EVN	Electricity of Vietnam
FGD	Focus Group Discussion
FI	Finance Institution
FPIC	Free and Prior Informed Consent
FS	Feasibility Study
FSL	Full Supply Level
Genco	EVN Generation Company
GoL	Government of Lao PDR
GoV	Government of Vietnam
GN	Guidance Notes
GRU	Grievance Redress Unit
GRP	Grievance Redress Procedure/Porcess
GRM	Grievance Redress Mechanism
ha	Hectare
HH	Household
HPP	Hydropower Project
IAA	Indirect Impact Area
IC	International Consultant
ICP	Informed Communication and Participation
ICS	Improved cooking stoves
IFC	International Finance Corporation
IFC PS	IFC Performance Standards

Abbreviation/Acronym	
IFI	International Finance Institutions
IIA	Indirect Impact Area
IP	Indigenous People
IUCN	International Union for Conservation of Nature
JSC	Joint Stock Company
KII	Key Informant Interview
kWh	kilowatt-hour
Lao PDR	Lao Peoples Democratic Republic
Lao SCB	Lao Statistics Bureau
MAF	Ministry of Agriculture and Forestry (Lao PDR)
MARD	Ministry of Agriculture and Rural Development
masl	meters above sea level
MIGA	Multilateral Investment Guarantee Agency
MOIT	Ministry of Industry and Trade
MOL	Minimum Operation Level
MONRE	Ministry of National Resources and Environment
mt/ha	metric ton per hectare
MVND	Million Vietnam Dong
MW	Megawatts
N	North
NC	National Consultant
NE	Northeast
NR7	National Road 7
NTFPs	Non-timber Forest Products
NTU	Nephelometric Turbidity Unit
NW	Northwest
PAF/PAP	Project Affected Family/Project Affected Person
PCDP	Public Communication and Disclosure Plan
PEC1	Power Engineering Consulting and Investment JSC
PECC1	Power Engineering Consulting Joint Stock Company 1
PGA	Peak ground acceleration
PPC	Provincial People’s Committee
PPE	Personal Protective Equipment
PS	Performace Standard
RAP	Resettlement Action Plan
RCC	Gravity Rolled Compaction Concrete
RCMP	Reservoir Catchment Management Plan
REMLRP	Resettlement and Ethnic Minority Livelihoods Restoration Plan
RP	Resettlement Plan
RPF	Resettlement Policy Framework
S	South
SBZ	Safeguard Buffer Zone
SE	Southeast
STDs	Sexually Transmitted Diseases
SW	Southwest
T/L	Transmission Line
TCU	True Color Unit

Abbreviation/Acronym	
TIA	Tertiary Impact Area
ToR	Terms of References
TSS	Total Suspended Solids
USD	US Dollars
VND	Vietnamese Dong
W	West
WB	World Bank
WES	Waterways Experiment Station
WHO	World Health Organization

EXECUTIVE SUMMARY

The Project

The Vietnam National Power Development Master Plan for 2011-2020 (revised and approved on 18 March 2016) states that there is an urgent need for more power with higher reliability and competitive electricity prices in all regions of Vietnam. One of the key changes in the revised masterplan is the emphasis on renewable energy development. It is estimated that there will be approximately 235-245 billion kWh of commercial electricity in 2020 and 265-278 billion kWh of electricity will be produced or imported in the same year. The Ca River basin, where the proposed Project is located, is one of the main ones identified for renewable – hydropower energy sources.

The My Ly Hydropower Project ('the Project') is a peaking project designed to have a capacity of 180MW with a storage reservoir of approximately 1248ha (1094ha of land). My Ly-Nam Mo Hydropower Joint Stock Company (JSC), a private Vietnamese enterprise was incorporated by Vietracimex to develop the Project.

The Project is situated in two of the nations in the Indochina region of Asia. Both the governments of Vietnam and Lao PDR have an agreement to develop hydropower projects on the Ca River. Ca River is located in Nghe An Province of Vietnam and most of the left bank is within the Laos territory in Houaphan and Xiangkhoang Provinces.

My Ly - Nam Mo Hydropower JSC, the Project Proponent, later engaged Hydropower Engineering Consultancy and Construction Company to prepare the Feasibility Study in June 2012. An agreement between the two Governments was signed in 2016 which stipulates the cooperation of the two countries to develop the My Ly HPP including its agreement terms on investment, construction, operation and management of the Project. After which, a more detailed FS has been carried out including procurement of primary permits such as national environmental clearances for both Lao PDR and Vietnam. One of the conditions of the agreement is the preparation of an Environmental Impact Assessment (EIA). Two national EIAs were prepared, one for each country and are subject to each country's respective national procedures and compliance. The approval from Vietnam has been obtained in 20 November 2016, while that of Laos is still under review.

My Ly-Nam Mo JSC, intends to acquire a loan to finance the development of the project. The Proponent plans to apply for a political risk guarantee from the Multilateral Investment Guarantee Agency (MIGA, World Bank Group) to secure the loan. The National EIAs were found not to be compliant with MIGA policy thus requiring upgrading. One of the requirements for a loan agreement is to prepare an international Environmental and Social Impact Assessment (ESIA) based on MIGA Performance Standards.

My Ly-Nam Mo Hydropower JSC engaged ENVIRO-DEV (based in Norway) to develop the ESIA in accordance with the requirements of MIGA Performance Standards (2013). Logistics, input on previous work and field assistance was provided by the Power Engineering Consulting Joint Stock Company (PECC1, EVN).

The salient features of the ESIA of My LY HPP are summarized here.

Technical Characteristics

The main components and auxiliary work areas are all located in the My Ly Commune, Ky Son District, Nghe An Province, Vietnam (Table 1). These were proposed through optimization studies including dam structure, installed capacity, number of powerhouse unit, water head, and quantity and dimension of spillway gate, among other technical features (Table 2). The Project's direct impact area includes four villages in Vietnam and five villages in Laos that will be subjected to relocation (Figure 1).

Table 1. Salient features of My Ly Hydropower Project

Project Location	Vietnam	Lao PDR
Region	North-Central Vietnam	North – East
Province	Nghe An	Houaphan, XiangKhoang
District	Ky Son	Kouan, Nonghed
Communes	My Ly, Keng Du	No commune unit is used in Lao PDR
Villages	Total of four villages to be relocated	Total of five villages to be relocated

The main features of the Project head works, reservoir and river are provided in Table 2.

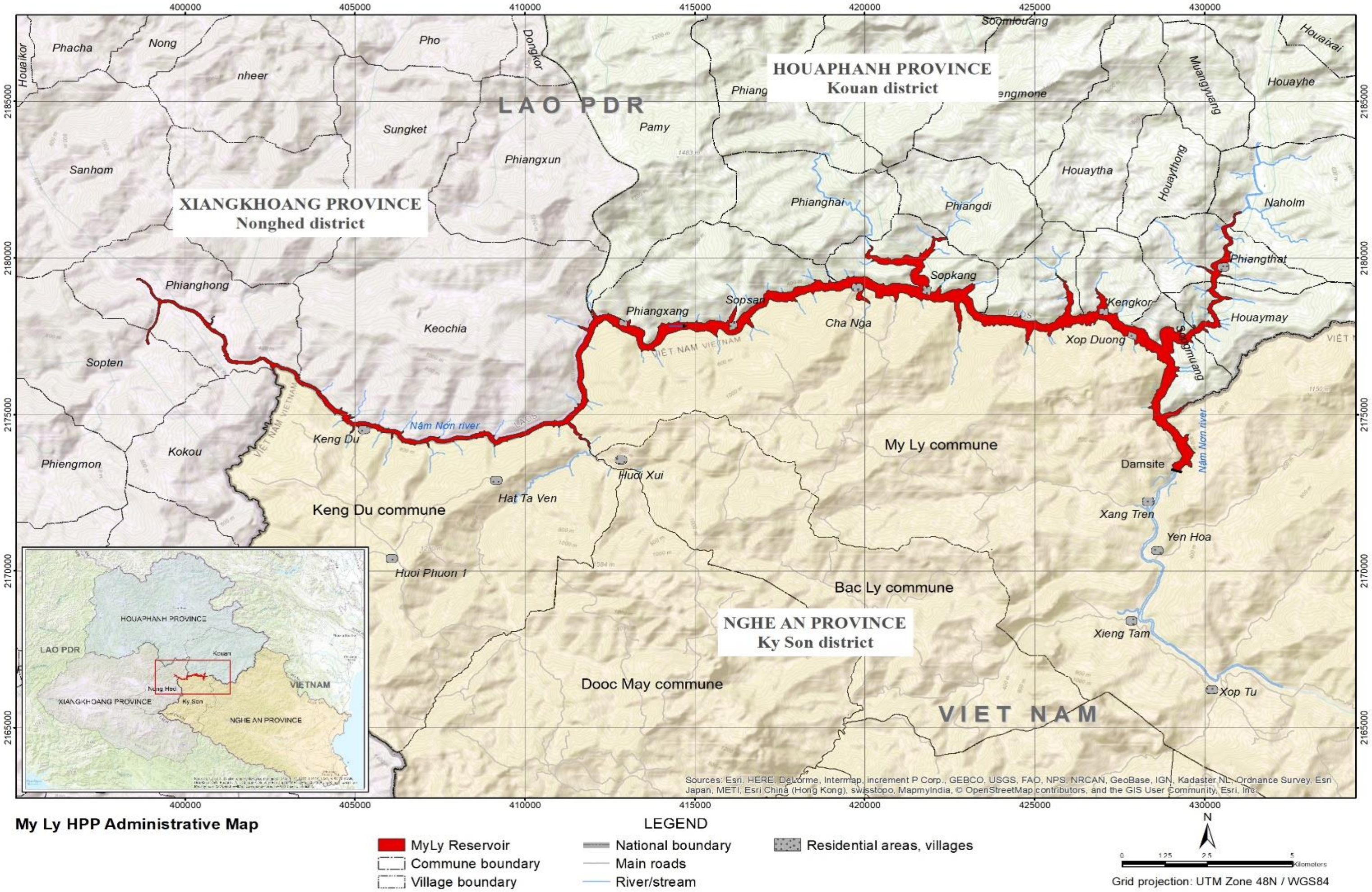

Figure 1. General map showing the project location and villages

Table 2. Main features of the Project

Project area	
Hydrology at intake	
Annual mean flow	107.2m³/s
Other features	
Installed capacity	180MW
Firm capacity	32MW
Annual energy production	660.2GWh
a. Headworks	
Location Latitude / Longitude	My Ly Commune, left bank and right bank in Vietnam N : 19º39'10.2" E: 104º19'27.3"
Dam type	RCC (gravity rolled compaction concrete)
Dam height	118.6m
Crest length / width	270.86m / 8m
Approximate reservoir length	42km
Calculated head	80.6m
Reservoir gross storage (total reservoir volume including dead storage)	391.1 million m^3
Reservoir active storage	197.8 million m^3
Reservoir Full Supply Level (FSL)	300m
Reservoir Minimum operating level (MOL)	280m
Reservoir area at FSL (full supply level)	1247ha
Maximum powerhouse discharge	253.5m^3/s
Highest regulated water level	310.0masl
Lowest regulated water level	304.8masl
Spillway Weir total length Stepped spillway - Step height/width	6 bays (10mx12m each) 77.5m 12m / 10m
Distance of powerhouse from dam site	350m
Distance of tailrace from dam site	350m
Potential total length of river expected to be affected due to reservoir	42km (length of reservoir) + 2.8km (low flow stretch) (+ 28.2km (Ban Ve HPP FSL to MOL stretch))
b. Headrace Tunnel	
Tunnel inlet elevation	264.5masl

During the construction of the dam, the river will be diverted through a twin tunnel. In addition to the construction of the dam, the tunnels and the power house, the Project will need new roads/upgraded roads, spoil tip areas, sand quarry areas, rig areas, permanent housing, temporary and labor camps, and transmission lines, among other areas, to complete the development. Some of these planned construction areas and structures will be permanent while others will be temporary. Transmission lines will be the subject of a separate ESIA and thus has not been included in this assessment. The construction areas (auxiliary works) are located clustered next to the dam site concentrating all activities. The only areas not located in the same site is the quarry.

Project site related roads. There are a number of district roads and local roads in the area that are linked to the main national roads. At necessary points in the project area, new project access roads will be built and connected to the existing road system. Most of these will be permanent roads, some will be upgrading of existing roads, and some may be temporary for use during the construction period. Permanent roads remaining will be 8km long and temporary construction area roads will be 3.7km long.

Quarry site. The Project will utilize the 11ha Sop Tu quarry for its source of rock aggregates. The Sop Tu quarry is located downstream of the dam site, approximately 13.58km in distance. Access to the quarry is through the Tay Nghe An Provincial road. Road surface will be rehabilitated to cater for delivery trucks to the project construction site. Three villages namely Xop Tu, Xieng Tam and Xang Tren in My Ly Commune are found along the access road to the quarry site.

Spoil disposal areas. The Project proposed four disposal areas with a total area of 31.36ha to accommodate the estimated spoil materials from the various excavation works for construction. Details on amounts needed will be assessed during the detail design phase. The disposal areas will be a temporary functional area of the Project, until the construction ends or until the area contains spoil at maximum volume capacity. Some of the disposal areas are designed to support structures (e.g., employees' accommodation) once the required height and flatness are achieved. The disposal areas will also be shaped and managed to maintain good and safe conditions such as slope, height and flatness.

Operation of plant. It is envisaged that the Project will store excess water in the reservoir during high flow to be utilized during low flow. The height of the dam will be 118.6m above the existing river bed and the FSL will be 300masl creating a reservoir length of 42km with a total volume of 391.1Mm^3. The water will be diverted through a twin tunnel down to a power station located adjacent to the dam. The water will be released back in the river, 72m downstream (tailrace) of the power station and 350m of the dam site. The release comes at about 2.5-2.8km from the FSL of the downstream Ban Ve HPP during the wet season and about 29km from the MOL of Ban Ve HPP during the dry season.

The Plant is optimized for maximum energy generation throughout the year. During the dry season, the Plant will run only as a peaking plant during daytime, while in the wet season, the Project will generate approximately 24-hours at full capacity. Details on planned operation are provided in the next section on salient features.

The dam will create a reservoir that will extend up to 42km upstream of 12 villages (communes of My Ly and Keng Du of Ky Son District, Nghe An Province). The flow in the river between the dam and the outlet, will be considerably reduced, particularly during the dry season. Below the outlet, the river will be subjected to daily flow fluctuations due to the peaking operation of the power plant. The detail design of operation will determine the degree of fluctuation and length of the river that may be impacted.

The proposed Project is planned with installed capacity of 180MW. Based on the planned installed capacity, the total annual energy generation in an average year will be approximately 660.2GWh. My Ly HPP has an active storage volume of 197.8Mm^3 and is a long-term regulation reservoir.

Environmental flow. The final operation regime will be confirmed during the design phase. There is a stretch of about 2.8km that will need to be assured to have ample flow of water to sustain biota and human use needs. In addition, the reservoir operating downstream will have its water level receding gradually reaching a distance of about 28km downstream the My Ly dam site. Monitoring and data collection on the water flow and needs will need to be conducted to decipher the likely impact on the added stretch which may not be wetted during a period of three months, at least. A discharge from My Ly HPP should take this regime into account in determining the required environmental flow.

Construction manpower. The estimated required manpower for construction is approximately 3400 persons. Ten to fifteen percent of the total estimated work force is expected to be local. Temporary and permanent camps will be constructed to provide accommodation for the workers and it is envisaged that the design is in-line with MIGA's standards with reference to IFC/EBRD Guidance Note on Worker's Accommodation.

In addition, an influx of new settlers and small businesses will normally establish themselves at such large construction sites. Unregistered persons and "camp followers" could come to the area, whose numbers should be held at a minimum.

Construction schedule. Start of construction is assumed to be 2018, i.e. preferably at the beginning of the dry season, and last for four years. The construction schedule is based on the construction procedures and corresponding rates of progress described in the Feasibility Report.

The development of the hydropower Project will commence with detailed technical design of the Project works and the elaboration of the environmental and social plans, including all safeguards at the pre-construction phase. The construction will essentially start once the resettlement implementation process is complete. It is possible that a staggered resettlement time-line may be employed with the households closest to the dam relocating before the construction commences, given that the ones further away will be affected when the reservoir is filled. Regardless of timing of physical relocation, all agreements for resettlement must be completed before construction begins.

Physical environment

General topography. The Ca River basin within the Project stretch is characterized by a rugged terrain with sharp variation in elevation. The few flat or gentle-sloped lands by the river banks, are either used as settlements and/or cultivation areas. Most of the settlements and agricultural lands are on hill slopes and at small flat highland areas. Areas with gentle slopes are used for agriculture, while the steep areas are common grazing lands, cropland or covered with limited secondary forests. Within the Project Area of Influence (AI), the elevation ranges from minimum of 218masl to maximum of 403masl. The average elevation of the river stretch is 302 masl. Slopes range from 15^o - 45^o.

Land use in the Project Area of Influence. The land use analysis shows that the Project's Direct Impact Area (DIA) and proposed buffer zone is highly influenced by human activities. Eighty percent of the DIA of 1333.8ha is vegetated (Table 3). Approximately 21% of the vegetation cover to be taken by the Project comprises a combination of mixed forests (Figure 2).

Precipitation and seasonality. The mean annual rainfall in the Project area is estimated at 1400mm. History of flooding has been reported in Ca River basin (e.g., May 1989). Annual rainfall changes along the Ca River basin as indicated in the following records:

- 1100 - 1700mm - Upstream area, where the Project construction will be;
- 1800 - 2500mm - Middle reaches of Ca River; and
- Over 2500mm - Downstream reaches

Table 3. Land use and main cover of Project Direct Impact Area (DIA)

No.	Land use and cover (land take of project)	Permanent area (ha) - DIA		Temporary area (ha)[1] in DIA	Total (ha)	Buffer area (ha)
		Reservoir	Main works			
I	**Total vegetated area**	**988.3**	**31.2**	**47.3**	**1066.5** (80%)	**692.8**
a	Forests	629.3	17.5	22.5	*669*	*425*
b	Scrub and grassland	327.0	13.4	17.6	*357.8*	*251*
c	Shrub/bamboo/cultivated/uncultivated land	32.0	0.3	7.2	*39.5*	*17*
II	**Built-up areas/residential/ others**	**51.0**	**0.2**	**3.4**	**54.6** (4%)	**12**
III	**River/stream**	**208.0**	**2.7**	**2.0**	**212.7 (**16%)	**2.7**
Total		**1,247.3**	**34.1**	**52.7**	**1,333.6**	**707.7**

1-axilliary areas to be used during construction are included in total land take of project.

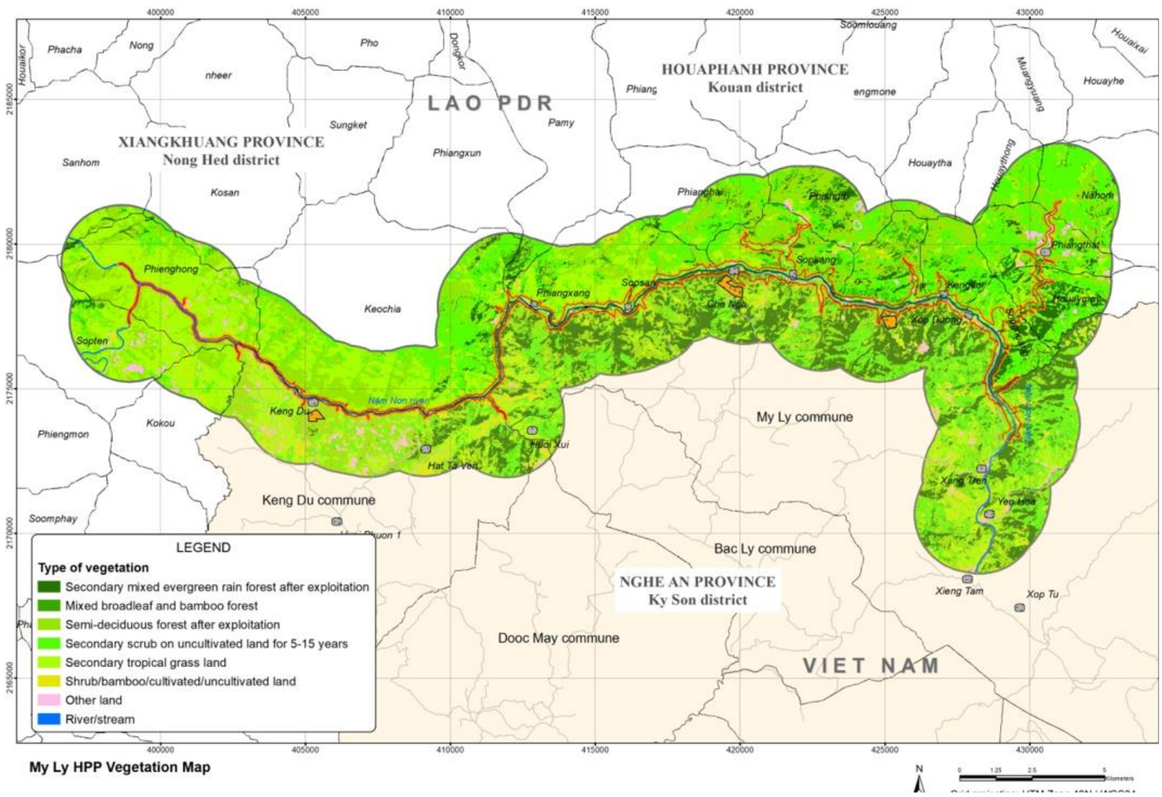

Figure 2. Land use map of My Ly HPP Project Area of Influence

Lao PDR has less variation in climatic conditions and is characterized by two distinct seasons, the wet and dry. Part of the Project reservoir area in Laos is dominated by both southwest and northeast monsoons forming the two climate regime, the wet and dry seasons similar to that in Vietnam. The annual rainfall distribution is approximately 80% from May to September, 10% from October to December and about 10% from January to April.

Geology. The proposed dam site is considered as the optimum location with favorable condition in terms of engineering geological conditions. The IIA rock zone can support the foundation at a design of 140m high concrete dam, where rock zone/layer to be excavated is not more than 10m. The permeability of overburden and bed rock also pass the design requirement.

The Project area also exhibits some tectonic broken zones, from grade 3 to even higher faults. The powerhouse base is founded on IIA hard rock (see next section for description). Since the soil/rock layer is weak and a failure zone exists, attention shall be paid to the stability of slopes and surface flow drainage into the foundation.

The geological mapping has shown that the slope stability in the reservoir area is mainly controlled by the geological structures, as would be expected. Steep areas with slopes in excess of 45 degrees will be at risk of erosion. Such areas can be observed within the Project area. There is however very thin overburden and rock foundation is considered stable.

Earthquake and hazard assessment. Based on the preliminary seismic investigation for the My Ly HPP[1], the fault lines within the Project area may generate an intensity 8 (MSK-64 scale) and trigger a 6.75 magnitude earthquake. The dam therefore has been designed to withstand the predicted earthquake magnitude, and the detail design will need to explicitly address this need.

The annual flow discharge at the planned dam site is 107m^3/s (Table 4). The table also shows discharge from tributary location downstream of the dam. Table 4 presents the various tributaries located in villages downstream of the proposed dam and their discharge contribution. Based on the table above, at the Lauan Mai Security Post, a total of 118.99m^3/s is estimated to currently feed unto the Ban Ve HPP.

Table 4 Tributaries downstream of the My Ly dam site and their discharge contribution

No	Tributaries located in downstream*	Annual discharge Qo (m3/s)
	At Mỹ Lý Dam	107.2
1	At Xàng Trên Village	0.53
2	At Yên Hòa Village	1.37
3	At Xiềng Tắm Village	3.17
4	At Xốp Tụ Village	0.75
5	At Xốp Tược Village	0.44
6	At Hòa Lý Village	0.29
7	At Tồm trên Village	0.09
8	At Piêng Mựn Village	1.60
9	At Xén My Village	1.33
10	At Tồm Village	0.06

[1] Geology Institute – Institue of Science and Technology of Vietnam, December 2012

No	Tributaries located in downstream*	Annual discharge Qo (m3/s)
11	At Cha Luân Village	0.27
12	At Xốp Pe Village	0.12
13	At Luân Mai Security Post	1.83

*Note: The tributaries are associated with settlements or a landmark, thus named accordingly.

Sedimentation. Sedimentation process of the My Ly reservoir was assessed under different scenarios (e.g., FSL/MOL alternatives and without flood storage). Results of the study showed that: after 30 years of operation, total sediment volume can reach up to 28.2 million m^3, occupying about 3.06% of the reservoir storage. At 50 years of operation, total sediment volume will increase up to 46.4 million m^3, occupying about 5.05% of the reservoir storage.

Water quality. The water quality of Ca River within the stretch of the Project area has no indication of industrial pollution, except from the tributaries coming from the Laos territory where elevated turbidity is visual which was attributed to the gold mining activities upstream of the river. Most of physo-chemical properties and heavy metal concentrations conform to the national water standards. Total Suspended Solids (TSS) showed a slightly elevated levels although still within the allowable limit. Elevated levels of coliform (up to three times higher) than the national water standard were also reported. This is expected when domestic sewage is haphazardly disposed off along the rivers and stream. In addition, raising of animals along the river banks is also common at the Project site.

Air quality. Air quality at the Project area is typical of a rural environment and no indication of air pollution. Among the three established air quality stations, two sampling sites, the village of Xang Tren and upstream of the proposed dam site, where traffic activities are still limited, air quality is clean and way below the national air standards. Also typical of rural areas, burning firewood for cooking meals has been the main source of air pollution at the household level. Exposure to indoor air pollution increases the risk of illnesses such as respiratory tract infections, pneumonia, chronic obstructive pulmonary disorder asthma and lung cancer.

Due to dirt roads there is a certain amount of temporary suspended particulate matter in the air which is seen as negligible.

Noise and vibration. Background noise in the Project area is low and inherent to a rural area where population density is low with limited economic activity (e.g., limited traffic noise, absence of industrial and/or commercial activities).

Biological Environment

Vegetation. My Ly Commune has altogether 17,731ha of forest land of which 2,520 is classified as Production Forest and 15,210ha as Protection Forest. Production forest area has been allocated to households for planting trees and some fast growing *Acacia sp*, teakwood species, *Chukrasia tabularis (*Indian mahogany*)* and *Erythrophleum fordii* (a legume species) are planted. However, most of the Production Forest area is farmed with rain-fed upland paddy, maize crop and cassava due to the lack of arable land. Protection Forests have poor quality due to past illegal exploitation and now are covered with secondary forest vegetation and tropical grassland.

Local households collect and depend on a regular supply of wild vegetables, bamboo shoots, mushrooms, *Auricularia auricula-judae (*Jew's Ear, an edible fungus), and herbal medicines such as "củ xa nhân", *Smilax* roots and *Ganoderma lucidum* (nấm Linh Chi) from Protection Forest. They also hunt wild animals such as wild boars, birds, wild chickens, squirrels, *Muntiacus muntjak (*barking deer) and mice for food, although wild boars and barking deer are now very few.

Keng Du Commune has 3,204.2ha Protection Forests and 148.9ha Production Forest. About 149ha Production Forest was allocated to households for tree plantation where *Styrax benzoides* and *Styrax benzoin,* some trees of *Acacia* spp. and *Melia azedarach* (Chinaberry) are planted. Similar to My Ly Commune households collect forest products.

Xiangkhoang Province in Laos, covers an area of 15,880km^2 and has a mountainous topography. The population of the province in the 2015 census was 244,684. This province has seven districts and My Ly HPP is located in Nonghed district. The reservoir area is a source of timber, forest products and used for agriculture and use is similar to that in Vietnam. It is noted that there are areas with matured trees in Laos mainly on steep and inaccessible sites including cliffs.

Aquaculture in the Project area is not developed, fisheries is limited to natural fish resources of Ca river and its tributaries. Fishes commonly caught in the Ca River are *Anguilliformes* (eel), *Bagridae* (cat fish), *Bagarius bagarius*, *Cyprinus carpio*, and *Trionychidae fitzinger*. They also catch small fish, snails, shrimp, *Caridina flavilineata*, *Brachyura* and tadpoles along the river and streams. They collect seaweeds and mosses during dry season for food.

Forest vegetation systems in the Project area. Forests close to the settlements and near the Project areas were heavily exploited and farmed without terraces using the swidden agriculture system. Typical for swidden agriculture, once soil fertility diminishes, the villagers abandon the farm and move to a new tract of land and the exploited forest was left to regenerate and restore naturally. Such areas gradually turn into grassland, scrubland and secondary forests.

Type of vegetation in reservoir and construction areas. Forest vegetation in the proposed reservoir area and construction areas is given in Table 5. Area of the proposed reservoir is 1,247ha of which 272ha is covered by Semi-deciduous Forest, 259ha Secondary Mixed Evergreen Rain Forest, 166ha Secondary Scrub, 161ha Subtropical Grassland, 98ha Mixed Broadleaf and Bamboo Forest, 32ha Shrub/bamboo /cultivated/ uncultivated land and 208ha river and streams. The Project will acquire 1,334ha of land and about 80% of this total area is forested or have some forest vegetation. About 75% of the 708ha proposed buffer zone area has secondary forest vegetation, 149ha is grassland and land under cultivation is less than 17ha (See Table 3).

Table 5. Vegetation types in direct impact area and proposed buffer zone strip

No.	Vegetation types	Permanent area (ha)		Temporary (ha)[1]	Total (ha)	Buffer area (ha)
		Reservoir	Main works			
Total vegetated area		**988.3**	**31.25**	**47.3**	**1066.3**	693
I	Secondary mixed evergreen rain forest	259	11.6	11.6	**282.2**	*150*
II	Mixed broadleaf and bamboo forest	98.3	2.1	4.0	**104.1**	*45*
III	Semi-deciduous forest	272	3.8	6.9	**282.7**	*230*
IV	Secondary scrub	166	8.2	11.5	**185.5**	*102*
V	Secondary Subtropical grassland	161	5.2	6.1	**172.3**	*149*
VI	Shrub/bamboo /cultivated/ uncultivated	32	0.3	7.2	**39.5**	*17*

Main works include dam and associated structures, powerhouse and permanent project facilities

[1] Temporary area includes disposal sites 1-4, auxiliary area 1-3, and roads

Biodiversity status. There are 447 vascular plant species from 341 genus and 124 families recorded in the 20 sampling sites. Biodiversity in the Project area is low since most of the vegetation has been disturbed. The secondary evergreen mixed rain forest has medium diversity while the secondary forest grown on uncultivated land, mixed broad leaf bamboo forest and predominant bamboo forests are of low biodiversity value. In general, number of tree species in the reservoir area is higher than in the proposed construction areas.

Regeneration, standing volume and total biomass. Regeneration in secondary forests is good, with more than 17 species of hardwood species regenerating in the proposed reservoir area. Regeneration in the proposed construction areas is lower than in the reservoir area. There is species similarity between these two Project areas with an exception of few species which were not recorded in the reservoir area. Table 6 summarizes the type of forests and its estimated organic biomass at the proposed reservoir and auxiliary areas.

Table 6. Estimated organic biomass above ground in the reservoir area

Type of forest	Reservoir		Buffer zone		Headwork / powerhouse	
	Area (ha)	Biomass (mt)	Area (ha)	Biomass (mt)	Area (ha)	Biomass (mt)
Secondary mixed evergreen rain forest and Semi-deciduous forest	531	29,140	380	20,500	15.4	880
Mixed broadleaf & bamboo forest	98	2,949	45	1,350	2.1	63
Secondary scrub/ grassland /shrub/cultivated /uncultivated	359	2,796	268	2,173	13.7	120
Total	**988**	**34,885**	**693**	**24,023**	**31.2**	**1,063**

Species of conservation importance. There are two species of concern namely the Gu Sui Bu (*Drynaria fortunei),* an epiphytic herb species native to East Asia and *Pterocarpus indicus*, a hardwood found in South East Asia, recorded within the Project area. The former is listed as endangered species in the Red Data Book of Vietnam, 2007[2] while the latter is recorded as regionally extinct in the IUCN. *Drynaria fortunei* is known as traditional Chinese medicine for bone healing while *Ptercarpus indicus* is a good source of timber. Both are heavily exploited for their uses.

Wildlife species. Mammals in the Project area include 19 rodent species *(Rodentia)*, 12 bat species *(Chiroptera)*, six carnivore species, three *primate* apes, two insectivores and two ungulates *(Artiodactyla)*. These animals are mainly distributed in area where forest is in good condition, usually above 500masl. Small mammals, rodents and bats are abundant in the proposed dam site and auxiliary areas.

The reservoir area comprises mainly of secondary forest, bamboo forest, scrub land and grass land. Since wildlife are dependent on their habitats, wildlife population in the Project area did not exibit a diverse population as compared to where forest is in good condition. There are no large size animals/species or rare species reported in the reservoir area instead, animals of small size such as the civet (*Viverridae)*, weasel (*Mustelidae)*, tree squirrel (*Sciuridae)*, rats (*Muridae)*, bamboo rats (*Rhizomyidae)* were reported to occur. There are also bird species which include wild chicken (*Gallus gallus)*, woodpecker (*Piciformes)*, rollers (*Coraciidae)*, kingfisher (*Alcedinidae)*, boucal, some species of cock, drongo and *Muscicapidae.* Reptiles and amphibians reported to be present include the

[2] Red Data Book of Vietnam (2007)

agama (*Agamidae*), ground dragon *(Physignathus cocincinus)*, gecko *(Gekko gecko)*, varan *(Varanidae)*, snake (*Coelognathus radiates)*, cobra (*Elapidae)*, and some species of frog. Species of conservation interest are given in Table 7.

Table 7. List of species of conservation interest

No	Scientific name	Common name	Vietnamese name	Vulnerability status[3]		
				Vietnam Red Data Book (a)	IUCN (b)	Decree 32/2006 (c)
1	**Mammals**					
	Nycticebus bengalensis	The Bengal Slow Loris	Cu li lớn	VU	VU	IB
	Macaca mulatta	Rhesus monkey	Khỉ vàng	LR		IIB
	Macaca fascicularis	Leopard cat	Khỉ đuôi dài	LR		IIB
2	**Reptiles**					
	Gecko gecko	Gecko	Tắc kè	VU		
	Physignatus coccincinus	Chinese water dragon	Rồng đất	VU		
	Varanus nebulosus	Clouded monitor	Kỳ đà vân	EN		IIB
	Varanus sanvator	Water monitor	Kỳ đà hoa	EN		IIB
	Ptyas korros	Indochinese ratsnake	Rắn ráo thường	EN		IIB
	Ptyas mucosus	Oriental ratsnake	Rắn ráo trâu	EN		IB
	Bungarus fasciatus	Banded krait	Rắn cạp nong	EN		IIB
	Naja naja	Indian or Asian cobra	Rắn hổ mang	EN		IIB
3	**Birds**					
	Falco severus	Oriental hobby (a falcon)	Cắt bụng hung			IIB
	Psittacula alexandri	Red-breasted parakeet	Vẹt ngực đỏ			IIB
	Copsychus malabaricus	White-rumped shama	Chích chòe lửa			IIB

[3] (a) VNRB.2007. Vietnam Red Data Book; (VU = vulnerable; LR = Lower risk; EN = Endangered)
(b) IUCN.2016. The IUCN Red List of Threatened species; VU = Vulnerable
(c) Decree 32/2006/ND-CP. Management of Endangered, Precious and Rare Species of Wild Plants and Animals; IB = Prohibiting collection and use for commercial purposes; IIB = Restricting exploitation and use for commercial purposes.

Use of forest plants, animals and forest ecosystem services. Out of the total 447 vascular plant species recorded in the Project area, 149 of them are medicinal plant species, fuelwood and timber species, edible plant species, ornamental plant species, rattan and bamboos species and others. There are 65 medicinal plant species of high value naturally growing in the Project area while 56 species are used for timber and fuel wood. The villagers have always used and are highly dependent on the forest as source of their fuel-wood, timber, fodder and forage, medicines, religious rituals and food.

The wildlife species in the mixed forest types are consumed and these include the yellow monkey (*Macaca mulatta)*, wild pig (*Sus scrofa)*, muntjac (*Muntiacus muntjak)*, wild cat and big bamboo rat (*Bandicota indica)*. It is also habitat for bird species from the families of drongo, crow, fly eating bird, honey eating bird, Chinese laughing-thrush, cock and turtle bird. Reptile and amphibian species that are found here include *Physignathus cocincinus*, *Varanus nebulosus*, cobra (*Naja naja)*, *Trimeresurus albalabris*, species of family tortoise *Emydidae*, and Gecko (*Gecko gecko)*. Secondary forest types also have good habitat for small mammals from the orders of rodents and bats; bird species, reptiles and amphibians like *Physignathus cocincinus*, *Ptyas mucosus*, *Bungarus fasciatus*, *Bungarus candidus and Naja naja*.

Habitats along Ca River, streams, swidden farming area and the village area. Areas along Ca River and the adjacent streams, swidden farming areas, settlement areas and along road alignment provide habitat for mammals which are also eaten regularly as a free source of protein: such as the black tail rat (*Crocidura attennata)*, mosquito eating bat (*Java Pipistrellus javanicus)*, mice (*Rattus flavipectus)*, rat (*R. norvegicus) and* bird species such as milky stork (*Egretta garzetta)*, fly stork (*Bubulcus ibis)*, Milky necked stork (*Amaurornis phoenicurus)*, big kingfisher (*Megaceryle lugubris)*, small kingfisher (*Ceryle rudis)*, wolly necked stork (*Halcyon chloris)* and *Alcedo atthis.* Some reptiles, the gecko water snake, amphibians such as family Ranidae, family Rhacophoridae (tree frogs)), Microhylidae (small frogs) and some insects (butterfly) were recorded in this habitats.

Fish species and diversity. There were a total of 77 fish species from 17 families and six orders recorded in the Ca River and the streams joining it. Fish living in streams are normally small fish species, preferring rapid water and high oxygen content. Typical stream fish species are those such as *Schistura*, *Rhinogobius* (gobies) and *Oreochromis niloticus* (tilapia).

Eight species have high economic value and most of them except *Onychostoma lepturus* are less common in the river (Table 8). None of these high valued fish species are found in streams.

Table 8. Fish species of high economic value in Ca River

SN	Fish species	Ca River	Stream
1	*Anguilla marmorata*	+	-
2	*Spinibarbus denticulatus*	+	-
3	*Cyprinus rubrofuscua*	+	-
4	*Onychostoma lepturus*	++	-
5	*Hemibagrus guttatus*	+	-
6	*Cranoglanis henrici*	+	-
7	*Bagarius rutilus*	+	-
8	*Channa striata*	+	-

	
Bagarius rutilus	*Bangana lemassoni*

Fish species recorded at Ca River and its tributaries

Migratory fish species. *Anguilla mamorata* is a long distance migratory fish species, migrating downstream to sea for feeding. This species is considered to be of high economic value, vulnerable and is now less frequently seen in the river. The Ban Ve HPP dam and Nam Non HPP dam downstream of this proposed Project has already obstructed its movement to the sea. Its habitat has been fragmented and a small population is now adapting to this new environment and is likely to disappear over time.

Vulnerable species. Of the 77 fish identified, two species are listed as Vulnerable (VU) according to the Vietnam Red Data Book while IUCN classifies five (2007; Table 9)[4].

Table 9. List of vulnerable fish species

SN	Scientific name	Common name	Vietnamese name	Vulnerability status[5]	
				IUCN	VNRB
1	*Bagarius rutilus*	Cat fish	Cá Chiên	VU	VU
2	*Acrossocheilus annamensis*	Carp	Cá trốc	VU	
3	*Bangana lemassoni*	carp	Cá Rầm xanh	VU	
4	*Hemibagrus guttatus*	catfish	Cá Lăng	VU	
5	*Anguilla marmorata*	Marbeled or giant mottled eel	Cá lệch, cá Chình hoa	VU	VU

[4] Kottelat, M., 2001. Freshwater fishes of northern Vietnam. A preliminary check-list of the fishes known or expected to occur in northern Vietnam with comments on systematics and nomenclature. Environment and Social Development Unit, East Asia and Pacific Region. The World Bank. 123 p.

[5] IUCN. 2016. The IUCN Red List of Threatened Species; VU = Vulnerable
VNRB. 2007. Vietnam Red Data Book; VU=Vulnerable; LR = Lower Risk


Fishing a common activity in the Ca River

<u>Fisheries.</u> Fishing is not a main occupation of the people in the Project area. However, most of the households do fishing regularly for their household consumption. Men, women and children go for fishing. Men use boat and cast net, while women and children use baskets for fishing. Families take a day off to go to streams for fishing with basic fishnets and baskets. Sometime they stop the flow on streams, dewater and do fishing. Some villagers also use poisonous leaves in a stream section. Also, although it has been prohibited, the use of electrofishing is still being practiced. Even with the various fishing methods, fish catch is reported to be low, at about 1-3 kg average per day, while on a good day catch could increase to 5-10 kg/day. The species caught are: *Onychostoma lepturus, Bagarius rutilus, Hemibagrus guttatus, Cyprinus rubrofuscua, Oreochromis mosambicus, Danio laoensi* and *Garra orientalis.* Some people also catch crab, shrimp and mussels for household consumption. Fish farming is not a prevalent practice in the Project area although there are small ponds noted. These are only for small production and not for large commercial purposes.

Social environment and livelihoods

Inundation area. The My Ly HPP reservoir at FSL will have an elevation of 300m and an inundation area of 1247ha. The area is upland forested area with steep slopes, the river is in most parts rocky with high current. Several isolated villages are located along the river close to the river bank and are in the proposed reservoir inundation area.

Three villages in Vietnam and five villages in Laos are expected to be inundated by the My Ly HPP reservoir. In Keng Du Commune, the village of Keng Du and in My Ly Commune downstream Keng Du, Cha Nga and Xop Duong villages by the river will be inundated.

In Kouan District in Laos, settlements of five villages will be inundated by the reservoir: Phiangxang, Sopsan, Sopkang, Kengkor and Phiangthat and in Nonghed District, also in Laos land areas of the villages Keochia, Phianghong, and Sopten will be inundated.

The affected villages and administrative areas can be seen in Figure 1.

Project construction areas. By the dam site, in My Ly Commune, Xang Tren Village is located 1km below the planned dam site and will be in the midst of the planned Project construction areas, and therefore is included in the list of villages to be relocated.

Downstream stretch. It is estimated that downstream the planned dam, about 28.4km of the river will be potentially affected by low flow during the dry season. Nine villages are located along this stretch of the river.

Socio-economic and cultural features of the affected villages

Population ethnicity and poverty. Almost all the people in the Project areas in both countries originate from different ethnic groups/minorities[6]. In the Vietnamese area they are

[6] In Vietnam, the Government recognises a total of 54 ethnic groups, of which the Kinh (Vietnamese) is the majority population with 87% of the national population, and all the other groups are defined as ethnic minorities. In Laos the national population is divided into three broad categories of 49 ethnic groups, and the term ethnic minority is not used.

Thai and Kho mu ethnic minority people and in Laos, Kho mu and Thai[7] with their own identity, language and cultural features. Most villages are inhabited with one ethnic group and people have family ties with each other. The ethnic groups in Vietnam and Laos are related to each other, some people have moved across the national border and settled down on the other side, and villagers have regular social and economic interaction with each other over the border river.

All the households in the affected villages are extremely poor, under or just above the poverty line as defined by the GoV[8] and the GoL[9].

Infrastructure and services. The affected villages are located remotely and can be reached either by boat in the Ca River or along soil roads that are hardly vehicle accessible year round. Local people mainly travel either by wooden boats, on foot or by motorcycles. In all the riverside villages, nearly every household owns a boat, and Ca River is the main transportation route for both people and goods. The Lao villages are located at a road distance of up to 80km from the District center, so when they e.g. need health services, they rather travel by boat to My Ly Commune center than to the Kouan District town.

The villages to be affected by My Ly HPP in both countries are outside the national electricity network, and most all households have a micro-hydropower (pico) generator in the Ca River or in a tributary stream next to the village, providing enough electricity for a few hours of lighting and TV. In the Lao villages, households use both micro hydro generators and solar panels for electricity generation.

In the Vietnamese villages household water is lead from tributaries and mountain streams to water tanks in the villages. These water tanks have been constructed through government or donor programs. Additionally, villagers use the Ca River and its tributaries for washing and bathing, as well as for watering animals. In the Lao villages water is likewise lead from a stream through a tube to a water post with tap centrally located in the village.

Health and sanitation. Hygienic conditions in the remote villages are in general very poor. Most villages lack toilets, and the existing ones are very rudimentary. Pigs, poultry and dogs roam freely around in the villages. Villages lack any rubbish disposal system, and litter may lie anywhere in and outside the village including the riverside. The general standard of knowledge about health, hygiene and nutrition is very poor and based on tradition.

No health services are available in the villages, and the distance to commune or district health center is too long and costly for people to travel. Health problems are treated with medicinal plants, herbs and fungi collected in the forest. Most common health ailments include headache, diarrhea, fever, respiratory infections, itchy eyes, and gynecological problems. Most always, babies are delivered in the villages, and women seldom attend any birth-controls/health check ups during pregnancy. Most children are vaccinated in the

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[7] Another spelling “Tai”, and also reported as Lao Loum, which is the larger ethnic group. In Laos, people are ethnically divided into three main groups: (1) The Lao Loum, who are also called the Lao Thai or the Lowland Lao, who make up approx. 75% of the population in the country; (2) Lao Theung, the midlands people, consisting of 58 sub-groups, among them the Kho mu; and (3) Lao Soung, the highland people consisting of the Hmong and Yao as the main sub-groups and making about 10% of the national population (sources: http://minorityrights.org/minorities; https://www.luangprabang-laos.com/The-people-tribes-and-ethnical).

[8] The official poverty line 2016–2020 issued through the GoV Decision No. 59/2015/QD-TTg *Promulgating multidimensional poverty levels applicable during 2016-2020* is for urban areas 900,000VND/capita/month and for rural areas 700,000VND/capita/month. 1USD≈22,700VND (22 Sept 2017).

[9] The official poverty line 2010–2015 issued through the Decree No.285/PO *Poverty and development standard 2010-2015* is for country level 192,000LAK/capita/month, for urban areas 240,000 LAK/capita/month and for rural areas 180,000LAK/capita/month. 1USD≈8,300LAK (22 Sept 2017).

villages through monthly mobile vaccination services provided by the commune health center, and few cases of infant or maternal deaths are reported.

Food and nutrition. Upland rice is the main cultivation crop and the staple food of all the affected people. Forest and river provide the resource base for other daily food. Women collect wild growing vegetables, roots, bamboo shoots and mushrooms in the forest several times every day for household food. Men are hunting rats, birds and bamboo rats for food on a daily basis. Another main protein source base is the river: Men are fishing with nets from boats and shore, women are fishing with baskets, and even children are collecting snails and shrimps in the shallow waters. Poultry with chicken and ducks is kept not only for selling but also for family food, but pigs are eaten more seldom at special occasions, during annual celebrations and family festivities such as weddings. Food is prepared on open fire, and both men and women collect firewood in the forests.

Education. According to the Vietnamese government standard, there is a kindergarten and a primary school in every village, in Laos there are primary schools in villages. Secondary boarding school is located in the commune center in Vietnam, and in Laos each village group has a secondary boarding school. Many ethnic minority children drop out of school after primary school or during the secondary school, and very few, if any, continue to high school that is located in the district center.

In the villages the ethnic minority people use their own ethnic language in everyday communication. Women regularly have lower education level than men, because girls drop out of school early during the secondary school in order to help their families with household work. Many elder ethnic minority women are not able to communicate fluently in the national language, and up to 50% of the elder women are illiterate.

Livelihoods. All the inhabitants in the Project areas are farmers living on low-productive rain-fed upland rotational swidden agriculture, combined with forest resources utilization, fishery and livestock breeding. Many households do not have sufficient food year round, in some villages 50% of the households lack rice during the period from March to August prior to the annual harvest. Apart from upland rice, all farmers cultivate maize and cassava for animal fodder. Vegetables and fruit trees are grown on riverbanks, but in many areas the land along the Ca River is too steep and rocky to allow cultivation activities.

Ky Son is a rural district and an overwhelming majority of the inhabitants in its 21 communes are farmers living on upland agriculture and forestry. Cultivable land resources are limited and main part of agriculture takes place in the upland areas. Table 10 below provides an overview of land use in the two communes to be affected by the My Ly HPP.

Table 10 Land use in the My Ly and Keng Du communes

SN	Land use	Commune	
		My Ly	Keng Du
1	**Agriculture land**		
	Wetland rice	31.8	41.0
	Annual crops	45.0	99.2
	Perennial crops	26.0	58.2
	Other farming area	25.0	19.0
		127.8	**217.4**
2	**Forest land**		
	Protection Forest	15,210	3,204.2
	Production Forest	2,520	148.9

SN	Land use	Commune	
		17,730	3,353.1
	Total land area	**27, 109.9**	**8,014.9**
	Households	1,247	888
	Population	5,595	4,329

Source: PECC1, Livelihoods Survey Report, My Ly HPP ESIA (April 2017);
Land use Plan of Villages 2015, Keng Du Commune, My Ly Commune;
Commune Annual Report 2016, Keng Du Commune, My Ly Commune.

Implementation of the Project will influence seven villages situated on the right bank of the Ca River (in Vietnam side) and five villages on the left bank (in Lao PDR). The seven villages namely Cha Nga, Xop Duong, Xang Tren, Keng Du, Huoi Phuon 1, Hat Ta Ven and Huoi Xui in My Ly and Keng Du communes have 739 households. Altogether they cultivate 940ha of upland farm and 23ha wetland paddy crop annually. Under the rotational farming system, they have access to about 1,180ha additional upland for crop cultivation. They grow 704ha upland rice, 311ha maize, 99ha cassava and 20ha other crops including peanuts (Table14). The estimated livestock population reared in these seven villages is 1,935 cattle, 535 buffaloes, 2,088 pigs, and 8,664 poultry birds including ducks.

Table 11. Estimated area under crop cultivation in Project IA villages in Vietnam

Village /Commune	Households	Population	Swidden land (ha)					
			Rice	Maize	Cassava	Others	Total	Wet rice
My Ly Commune, Ky Son District, Vietnam								
Cha Nga	97	435	109	45	10	2	166	x
Xop Duong	61	224	93	9	6	2	110	x
Xang Tren	174	688	223	35	26	3	287	6
Total	**332**	**1,347**	**424**	**89**	**42**	**8**	**563**	**6**
Keng Du Commune, Ky Son District, Vietnam								
Keng Du	46	183	31	46	12	3	92	2
Huoi Phuon 1*	93	388	71	35	13	3	122	X
Hat Ta Ven*	130	636	81	104	26	4	215	15
Huoi Xui*	138	564	97	37	6	2	142	x
Total	**407**	**1,771**	**280**	**222**	**57**	**12**	**571**	**17**
Vietnam total	**739**	**3,148**	**704**	**311**	**99**	**20**	**940**	**23**

Source: PECCI, 2017. Livelihoods Survey Report and – Village Baseline Report, My Ly HPP ESIA (April 2017).
Note: Average farmed area by a household for each crop is multiplied with the total number of households to get a better estimate of land under cultivation. X -not present
*Note: Only some cultivated land of Huoi Phuon 1, Hat Ta Ven and Huoi Xui will be affected

There are 3,076ha of forests in the Laos Project influenced villages (Table 12). In some villages, people have encroached on Production Forest for upland cultivation. Upland cultivation covers 207ha, averaging 1.6ha per household. It is to be noted that there is encroachment of the different forest types, particular production forest areas, for agriculture, which are not reported or available officially.

Table 12. Land use in the Project IA in Laos

Agriculture and forest land	Area (ha)					
	Kengkor	Phiangsang	Phiangthat	Sopkang	Sopsan	Total
Agriculture	50.0	10	54	48	45	**207.0**
Forest	563.9	182.0	1439.7	557.3	332.9	**3,075.8**
Production forest	174.5	110.2	40.6	272.0	182.5	**779.8**
Conservation forest	313.9	71.8	386.7	92.2	150.4	**1,015.0**
Protection forest	75.5	-	1,012.4	193.1	-	**1,281.0**
Households	29	9	44	48	16	**146.0**
Population	150	36	276	320	89	**871.0**

Source: PECC1. Livelihoods Survey Report – My Ly HPP ESIA, April 2017; Village Baseline Report - My Ly HPP ESIA, April 2017 ; Land use plan of villages in 2015

Upland farming (swidden land) area is estimated to be about 413ha in the Project influenced villages. Upland rice is the major crop grown in about 368ha (89% of the total land) followed by maize 38ha (9%). All households plant cassava but the area is small just over 7ha. Peanut is grown only in Kengkor Village. Table 13 summarizes the productivity of farm products in the different Project villages in Lao PDR. In terms of production, cassava has the highest yield among the crops.

Livestock breeding is the most important livelihood after farming for people in the remote villages. All households have chicken and geese for family food, pigs are grown mostly to be sold but also to be eaten at special occasions as festivity food in the village. Animal diseases and deaths are not uncommon, especially among pigs and chicken that are roaming freely in the villages, and epidemics and cold weather kill even cattle. Animal deaths are reported to be more common in the villages in Vietnam, where veterinary services appear to be less available than in Laos, where villagers' knowledge in animal breeding appears to be somewhat better than in the Vietnamese villages. Most families have a few cows and some households even have buffaloes, which both are kept entirely for selling to generate cash. Together with goats kept by some farmers they are grazing in riverbank grasslands and forests near the upland fields. Animals can roam freely because there are no wildlife predators in the nature. Veterinary services are not well developed in Vietnam but are better available in Laos.

Table 13. Productivity of farm crops (mt/ha) in Project IA villages in Laos

Villages	Swidden land			
	Rice (mt/ha)	Maize (mt/ha)	Cassava (mt/ha)	Peanut (mt/ha)
Phiangsang	1.1-2.0	4.0-4.5	15-17	
Phiangthat	1.5	2.5-3.5	18-20	
Sopkang	1.5-2.2	3.0	16.0-18	
Kengkor	1.5-2.0	3.5-4.0	18.0	0.15
Sopsan	1.5-2.0	3.5-4.0	18 - 20	

Source: PECC1, Livelihoods Reports and Village Baseline Reports, My Ly HPP ESIA (April 2017).

Forest resources are the crucial base for the daily food and provide approximately 50% or more of the livelihoods of the people in the riverside villages. Non-timber forest products (NTFPs) are important for household food, medicine supply and economy. Women collect bamboo shoots and wild-growing vegetables and mushrooms every day for family food. Some NTFPs like mushrooms, bamboo shoots and medicinal herbal plants are sold to traders. Men collect firewood and do logging of timber that is both used for construction of houses and other structures in the village, and sold to traders. Hunting of birds, rats, bamboo rats, squirrels and snakes is done regularly for household food, mainly with crossbows and traps, and wild boars are hunted during the harvest season near the upland fields.

Ca River is important as a source of livelihoods and as a transportation route for upland products, timber, firewood and other goods. Almost all households in the villages along the Ca River to be affected by the HPP have boats and are fishing for household food on a daily basis. In addition they sell fish when the catch is large enough; fish is dried and salted and also made into fish sauce to be sold later. Men fish with nets both from boats and from the shore, women and children use baskets, and also collect shrimps, snails and moss in the shallow river. Fish is an important protein source for the inhabitants along the Ca River. Riverbanks are in some places also used for home gardening, and these areas serve as pasture for animals as well. However, large parts of the river and riverbanks are rocky and many areas are steep, where riverbank cultivation is not possible.

Due to the remote location and poor transportation infrastructure **trade and business is very limited**. There are no commune markets, only a district market in the district town. In most villages, there are one or two petty (sundry) shops selling daily consumer goods like rice, salt, fish sauce, drinks, sweets and gasoline. Mobile Vietnamese traders visit villages in both countries for buying and selling goods.

There are very few available non-agricultural labour opportunities. Both permanent and seasonal labour migration of mostly young men and women but even entire families is very common both in Vietnam and in Laos.

Cultural heritage. People in the villages along the Ca River belong to the ethnic groups of Thai and Kho mu, which share the same kind of worldview and cultural features through living for generations in the same geographical environment. Forest and river provide their needed resources and form the context for their material and spiritual culture. The local worldview contains gods/spirits related to different elements and places in nature. In addition every family respects its household gods/spirits and ancestors' spirits.

The physical elements of the spiritual culture include spirit forests which are usually located at some distance (about 1km or more) from the village. People are not allowed to utilize forest resources in the spirit forest, however, cattle graze there. Death ceremonies are related to the river, and village graveyard is often located near the river. Each village has a village worship place that is importantly located under the biggest tree in or outside the village. In some villages there is a small wooden spirit house in place, while in some villages only a small wooden platform is used for offerings. Annual ceremonies take place there twice a year: the month of the year depending on the ethnic group residing in the village. Ceremonies are typically connected to the cultivation cycle in the upland fields.

Gender roles and issues. In the Project-area villages, women work in upland fields, in forest and by the river, side by side with men in the livelihoods activities. Women in the ethnic minority villages have in general, lower education level than men. Elder women are often illiterate and cannot fluently use and understand the national language. The Kho mu girls drop out of school early, in order to help their families with household work and livelihoods activities. It is common for these girls to get married when 14-15 years. Women are less mobile than men, and they rarely travel outside their village and livelihoods activity areas. Men are decision makers in the village, and women are not customed to speak-up or express their opinions in meetings. Due to the low educational level and limited knowledge of ethnic minority women, it is difficult for them to learn new skills for improving their livelihoods and living conditions.

Major reasons for prevailing poverty. There are very few available livelihoods opportunities apart from upland cultivation combined with livestock breeding, fishing and forest resources utilization. The available production land is located in high areas with deep slopes, and in the Vietnamese territory, where the available land is not sufficient for the farming population, pressure on land is therefore high.Erosion and poor soil quality also contribute to very low field yields. Cultivation methods are manual, seeds are local, farmers lack fertilizers and there are no soil improvement methods, which lead to low productivity with hardly enough food for household annual consumption. Every year, many households in the Project-area villages lack rice during the months before the annual harvest.

Cultivation is rain fed and there are no irrigation systems. Agricultural and livestock services are very deficient in Vietnam. In Laos, veterinary services appear to be better available and consequently animal mortality lower than in Vietnam. Support and advice from the commune/district is lacking, seeds are not provided at an optimal time, seeds provided are often that of high-fertilizer demanding varieties, and farmers lack sufficient skills to take care of the animals that they receive through government development programs.

Villages are remote, far away from the district center both in Laos and in Vietnam, and poor road infrastructure affects people's mobility and market access. Market infrastructure is undeveloped with the only available markets in the district towns. Most villagers rarely visit the district center, and women do not even go to the commune center or village group center more than 1-2 times per year. Mobile traders buy agriculture and forest products from farmers in the villages for low prices and sell them household goods for high prices.

All the affected people are ethnic minorities who use their own language in everyday communication. Many elder people are illiterate and the general educational level is low, especially in the Vietnamese villages. Many people are not fluent in the national language and lack ability to take opportunities for health, hygiene, livelihoods or other living standards improvements. Still many children in Vietnam drop out of secondary school in order to contribute to the economy of their poor families. Children grow up with deficient education which further hampers their capacity to avail new opportunities to escape poverty.

PROJECT IMPACTS

Land and households

Land loss. A total of 1334ha of land will be used by the Project (direct impact area, Table 3). This will include mainly agricultural, different forest assemblages and grassland. The wildlife and plant resources will be lost permanently, while some areas in the auxiliary areas, although used only during construction phase, the change will be permanent.

Villages to be inundated. The reservoir is expected to inundate three villages in Vietnam and five villages in Laos that have to be relocated. The table below summarises the number of households and people count and their ethnicity in each of the villages that will be affected. All the households in the affected villages are extremely poor, under or just above the poverty line as defined by the GoV and the GoL.

Table 14. Villages in the reservoir inundation area and construction area of My Ly HPP to be relocated

My Ly HPP Villages to be relocated				
Village	HH	Population	HH poverty %	Ethnicity
Keng Du Commune - Vietnam				

My Ly HPP Villages to be relocated				
Village	**HH**	**Population**	**HH poverty %**	**Ethnicity**
Keng Du	46	183	78	Thai
My Ly Commune - Vietnam				
Cha Nga	97	435	60	Thai
Xop Duong	61	224	90	Thai
Xang Tren*	174	688	84	Thai
Subtotal My Ly Commune	332	1,347		
Total Vietnam	**378**	**1,530**		
Kouan District - Laos				
Phiangxang	9	36	100	Kho mu
Sopsan	16	89	88	Thai (Lao Loum)
Sopkang	48	320	63	Thai (Lao Loum)
Kengkor	29	150	100	Kho mu, Thai
Phiangthat	44	276	93	Kho mu
Total Laos	**146**	**871**		
Total My Ly HPP	**524**	**2,401**		

* Xang Tren Village is located in the middle of the Project construction areas and will be highly impacted by the construction, its related activities and workers' camp. The village should be relocated and is therefore included in the list of villages to be relocated.

Village land to be inundated. Added to the villages that will be inundated, land in the area of four villages in Keng Du Commune is located within the proposed reservoir area. In the Laos territory, the reservoir will affect land areas that belong to Keochia and Phianghong villages in Nonghed District in Xiankhoang Province. Additionally the very tail end of the reservoir according to the current design will affect a small area of Sopten Village. The riverbank here is very steep and no villages are located along the river stretch of the My Ly HPP reservoir (Table 15).

Table 15. Four villages in Keng Du Commune in Vietnam with land areas to be inundated

My Ly HPP Villages in Vietnam with land losses					
Village	**HH**	**Population**	**HH poverty %**	**Ethnicity**	**Impact**
Keng Du Commune - Vietnam					
Huoi Phuon 1	93	388	60	Kho mu	Land affected is used for animal grazing.
Huoi Phuon 2	138				Land potentially affected, status to be confirmed.
Hat Ta Ven	130	636	75	Kho mu	Land affected includes cultivation land with maize, sugarcane, eggplant and fruit trees.

My Ly HPP Villages in Vietnam with land losses					
Village	**HH**	**Population**	**HH poverty %**	**Ethnicity**	**Impact**
Huoi Xui	138	564	87	Kho mu	Land affected. Some HHs worried over living too close to the reservoir edge (about 100m above the water level).
Nonghed District –Laos					
Keochia					Land affected by the propsed reservoir. The riverbank is very steep and there are no settlements along the river.
Phianghong					
Sopten					The very tail end of the reservoir. There are no settlements along the river.

Phiangthat Village in Laos subject to relocation

Construction area impacts. Xang Tren Village in My Ly Commune with 688 Thai ethnic minority people in 174 households is located 1km downstream the river from the planned dam site and in the midst of the project construction areas. This village will be highly impacted of the planned workers' camp with estimated 3,400 workers next to it, and of all the construction transportations in the road along the village border as well as of dust, noise, pollution and material disposal from the dam construction in the vicinity of the village. Xang Tren Village should be relocated.

Downstream water regime. It is estimated that downstream the planned dam about 28.4km of the river will be potentially affected by low flow during the dry season. There are nine villages along this stretch of the river, however, all the villages downstream Yen Hoa village that is located 2.8km downstream the planned My Ly dam site, are affected by the Ban Ve HPP more than 80 km downstream. The identified downstream villages can be seen in Table below.

Table 16. Villages in the potential downstream impact area

Village	HHs	Population	Hh poverty %	Ethnicity	Location
Yen Hoa	99	442	70	Thai, 3 HHs Kho mu	2.8km downstream of the dam site.
Xieng Tam	48	287	67	Thai, 5 HHs Kinh	Commune center, 5.1km downstream of the dam site,

Village	HHs	Population	Hh poverty %	Ethnicity	Location
					within the tail end of Ban Ve HPP reservoir.
Xop Tu	175	774	65	Thai, Kho mu, Kinh, Hmong	8.7km downstream of the dam site, within the impact area of Ban Ve HPP reservoir.
Hoa Ly	158	702	74	Thai, 3 HHs Kho mu	14.7km downstream of the dam site, within the Ban Ve HPP reservoir.
	Status of villages further downstream in the Ban Ve reservoir area				
Pieng Mung	Village located by a tributary and separated from the Ca River by hills				
Xen My	Ban Ve resettlement village. No road access.				
Ban Tom	Ban Ve resettlement village. No road access.				
Cha Luan	Ban Ve resettlement village. No road access.				
Sop Pe	Ban Ve resettlement village. No road access. About 28.4km downstream of My Ly dam site.				

Physical losses due to reservoir inundation and dam construction

Loss of private property. Affected households will lose their private houses and attached assets.

The structures include:
(i) family home;
(ii) barns for preserving agricultural products;
(iii) fences around the house.;
(iv) There is no grid electricity in the affected villages, and in the villages in Vietnam each household provides its own electricity through a mini-hydro generator in the river and in Laos each household has a micro-hydro generator or solar panels; and
(v) private boats that are used for fishing and river transportation.

Loss of land. The land to be inundated consist of:
(i) residential land that each household has a land certificate on;
(ii) land used for production: (a) upland cultivation land; (b) home garden; (c) riverbank cultivation land;
(iii) forest that is utilized for: (a) timber logging for house construction and for selling; (b) hunting animals for household food and for selling; (c) collecting NTFPs at a daily basis for household food, such as wild growing vegetables, bamboo shoots, mushrooms; (d) collecting firewood; and
(iv) animal grazing land.

Loss of public infrastructure. The reservoir will inundate public infrastructure in villages and adjoining areas, including:
(i) village access road;
(ii) inter-village roads;
(iii) water supply system with water tanks and water pipes leading water from streams to villages;
(iv) village cultural house; and
(v) school (and kindergarten in Vietnam).

Loss of cultural heritage. All the villages have areas that are of cultural and spiritual importance. The reservoir will inundate:
(i) village spirit forest located at some distance from the village in a Protection forest area;
(ii) graveyard located outside village; and
(iii) village worship place under a big tree with a small wooden spirit house or altar for offerings.

Non-physical losses due to reservoir inundation and dam construction

Loss of access to livelihoods resources. The Project will inundate land, forest and water areas that are used for household livelihoods. The reservoir and dam construction will also cut accessibility to areas with livelihoods resources such as cultivation and forestry areas across the reservoir lake. Moreover, the HPP will disturb aquatic resources (amount of fish, shrimps, snails and other crustaceans) and wildlife that are important for households food security in the Direct and Indirect Impact Area.

Loss of access to transportation. For most villages along the Ca River, the river is the main transportation way to services in My Ly Commune center. People from the villages both in Vietnam and in Laos travel along the Ca River to My Ly Commune health center when they need health services, and for buying and selling goods in the commune center. Villagers also travel by both to other villages to socialize with relatives and to attend festivities such as weddings. The dam will cut off boat transportation between upstream and downstream areas of the dam, affecting people's access to healthcare and government services as well as to trade.

Vietnamese mobile traders selling household items to the local people in the Project area and buying from them agricultural and forest products, animals, hunted wildlife and timber are using waterways to access the villages and areas along the river both in Vietnam and in Laos. The dam will cut off transportation between upstream and downstream areas of the dam and, consequently, trade connection to the affected villages, which is important for the Project affected people's access to consumer goods and for their cash income generation activities.

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Major constraints in agriculture

Farming system. The Project IA has a mountainous terrain and the people living there are ethnic minority, people who rely on subsistence farming for their livelihoods. The area for wetland paddy and for perennial crops is limited. Farmers grow rain-fed crops on swidden land on slopes located mostly in Production Forests. They harvest one crop per year and leave the land to fallow between three to six years. On sloping land without terraces, animals or machines cannot be used for ploughing land and therefore farming operations are done manually. Farmers use local seed materials except maize, and farming technology has not improved over the years. Many farmers do not grow vegetable because they prefer to collect wild-growing vegetables for home consumption in the forests. Crops are grown as monoculture, but peanuts, ginger and other crops grown in small areas are also intercropped with cassava and maize. Agriculture extension service is deficient.

Soil fertility. There is no intervention observed in improving swidden cultivation in the Project IA. This agriculture practice is not sustainable. The period of keeping land fallow after cultivation to rejuvenate soil fertility is very short (not sufficient for the soil to recover) due to demand for farming the land again. Fertilizers are not used, except occasionally in maize cultivation, and there is no system of compost making although a few farmers in Hat Ta Ven use cow dung in vegetable plots. Legumes are not grown as main crop or as an inter-crop which could gradually build up soil fertility. In upland agriculture, annual cropping without reasonable improvement measures rapidly degrades soil. Farmers indicated poor crop yields due to low soil fertility.

Climate change. Crop yields are highly varying, and farmers reported reduced yields due to unfavorable weather conditions and long periods of droughts. Yield of the hybrid maize is only 40-50% of its potential. Failures of harvest were reported by the villagers. Climate change effects will be more profound for crops growing on swidden land because these crops grow under natural conditions and wholly depend on rainfall and temperature regimes, which are gradually changing.

Livestock feeds and fodder. All the livestock reared are of undescribed local breeds adapted to free-ranging system and low level of nutrition and management. Farmers reported shortage of fodder for ruminants during winter months, and in some villages an acute shortage was observed. A few farmers in Hat Ta Ven Village grow local maize as a fodder crop. Some farmers rearing hybrid pigs buy commercial livestock feeds. Nutrition level has to be improved for livestock development and better yields.

Animal health service. Livestock health status is in general poor and high mortality in pigs and poultry was reported. Animal health service is not easily available and if available, it is costly and of poor standard. Farmers are not trained and lack knowledge in disease treatment. In some villages, farmers are aware of prevention methods such as vaccination, but the lack of veterinary services makes it very difficult for them to improve their livestock farming.

Livelihoods – linkages and dependence

Currently, livelihoods of the local communities in Laos and Vietnam in the Project IA depend upon forest, water and land resources, the later in the form of swidden (shifting cultivation) agriculture (Figure 3)**.** Forest dependence is high, forests providing protein resources, edible and medicinal plants, vegetables, materials for household energy, construction and other uses, and animal protein through small mammals, birds, rodents, lizards and amphibians. Water resources provide free protein through fishes and aquatic insects. Apart from daily food, both these resources are helpful in generating some occasional cash through sale of small mammals and rodents. Livestock is another source of animal protein (mainly poultry) and of cash income through sale of live animals. However, animal health services are poorly available and animals are often lost in disease outbreaks. Swidden agriculture is less productive but provides carbohydrates in the form of rice as a staple food, while maize and cassava are grown for livestock fodder. Rice production is, however, not sufficient for yearly consumption needs for the poor families, and food security is a serious aspect influencing PAP lives and wellbeing. This livelihoods scenario among the ethnic minorities/groups will continue resulting in deterioration of forest and other land in use until changes are brought to the practices used and sustainable processes are put in place. The My Ly HHP Project affecting the above resources will have detrimental effects on livelihoods of the people living in the Project DIA. In the context of livelihoods, forest resources are significantly more important than fisheries, livestock and crop farming, as these provide a reliable and available source of food and other products.

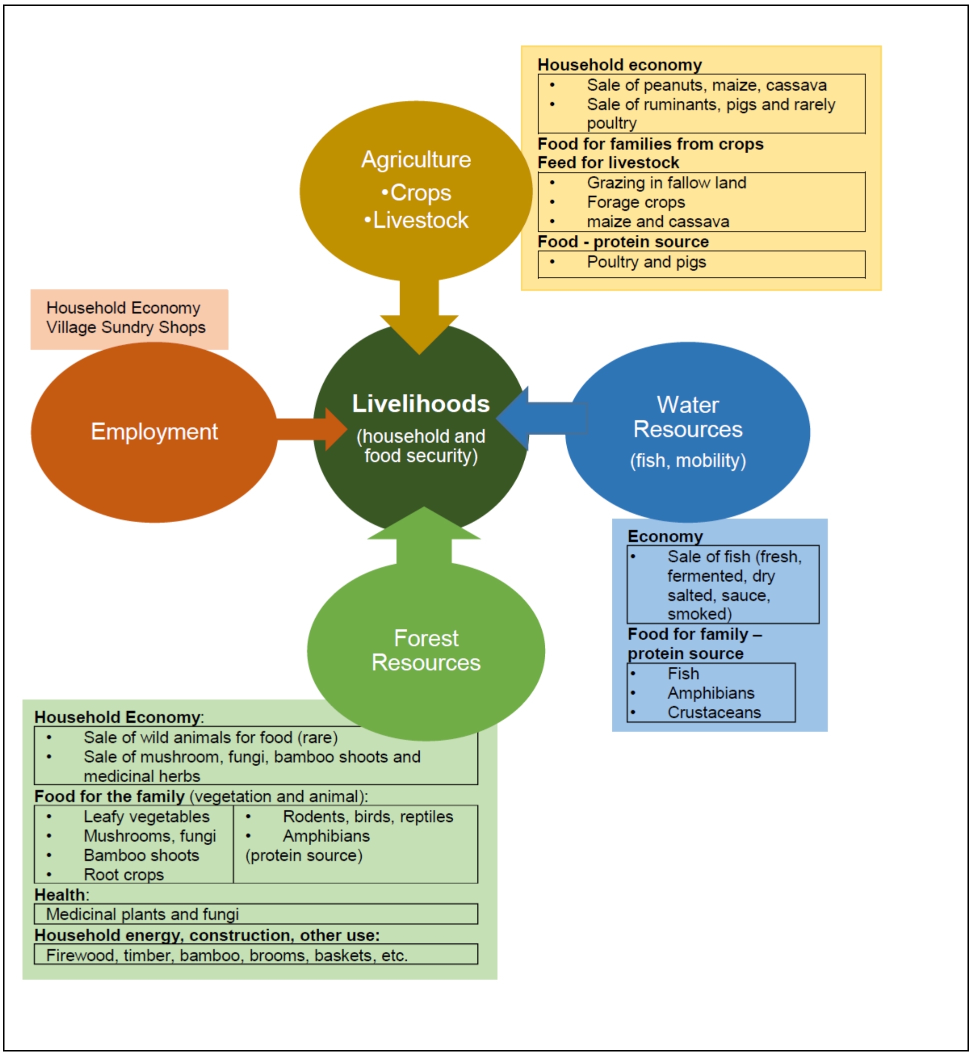


Figure 3. Livelihoods of Project affected households are primarily dependent on forest resources followed by upland agriculture and the water resources of the river.

Biodiversity

The terrestrial ecosystem, mainly forests and grasslands, and aquatic ecosystems and their quality in the form of water resources in rivers, as a function of river's catchment, provide a good habitat for wildlife and aquatic life including fish. Biodiversity of forest vegetation and wildlife are inter-related, and serve to provide products for humans, enriched soil (after a few years or regeneration) for agriculture and work to reduce siltation through providing a more stable land cover than, for example, grasslands do. In the My Ly HPP area, biodiversity of forest vegetation is low. A growing secondary forest vegetation after exploitation or developing through a progressive forest succession on uncultivated fallow land has a comparatively low cover but it is growing. This is reflected in the riverine location of habitats where biodiversity of wildlife is limited to smaller size mammals, e.g., rodents and bats, and reptiles and amphibians. A past long period of exploitation of mature forests has depleted larger wildlife and timber resources. Short - to long-distance migratory fish species and resident species make-up the existing fish biodiversity, however a dam (Ban Ve HPP) operating downstream from the proposed My Ly HPP has already impacted upward movement of migratory species, particularly for spawning. Nonetheless, the presence of 77 fish species and several other aquatic species in Ca River indicate that the biodiversity has not deteriorated significantly.

Both the terrestrial and aquatic ecosystems in the Project AI provide tangible food products and some cash flow for the ethnic minority communities. The communities in the Project AI depend more on forest resources including wildlife and aquatic resources, fish and other, for their livelihoods than on crop farming which is restricted to mainly upland rice. The food resources from the forests are vital, for daily needs and during lean periods when food is insufficient.

In general, a hydropower project disturbs the ecosystem, and as in the case of My Ly HPP it will affect significantly product availabililty from forests and rivers to the local people. The mitigation suggested is meant to minimize impacts due to the land-take of the Project through proposing forest conservation, biodiversity restoration, fish monitoring and agriculture enhancement measures linked to community involvement.

Cumulative Impacts

Cumulative impacts are those that result from the incremental impact of the Project when added to existing, planned and reasonably predictable future projects and developments. The cumulative impacts of the propsed Project have been assessed based on the principles outlined in the IFC Guidance Notes (2012). It aims to better understand the impacts of the existing HPP and planned HPPs within the Ca River cascade system, together with the proposed development.

While there is currently limited quantitative data available to make a fully informed cumulative impact assessment, the assessment nevertheless looked at different vital ecosystem and social attributes aspects such as biodiversity, critical habitats, sensitive receptors, livelihood and ecosystem services.

The My Ly HPP is planned on the Ca River where there are both hydropower projects planned and in operation. During the preparation of this ESIA, there are three planned projects upstream, namely Nam Non 2, Lower Nam Non 1 and Lower Nam Non, all are located in Laos territory. The two latter Projects have feasibility studies completed.

Downstream, there are two hydropower projects which are already in operation, namely the Ban Ve HPP (320 MW) and the Nam Non HPP (15 MW), both are in the Vietnam territory.

The upstream projects have the potential to affect the river/water use downstream including the operational requirements of this Project. The current plan also indicates that the backwater of My Ly HPP may overlap with the location of the planned Lower Nam Non HPP in Laos, although this is not an unusual condition in Vietnam. In the absence of sufficient information on the upstream HPPs at this stage, this needs to be studied further and consultation/negotiation between the HPP owners is necessary.

Downstream, the Ban Ve HPP's reservoir's tail end at FSL is only 2.8km from the My Ly's dam site, while it extends up to 31.20km during MOL and therefore will affect the villages using the river as the reservoir recedes from its FSL to MOL, a distance of about 28.4 km from the My Ly proposed dam site. At present, the receding level of the reservoir leaves the river with the natural flow in the river, however, with the My Ly HPP the flow is anticipated to be further reduced. This may affect current river related activities, particularly during the dry season. The reduction of water will be based on the discharge decided for My Ly HPP.

Fish species however are not likely to be significantly affected as long as the reservoir shall be maintained at its MOL level all the time. The river bank natural vegetation has already been affected by the Ban Ve HPP reservoir regime, since its operation in 2010 and therefore no significant impact is foreseen.

Navigation to the downstream villages without access roads however maybe affected from the potential reduction of water flow and therefore monitoring of the potential impacts is necessary to further assess seasonal effects.

Ecosystem services

Ecosystem Services (environmental services) are the benefits that people derive from the ecosystems and includes four types: provisioning, regulating, cultural and supporting services. In the case of My LY HPP the most relevant types are those provisioning services commonly referred to as natural resources, e.g., water, food and fuel contributing to the human well-being, being central to livelihoods in the DIA and IIA. In order of decreasing relative contribution to livelihoods and importance, the ecosystems services including provisioning, cultural, recreation are from:

- Forest and forest-bamboo (food sources mainly rodents, snakes, birds; medicinal plants; firewood, wood for construction);
- Land (agriculture for rice production, cash crop (peanuts) and feed (maize and cassava) for livestock, some grazing of livestock; vegetation cover that provides for soil and slope stability in Project direct and indirect impact areas); and
- Water (fish, crustaceans; transport; cultural importance linked to rituals related to burials and spirits; bathing).

The dependence on the forest and forest-bamboo ecosystems is high and its contribution is directly contributing to provision of food sources, especially protein in the form of rodents and snakes. Many HH make daily collections for food sources from forest ecosystems. The areas that will be inundated will result in a loss of core nutrition and protein source. The water resources of the river are important sources of fish for many villages located in the planned inundation area (direct impact area, reservoir). This ecosystem service will change in composition and will need to be managed if the reservoir is to be used as a source of fish. The river which is currently free flowing and the downstream dam is more than 80km away is an important rapid way of travel across the river and along the river. Burial ritual related sacrifice (chickens) is performed with the river serving as a pathway for spirits.

There are intimate livelihoods links with forests, the Ca River and upland lands which all provide ecosystem services to the local communities. Ecosystem services and their dependence is high and the loss is significant. The conservation and sound management of forests ecosystems and sustainable use of agricultural and grazing land is required in the relocation areas, so that the ecosystems services are available. The river provisioning services may be lost, except for fishing in the form of aquaculture or reservoir fishing.

Communication

Previous consultations. The Proponent and hired national consultants in Vietnam and Laos have had several meetings with the local authorities at commune and village levels about the proposed Project during 2012-2016. People in the villages to be affected by the Project have also been informed about the possibility of the HPP in a few instances. These consultations were not arranged in a manner to allow informed consultation and participation of the project affected people and cannot be considered as part of the Informed Communication and Participation (ICP) process.

ICP process initiated. The Free, Prior, and Informed Consent (FPIC) process was initiated in June 2017, when a Vietnamese communication team hired by the Proponent according to advice from and designed by the International Consultant undertook informed consultations in all the villages to be affected by the HPP. Villagers were provided information about the planned project, its impacts and proposed mitigation measures using communication methods that were understandable for them. Their questions, opinions, views and concerns on the project impacts and proposed mitigation measures were discussed and recorded in a village consent document in each village to be relocated. In those villages that will lose riverside land but not be relocated, the consultant had similar consultations with the Village leader.

The FPIC consultations showed *broad community support* for the Project and agreements were obtained through the consultations. Main concerns of communities are presented below.

Main concerns from the affected people. People in all the villages to be relocated agreed in principle to the relocation, but some of them expressed concerns and had alternative suggestions for the proposed relocation site. Relocation site and the available land and water resources were the most important criteria for the affected villagers to agree to the relocation. Other concerns and suggestions that commonly came up in the consultations included:

- Compensation payment should be made in maximum of two larger payments and not in several smaller ones, and the payment should be made in full before relocation;
- Affected households should receive compensation payment directly from the Proponent, not through commune or village government authorities;
- Request that people will screen the proposed relocation site together with the project planning team in order to verify the location, land and water availability, etc.;
- Request that people are involved in the design and relocation of the village, location of graves and spirit forest;
- House placement direction is important and depends on each ethnic clan;
- Forest protection and management and the income it brings to local people is important, and should not be disrupted by the relocation;
- Land use certificates have to be issued on the new location to all households; and
- There has to be a monitoring and compliant (grievance) system, and villagers should be involved in monitoring.

These and other expressed concerns are to be addressed by the Proponent in follow-up-community consultations.

Mitigation and enhancement measures

Specific and general measures have been proposed to mitigate impacts. Below are flow charts of the key plans for managing social, environmental and resettlement impacts. Elaboration of the key plans spanning all programs are provided in the ESIA and Environment and Social Management Plan (ESMP), the Resettlement and Ethnic Minority Livelihoods Restoration Plan (REMLRP) and the Public Commmunication and Disclosure Plan (PCDP). A resettlement policy and entitlements framework is proposed in the REMLRP.

Physical and biological impacts of hydropower projects can be significant and permanent and if proper mitigation is not conducted at the appropriate time, consequences can be dire. Similarly, the loss of land and properties and the displacement of population from their settlement areas are probably among the major social and cultural impacts of the My Ly HPP. As part of the project optimization process, a number of measures have been taken to minimize the social and ecological footprint of the Project. The main Programs are:

- Physical Environment Program
- Biological Environment Program
- Social Program

In addition, requirements for the construction contractor are eluded to for initial guidance to the Proponent. See figure below for an overview of the Programs.

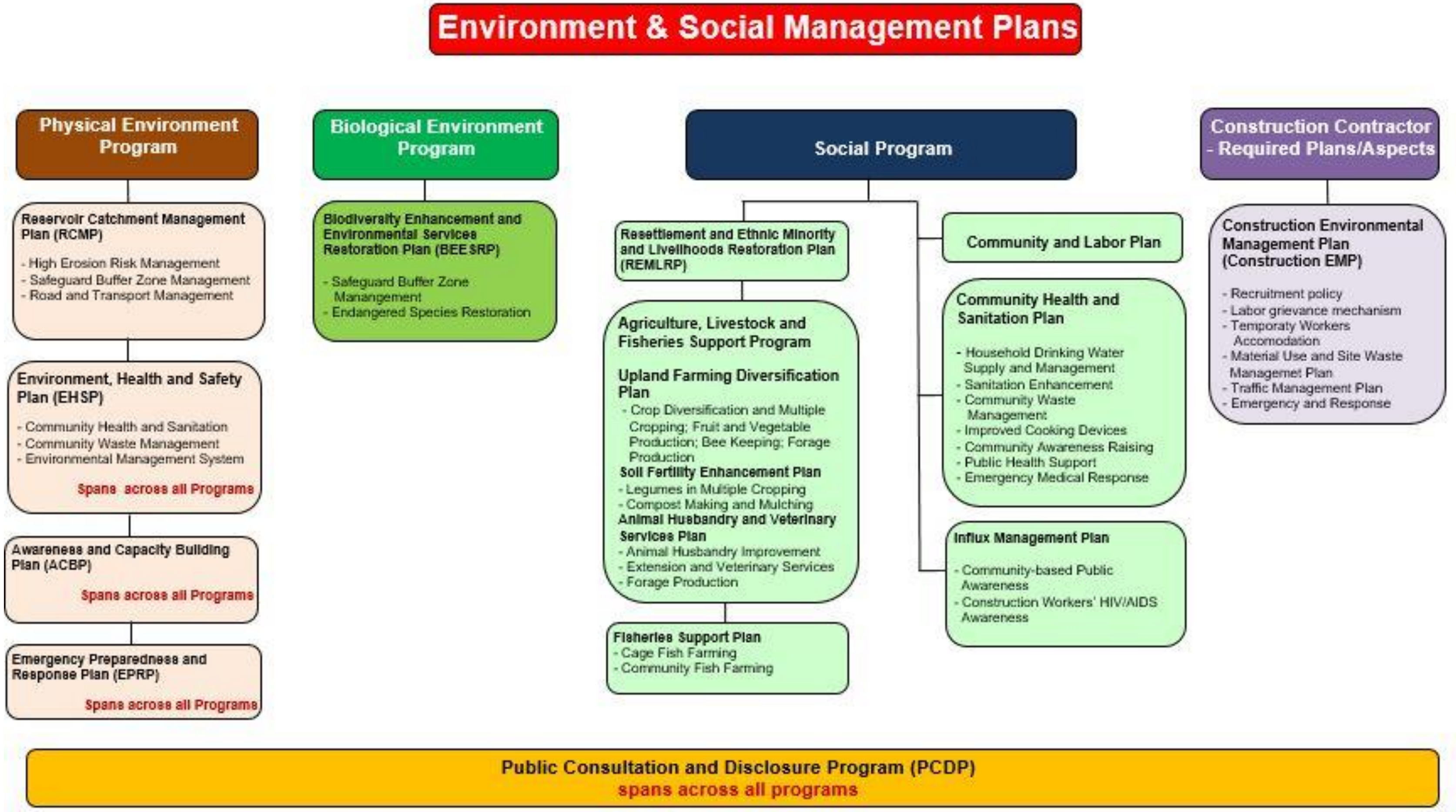
Grievance Redress Mechanism. The proponent has to establish in the project planning phase a Grievance Redress Mechanism (GRM) consistent with the MIGA PSs. The GRM will provide the PAP clear and practical mechanism to express their complaints and concerns about the project's social and environmental performance. The GRM will allow the Proponent to receive and address any issues on land acquisition, compensation and relocation from the relocated people and host communities. The GRM will also allow the Proponent to address complaints from people in the Indirect Impact and Tertiary Impact Areas who may be affected due to the project activities and activities related to the presence of the Project. The GRM will allow issues to be raised in a timely fashion, and include a mechanism designed to resolve disputes in an impartial manner.

The GRM should be based on the local community organization and be culturally appropriate and understandable for the affected people. It is an integral part of the PCDP. Prior to relocation, the GRM should be adapted to the local community organization structure.

Social and environmental planning and management, monitoring and auditing

The application of mitigation measures, monitoring, and environmental audit of the proposed Project have been recommended to ensure the validity of impact prediction, effectiveness of mitigation measures and sustainable social, economic and cultural development of the local and adjacent community. The measures proposed are expected to be formulated in detail during the pre-construction (design phase) of My Ly HPP. A Social and Environmental Management Division has been proposed to manage and implement the proposed ESMP and the REMLRP under the Proponent's management. The ESMP and REMLRP will be linked to the social mitigation and enhancement measures undertaken under the same division. Similarly, a PCDP and GRM have been proposed for the Proponent's management. An organization structure and program has been proposed for the ESMP and other safeguard documents. Note that the mitigation measures may change after the public consultations are held during the pre-construction phase.

The proposed PCDP sets the principles and procedures as required according to MIGA PS 1 and PS 7 for an ICP process during the project planning, implementation and operation monitoring to ensure the FPIC of the project affected ethnic minority/groups communities in Vietnam and in Laos.


Environment & Social Management Plans
Physical Environment Program
Reservoir Catchment Management Plan (RCMP)
- High Erosion Risk Management
- Safeguard Buffer Zone Management
- Road and Transport Management
Environment, Health and Safety Plan (EHSP)
- Community Health and Sanitation
- Community Waste Management
- Environmental Management System
Spans across all Programs
Awareness and Capacity Building Plan (ACBP)
Spans across all Programs
Emergency Preparedness and Response Plan (EPRP)
Spans across all Programs
Biological Environment Program
Biodiversity Enhancement and Environmental Services Restoration Plan (BEESRP)
- Safeguard Buffer Zone Manangement
- Endangered Species Restoration
Social Program
Resettlement and Ethnic Minority and Livelihoods Restoration Plan (REMLRP)
Agriculture, Livestock and Fisheries Support Program
Upland Farming Diversification Plan
- Crop Diversification and Multiple Cropping; Fruit and Vegetable Production; Bee Keeping; Forage Production
Soil Fertility Enhancement Plan
- Legumes in Multiple Cropping
- Compost Making and Mulching
Animal Husbandry and Veterinary Services Plan
- Animal Husbandry Improvement
- Extension and Veterinary Services
- Forage Production
Fisheries Support Plan
- Cage Fish Farming
- Community Fish Farming
Community and Labor Plan
Community Health and Sanitation Plan
- Household Drinking Water Supply and Management
- Sanitation Enhancement
- Community Waste Management
- Improved Cooking Devices
- Community Awareness Raising
- Public Health Support
- Emergency Medical Response
Influx Management Plan
- Community-based Public Awareness
- Construction Workers' HIV/AIDS Awareness
Construction Contractor - Required Plans/Aspects
Construction Environmental Management Plan (Construction EMP)
- Recruitment policy
- Labor grievance mechanism
- Temporaty Workers Accomodation
- Material Use and Site Waste Managemet Plan
- Traffic Management Plan
- Emergency and Response
Public Consultation and Disclosure Program (PCDP)
spans across all programs

Conclusion

The My Ly HPP is planned along a stretch of the Ca River at the border of Vietnam and Laos. The technical feasibility of the Project has been performed for an installed capacity of 180 MW.

The main anticipated negative impacts of the Project include:

(i) the loss of land and assets of Project Affected People due to land permanently acquired and used by the Project both in Laos and Vietnam;

(ii) resettlement and social change;

(iii) changes related to the loss of production and protection forests, agricultural land and associated wildlife habitat;

(iv) changes related to the change of the river into a reservoir affecting connectivity/transport and fisheries;

(v) loss of forest-river related ecosystem services affecting livelihoods which are dependent on these systems.

The main anticipated positive impacts of the Project include:

(i) Increase in mobility and accessibility to the affected villages and Project area in general due to improved roads and provisions of new roads to the villages. This may trigger positive impacts on livelihoods, in making markets accessible, easier access to health care and other services;

(ii) Restoration of forest-grassland areas so that the vegetated areas improve in quality, such that sediments are reduced, availability of forest products are assured overtime and wildlife habitat is increased. This will ensure that ecosystem services are enhanced, maintained and is sustainable;

(iii) Improvement in agricultural methods and products whereby food insufficiency does not occur;

(iv) Improved energy availability and use, better cooking methods and electricity; and

(v) Increase in well being is expected, provided proposed measures are implemented.

Mitigation and enhancement measures on potential social-cultural, forest, agricultural, biological and physical impacts are proposed to minimize the effects and therefore enhance community well being and forest-agriculture central to livelihoods. Measures include, among others, plans for livelihood restoration, immediate catchment management, ecosystem services enhancement, health and safety measures. The measures proposed in the ESMP will help minimize the ecological footprint of the Project. Safeguard documents include the REMLRP and ESMP guided by the PCDP. An adaptive management process should be adopted to adjust plans according to findings from monitoring, consultations, and audits. A Social and Environment Division (SEMD) of My Ly HPP will administer the ESMP through the establishment of a Social and Environmental Management Unit (SEMU).

CHAPTER 1: INTRODUCTION

1.1 The Project

The Project is situated in two of the nations in the Indochina region of Asia, bordered by China, Myanmar, Thailand and Cambodia. Laos is land locked. Both the governments of Vietnam and Lao PDR have an agreement to develop hydropower projects on the Ca River and its tributaries. Ca River is located in Nghe An Province of Vietnam and parts of it is within the Lao territory in Houaphanh and Xiangkhoang Provinces. This is an essential part of Vietnam's master plan for a hydropower power cascade development along the Ca River system.

In March 2016, a meeting between the two governments took place to craft the terms of the agreement and content of the cooperation[10] (Annex 1.1). Prior to the meeting there have been numerous studies to determine the feasibility of the hydropower scheme, and further detailed studies were carried out after the signing of the agreement.

The My Ly Hydropower Project is designed as a peaking project to have a capacity of 180MW with a storage reservoir of about 1248ha (1040ha land take). My Ly-Nam Mo Hydropower Joint Stock Company (JSC), a private Vietnamese enterprise was incorporated by the Vietracimex (a Vietnam based enterprise) to develop the Project.

One of the conditions of the agreement between Vietnam and Lao PDR is the preparation of an Environmental Impact Assessment (EIA). Two national EIAs were prepared, one for each country and are subject to each country's respective national procedures and compliance.

My Ly-Nam Mo JSC, the project 'Proponent' intends to acquire a loan to finance the development of the project. The Proponent plans to apply for a political risk guarantee from the Multilateral Investment Guarantee Agency (MIGA, World Bank Group) to secure the loan. The national EIAs were found not to be compliant with MIGA policy thus requiring upgrading. One of the requirements for a loan agreement is to prepare an international Environmental and Social Impact Assessment (ESIA) based on MIGA Performance Standards.[11]

This ESIA Report presents an assessment of the potential environmental and social impacts associated with the My Ly Hydropower Project in Nghe An Province, Vietnam ('the Project').

[10] The First Negotiation Round. Agreement Between the Government of the Lao Peoples Democratic Front and the Government of the Socialist Republic of Vietnam. 11 March 2016. (Vol. 11, Annex 1.1)

[11] MIGA standards are identical to that of IFC. MIGA also applies IFC's Guidance Notes (2012).

1.2 The Project Proponent

My Ly - Nam Mo Hydropower JSC is a special purpose company/enterprise that has been set up by Vietracimex in Vietnam to develop the Project. The Proponent involved in the development of the Project and this ESIA is:

Proponent of Project ('Proponent')
Name of Proponent: **My Ly - Nam Mo Hydropower Joint Stock Company (JSC)** Representative: Mr. Nguyen Tien Phong Position: General Director Headquarters: No. 148 Nguyen Sy Sach street, Hung Dung ward, Vinh city, Nghe An Province, Viet Nam Working office: No. 926 Bach Dang road, Thanh Luong Ward, Hai Ba Trung District, Ha Noi City. Telephone: +84 (04) 36334194; - Fax: +84 (04) 36334194: Tax code: 2901444639

1.3 The International ESIA consultant and supporting teams

The International Consultant Team responsible for the ESIA is managed by a Norwegian based entity, ENVIRO-DEV, 2510 Tylldalen, Norway. Org. No. 988 903 620. (env-dev@online.no)

National teams providing input and support

The National Consultant Team which assisted with logistics, field work in the local language and interpretation/translation of the earlier reports/data (technical feasibility) in Vietnamese, and maps is Power Engineering Consulting Joint Stock Company (PECC1; Tax Code: 01100100953), an affiliate of EVN (Electricity of Vietnam), Vietnam. Address: Km 9+200 Nguyen Trai Street, Thanh Xuan Nam Ward, Thanh Xuan District, Hanoi.

The independent National Consultant Team under the direction of ENVIRO-DEV for informed communication and participation processes was headed by Ms. Vu Thi Hien (ID034154001218), Room 11.21, Floor 11, Bac Ha Lucky Building, No. 30, Pham Van Dong str.; Cau Giay district, Hanoi, Vietnam.

1.4 Purpose of this document

The purpose of this report is to present the environmental and social assessment carried out for the Project in compliance with the requirements of MIGA.

The specific objectives of the ESIA are:

- Identify and establish the current environmental, social, and economic conditions of the Project's Direct Impact Area (DIA), including all project structures and work areas;
- Describe the Project and its associated activities and identify potential impacts to the environment within the Project's Area of Influence (AI), similarly identify environmental and social conditions that may have an impact to the proposed Project and its design;
- Evaluate potential impacts of the Project including factors such as magnitude, extent and duration of the impacts and the affected elements such as the Project Affected People/Community (PAP) and the natural environment;
- Identify potential mitigation measures to avoid and minimize the impacts including compensation costs, if avoidance is not feasible;
- Assess the best alternative Project and measures; and
- Formulate an environmental and social management plan and key safeguard frameworks.

1.5 Report structure

The report is structured to generally conform to the preferred outline for international environmental and social assessments. It has eight volumes, the main report and the annexes. Volume 1- Main Report (the ESIA) has 17 chapters while Volume II – Annexes contains supporting documents such as copy of agreements, relevant permits and approval issued to the Project, and appendices to the Specialists reports. Chapters 3 and 4 present the technical basis of the Project while Chapters 5-10 provide the approach taken for the ESIA, baseline environments, key cross-cutting aspects and the communication conducted. The impact assessment and mitigation are covered in Chapters 11-12 and culminate in the Environment and Social Managament Plan (ESMP) and monitoring needs in Chapters 13 and 14, respectively. The references are provided in Chapter 15 followed by the list of key individuals involved in the Project and a brief concluding chapter make up the last two chapters. Volume III covers the social baseline and Volume IV the records of communication conducted. The following volumes V-VII provide the main safeguard and management plans.

Volume I - Environmental and Social Impact Assessment (ESIA)
Main report has the following chapters:
- Chapter 1 - Introduction
- Chapter 2 - Policy, guidelines and legal instrumental framework
- Chapter 3 - Project description
- Chapter 4 - Analysis of alternatives
- Chapter 5 - Approach
- Chapter 6 - Physical environment
- Chapter 7 - Biological environment
- Chapter 8 - Social environment and livelihoods
- Chapter 9 - Cross cutting issues
- Chapter 10 - Communication, participation and disclosure
- Chapter 11 - Impact assessment and mitigation
- Chapter 12 - Summary of mitigation, enhancement and safeguard measures
- Chapter 13 - Environmental and Social Management Plan
- Chapter 14 - Monitoring matrix
- Chapter 15 - References
- Chapter 16 - Teams involved
- Chapter 17 - Conclusion

Volume II - Agreements, approvals and specialist reports
- Annex 1 Agreements and approvals
- Annex 2 Appendices, Specialist reports on (a) Biology and (b) Water quality

Volume III - Social baseline
- Annex 3 Social and livelihoods reports

Volume IV - Communication
- Annex - 4 Consultations before 2017
- Annex - 5 ICP process reports

Volume V - Public Communication and Disclosure Plan (PCDP)

Volume VI - Resettlement and Ethnic Minority Livelihoods Restoration Plan (REMLRP)

Volume VII - Environmental and Social Management Plan (ESMP)

CHAPTER 2: POLICY, GUIDELINES, & LEGAL INSTRUMENTAL FRAMEWORK

This Chapter outlines the main standards and guidelines that were used as benchmarks for the ESIA and safeguard documents that will be developed. These were also used in assessing the adequacy of the data and information collected for the ESIA.

2.1 International standards and guidelines

This Chapter outlines the main standards and guidelines that were used as benchmarks for the ESIA and safeguard documents that will be developed. These were also used in assessing the adequacy of the data and information collected for the ESIA.

The Project is Category A under MIGA's Policy on Environmental and Social Sustainability (2013). It is expected to have potentially significant adverse social and environmental impacts that are diverse, irreversible, or unprecedented.

The Project Developer, My Ly-Nam Mo Hydropower JSC, was asked to prepare and submit to MIGA the ESIA, a Resettlement Policy Framework (RPF) and Ethnic Minority Development Framework documents prior to the decision of the loan from the Bank.

MIGA, a division of the World Bank Group that lends to private investors, has a Sustainability Policy and set of Performance Standards (PS) on Social and Environmental Sustainability (2013) (Table 2.1) to which compliance is required. The PS[12] highlights the significance of managing environmental, social and health issues during the life of a Project. They identify the need for an effective social and environmental management system that is dynamic and continuous, 'involving communication between the client, its workers, and the local communities directly affected by the Project'. They require 'thorough assessment of potential social and environmental impacts and risks from the early stages of project development and provides order and consistency for mitigating and managing these on an ongoing basis'.

The PS strengthen the significance of successful community engagement through disclosure of project-related information and consultation with local communities on concerns that directly affect them. Through the PS, MIGA, like IFC, necessitates clients to engage with affected communities through disclosure of information, informed consultation and participation, in an approach commensurate with the risks to, and impacts on, the affected communities. MIGA also referes to the Guidance Notes (2012) supporting each of the PS are available on the IFC website and were utilized[13].

Table 2.1 Summary of MIGA Performance Standards

MIGA Performance Standards (2013)	Brief description
Performance Standard 1	Identify and assess social and environmental impacts, both adverse and beneficial, in the Project's area of influence.

[12]Source: https://www.miga.org/projects/environmental-and-social-sustainability/performance-standards/, see also reference to IFC guidance notes linked to the performance standards listed here. These are similar to the ones of MIGA sister organization IFC.

[13]Source:http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/our+approach/risk+management/performance+standards/environmental+and+social+performance+standards+and+guidance+notes

MIGA Performance Standards (2013)	Brief description
Assessment and Management of Social and Environmental Risks and Impacts	Avoid, or where avoidance is not possible, minimize, mitigate, or compensate, for adverse impacts on workers, affected communities, and the environment. Ensure that affected communities are appropriately engaged on issues that could potentially affect them. Promote improved social and environment performance of companies through the effective use of management systems.
Performance Standard 2 Labor and Working Conditions	Establish, maintain and improve the worker-management relationship. Promote the fair treatment, non-discrimination and equal opportunity of workers and compliance with national labor and employment laws. Protect the workforce by addressing the child labor and forced labor. Promote safe and healthy working conditions, protect and promote health of workers.
Performance Standard 3 Resource Efficiency and Pollution Prevention	Avoid or minimize adverse impacts on human health and the environment. Avoid or minimize pollution from project activities. Promote the reduction of emissions that contribute to climate change.
Performance Standard 4 Community Health, Safety and Security	Avoid or minimize risks to and impacts on the health and safety of the local community during the project life cycle from both routine and non-routine circumstances. Ensure that the safeguarding of personnel and property is carried out in a legitimate manner that avoids or minimizes risks to the community's safety and security.
Performance Standard 5 Land Acquisition and Involuntary Resettlement	Avoid or at least minimize involuntary resettlement wherever feasible by exploring alternative project design. Mitigate adverse social and economic impacts from land acquisition or restrictions on affected person's use of land by: (i) providing compensation for loss of assets at replacement cost; and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected. Improve or at least restore the livelihoods and standards of living of displaced persons. Improve living conditions among displaced persons through provision of adequate housing with security of tenure and resettlement sites.
Performance Standard 6 Biodiversity Conservation and Sustainable Natural Resource Management	Protect and conserve biodiversity. Promote the sustainable management and use of natural resources through the adoption of practices that integrate conservation needs and development priorities.
Performance Standard 7 Indigenous Peoples (IPs)	Ensure that the development process fosters full respect for dignity, human rights, aspirations, cultures and natural resource-based livelihoods of IPs.

MIGA Performance Standards (2013)	Brief description
NOTE: the term Ethnic Minorities is used in this ESIA and associated documents for consistency with the national terminology.	Avoid adverse impacts of the Project on communities of IPs, or when avoidance is not feasible, to minimize, mitigate or compensate for such impacts and to provide opportunities for development benefits, in a culturally sensitive manner. Establish and maintain an ongoing relationship with the IPs affected by the project throughout the life of the Project. Foster good faith negotiation with and informed participation of IPs when projects are to be located on traditional or customary lands under use by the IPs. Respect and preserve the culture, knowledge and practices of IPs.
Performance Standard 8 Cultural Heritage	Protect irreplaceable cultural heritage from the adverse impacts of project activities and support its preservation as well as promote the equitable sharing benefits from the use of cultural heritage in business activities.

The framework under which an MIGA ESIA is undertaken cascades down from the performance standards to a set of EHS - there is a general IFC EHS Guideline and a series of industry specific guidelines (World Bank Group; IFC 2007). For this Project, the Proponent have required that the following guidelines in addition to the performance standards need to be adhered to, as relevant (Table 2.2).

Table 2.2 Summary of IFC EHS guidelines

IFC EHS (2007)	Brief Description
Environment	
Air Emissions and Ambient Air Quality	This guideline provides an approach to the management of significant sources of emissions, including specific guidance for assessment and monitoring of impacts. They are: (1) Ambient Air Quality, (2) Point Sources, (3) Fugitive Sources, (4) Mobile Sources – Land-based (5) Greenhouse Gases (GHGs) and, (6) Monitoring.
Energy Conservation	This guideline complements the industry specific emissions guidance presented in the Industry Sector Environmental, Health, and Safety (EHS) Guidelines by providing information about common techniques for energy conservation that may be applied to a range of industry sectors. This guideline includes (1) Process Heating, (2) Process Cooling and, (3) Compressed Air Systems.
Wastewater and Ambient Water Quality	This guideline provides information on common techniques for wastewater management, water conservation, and reuse that can be applied to a wide range of industry sectors. This guideline includes (1) General Liquid Effluent Quality, (2) Wastewater Management and, (3) Monitoring.
Water Conservation	Water conservation programs should be implemented commensurate with the magnitude and cost of water use. Water conservation measures may include water monitoring/management techniques; process and cooling/heating water recycling, reuse, and other techniques; and sanitary water conservation techniques.
Hazardous Materials Management	The overall objective of hazardous materials management is to avoid or, when avoidance is not feasible, minimize uncontrolled releases of hazardous materials or accidents (including explosion and fire) during their production, handling, storage and use. The objectives of the guideline are (1) General

IFC EHS (2007)	Brief Description
	Hazardous Materials Management, (2) Preventive Measures, (3) Control Measures and, (4) Management of Major Hazards.
Waste Management	These guidelines apply to projects that generate, store, or handle any quantity of waste across a range of industry sectors. It provides specific guidance for Waste Management Facilities. This guideline applies to Waste Management, Hazardous Waste Management and Monitoring activities associated with the waste management.
Noise	This section addresses impacts of noise beyond the property boundary of the facilities. This guideline applies noise prevention, mitigation measures and monitoring.
Contaminated Land	This section provides a summary of management approaches for land contamination due to anthropogenic releases of hazardous materials, wastes, or oil, including naturally occurring substances. The steps to be taken: (1) Risk screening, (2) Interim risk management, (3) Detailed quantitative risk assessment and, (4) Permanent risk reduction measures.
Occupational Health and Safety	This section provides guidance and examples of reasonable precautions to implement in managing principal risks to occupational health and safety. Preventive and protective measures should be introduced according to the following order of priority: Eliminating the hazard by removing the activity from the work process. Examples include substitution with less hazardous chemicals, using different manufacturing processes, etc.; Controlling the hazard at its source through use of engineering controls. Examples include local exhaust ventilation, isolation rooms, machine guarding, acoustic insulating, etc.; Minimizing the hazard through design of safe work systems and administrative or institutional control measures. Examples include job rotation, training safe work procedures, lock-out and tag-out, workplace monitoring, limiting exposure or work duration, etc.; Providing appropriate personal protective equipment (PPE) in conjunction with training, use, and maintenance of the PPE.
Community Health and Safety	This section complements the guidance provided in the preceding environmental and occupational health and safety sections, specifically addressing some aspects of project activities taking place outside of the traditional project boundaries, but nonetheless related to the project operations, as may be applicable on a project basis. This section complements includes (1) Water Quality and Availability, (2) Structural Safety of Project Infrastructure, (3) Life and Fire Safety, (4) Traffic Safety, (5) Transport of Hazardous Materials, (6) Disease Prevention and (7) Emergency Preparedness and Response.
Construction and Decommissioning	This section provides additional, specific guidance on prevention and control of community health and safety impacts that may occur during new project development, at the end of the project life-cycle, or due to expansion or modification of existing project facilities. This guideline applies to Environment; Occupational Health and Safety and Community Health and Safety.

2.2 Relevant policies, guidelines, permits/licenses and procedures of Vietnam and Lao PDR

2.2.1 Vietnam

This section describes the local legislations, standards and guidelines in Vietnam which are relevant to the Project. Table 2.3 presents the key policies while Table 2.4 lists the various permits, both primary and secondary permitting required in Vietnam.

Table 2.3 List of key policies and regulations of Vietnam

Policy and guidelines/regulations	Description
Environment Protection Law 55/2014/QH13 (23 July 2014)	The Environmental Protection Law (EPL) of Vietnam provides an umbrella framework for environmental management and protection of the country and has the latest revision in 2014. The primary authority to carry out the mandate is the Ministry of Natural Resources and Environment (MoNRE). At the provincial level, the Provincial Department of Natural Resources and Environment (DoNRE) is the operating unit for overall environmental management. **The Law has the relevant decrees as follows:** **Decree 29/2011/ND-CP (18 April 2011).** This decree provides regulations on strategic environmental assessment, environmental impact assessment and environment protection commitment/plan. It spells out the need for an EIA for various project developments. The above decree was used as reference by the Project during the preparation of the local EIA. *The Project was granted its government consent and was issued the Decision of Approval from MoNRE on 20 November 2015.* **Decree No. 18/2015/ND-CP (14 February 2015)** In 2015, this decree was issued and supersedes Decree 29/2011/ND-CP, above. This new circulation expands the list of projects which requires environmental and social impact assessment, and therefore has no impact on the Project's approval. Figure 2.1 shows the EIA procedures.
Land Law No. 45/2013/QH13 (29 November 2013)	This law spells out the States authority and responsibilities on land regimes. It provides the regulations on unified management of land and land-uses, land ownerships and land use rights as well as obligations of land owners/users. **Relevant decrees:** Decree No 43/2014/ND-CP (01 July 2014) Regulates the compensation, allowances, resettlement in case of land acquisition.

Policy and guidelines/regulations	Description
	Decree No. 47/2014/ND-CP (15 May 2014) Regulations on compensation, support, and resettlement upon land expropriation by the State.
Law on Forest Protection and Development No 29/2004/QH11 (3 December 2014)	This law provides for the management, protection, development and use of forests and forests resources, forest owner's rights and obligations. It is MoNRE which is responsible for the management and protection of biodiversity and forest environment. **Relevant decrees** **Decree No 32/2007 (30 March 2006)** Decree on the implementation of Law on Forest Protection and Development **Circular Letter No.24/2013/TT-BNNPTNT** Circular issued by Ministry of Agriculture and Rural Development (MARD) where it provides the requirements when forests are converted to other land uses/purposes (e.g., off-sets). **Decree No 99/2010/ND-CP** and its amendment Decree No 14/2016/ND-CP. Policy on payment for forest environmental services. This decree and its amendment spell out the forest services that require payment, obligations of forest services provider and users, including rate of payment.
Law on Water Resources No. 17/2012/QH13 (21 June 2012)	This law outlines principles and responsibilities relating to water resources. A relevant regulation, the national technical regulation on hydraulic structures for design (QCVN 04-05 – 2012/BNNPTNT) provides the requirement for minimum flow for HPP's. Minimum flow (environmental flow) shall be equal to the average flow of the river during dry season, with frequency of 90%.
Biodiversity Law, No. 20/2008/QH12 (13 March 2008)	Pursuant to the 1992 Constitution of the Socialist Republic of Vietnam, which was amended and supplemented under Resolution 51/2001/QH10 dated on December 25, 2001 of the 10th National Assembly, the 10th session; this Law stipulates biodiversity conservation and sustainable development. **Decree No. 65/2010 (11 June 2010)** Detailed regulation and guidance on the implementation of some articles of the Law on Biodiversity.

In Vietnam, there are three stages of project development namely:

Stage 1 – Investment Preparation

Stage 2 – Investment Implementation

Stage 3 – Project Hand-over

Table 2.4 lists the permits and licenses required for each stage of the Project development.

Table 2.4 List of permits and licenses required for My Ly HPP in Vietnam

No.	Permits and licenses	Required by:	Permit status (obtained /applied for/ to apply for)	Remarks
Stage 1 – Investment preparation (Pre-FS and FS stage)				
1	Master Plan VII	MOIT	Obtained 21 July 2016; amended 23 November 2016 to include My Ly HPP	
2	Investment Decision (Approval of FS)	MOIT	Obtained 28 February 2017	
3	EIA Decision Approval	MONRE	Obtained 20 November 2015	The EIA included in-principle approval of tree and reservoir clearing, including water use but a detailed plan will need to be prepared and approved by relevant authority as part of the EIA approval compliance.
3	Compensation Framework and General Resettlement plan	Provincial People's Committee (PPC)	Submitted, in review	
4	Quarry Permit	PPC	To be applied for	
Stage 2 – Investment Implementation				
4	Detailed plan for Compensation and Resettlement	PPC/District People's Committee (District PC)	To be applied for	
5	Land permit/Land use for Construction	PPC	To be applied for	
6	Construction permit	PPC	To be applied for	
7	Power Purchase Agreement	EVN	To be applied for	
Stage 3 – Project Handover				
Stage 3 is the period for performance and completion of the Project - from commencement of construction activities until Project delivery. During this period, Project's compliance to various commitments are monitored. Construction phase is estimated to be completed within a four year period under the supervision of the PPC.				

2.2.2 Lao PDR

Relevant key policies and guidelines and list of permits and licenses of Lao PDR are shown in Table 2.5 and Table 2.6.

Table 2.5 List of key policies and guidelines of Lao PDR

Policy and guidelines/Regulations	Description
Environmental Protection Law No 29/NA 2012 (amended version)	The Environmental Protection Law (EPL) is the principal legal framework for environmental management of development projects in Lao PDR. This law was first promulgated on 3 April 1999 and was amended in 2012. It establishes the structure for unified environmental management with the aim of preserving the environment and making rational and sustainable use of natural resources. It defines the principles, regulations and measures related to environmental management, monitoring of protection, control, preservation and rehabilitation activities. It also aims to provide balance between social and natural environment, to sustain and to protect natural resources and public health; and contribute into the national socio-economic development and reduction of global warming. The Ministry of Natural Resources and the Environment (MoNRE) is the primary agency responsible for the implementation of this law. In December 2013, two Ministerial Decrees were passed to implement the provisions of Article 21 (Initial Environmental Examination-new) and Article 22 (Environmental Impact Assessment -revised) of the EPL. These were: **Ministerial Instruction No 8030/MONRE 17 Dec 2013** - Process of Environmental and Social Impact Assessment of the Investment Projects and Activities **Ministerial Instruction No 8029/MONRE 17 Dec 2013** – Process of Initial Environmental Examination of Investment Projects and Activities. These decrees maintain the distinction between IEE and EIA processes. It aims to ensure uniformity in carrying out IEE/EIA for investment projects. The EIA procedures is shown in Figure 2.2 below. The EIA review process for the Project is still on-going. **MoNRE (2010) Environmental Guidelines for Biomass Removal** from Hydropower Reservoirs. This guideline provides a step by step procedure on the preparation of biomass removal plan, which is a requirement in the EIA. The biomass removal plan aims to assess water quality and GHG emissions when building the reservoir. **Environmental Quality Standards No 2734/PMO MoNRE 2009.** Consists of the following standards: Water Quality, Soil Quality, Air Quality, Noise Quality including pollutants emission standards.
Policy for Sustainable Hydropower Development in Lao PDR, 2015	**Policy No.561/CPI 7 June 2015** - This policy requires the conduct of a comprehensive EIA for all hydropower projects, including cumulative impacts for transboundary projects. The EIA requires the inclusion of Watershed and Water Resources Plan and Monitoring. The policy also states the need for a comprehensive social impact assessment to safeguard the interest of

Policy and guidelines/Regulations	Description
	the Project Affected People (PAP) and shall include a transparent consultation, taking into consideration ethnic's languages (if applicable), resettlement and just compensation, and gender development plan. It also states the revenue and benefit sharing through community funds.
The Forestry Law, 2007	The amended Forestry law outlines principles and responsibilities relating to all forest resources, including soil, flora, fauna, water, living and non-living resources. All forest land is owned by the State and has the authority to give user rights to communities in return for sustainable management of the resource. The Law outlines a nationwide forest classification system, under the Ministry of Agriculture and Forestry, which demarcates land to reflect its values for preservation and development. Forests in Lao PDR are classified into three primary categories: protection forest, conservation forest, and production forest. **Relevant Decrees of the Forest Law:** **Decree on Protection Forest No 333/PMO, 2010** Section 6 Chapter 31 spells the responsibility of project developers. Developers are required to set up a Forest and Forest Resources Development Fund for forest rehabilitation and shall be 1% of their annual income. Forests affected from road development and transmission lines requires 100% offsetting. **Ministerial Regulation No. 0112, 2008,** Regulation on Logging and Reservoir Clearing. Issued by the Ministry of Agriculture and Forestry, this regulation provides principle on logging and clearing forests from preparation to implementation including the responsible agencies
The Land Law, 2003	The Land Law was enacted on 23 October 2003. The law describes the system of land tenure, with all lands as the property of the nation, and remains under the control of the Government of Lao PDR. The law also recognizes and protects private land use rights. These rights can be transferred, granted by the state, or inherited, provided taxes payable on the land have been paid. This law provides an important framework for any land compensation, as despite the lack of title ownership, the land use rights are a trade able commodity. The land classification administration is also important for determining the various categories of land use within the Project DIA. The overall responsibility for land administration is the National Land Management Authority. **Decrees relevant to Land Law:** Implementing decree on Land Law (2008) – this decree relates to the management, protection, use and development of land in an efficient, peaceful and fair manner. **Decree 84 on Compensation and Resettlement (5 April 2016)** Provides detailed guidance to issues on resettlements and fair and equitable compensation. This decree provides a range of compensatory mechanisms required to ensure Project Affected Peoples (PAPs) are not worse off in terms of their socio-economic conditions. This includes consideration of economic, social, cultural and environmental aspects of the potential impacts of the proposed development. The decree also provides direction for community

Policy and guidelines/Regulations	Description
	participation in the development of sound policies and procedures for implementing a compensation package.
Law on Electricity 2011	The Ministry of Energy and Mines (MEM) is the responsible agency for framing polies and strategies for the energy sector, while the Institute of Renewable Energy Promotion (IREP) under MEM oversees the implementation of renewable energy, energy efficiency and rural electrification programs in Lao PDR. The law also requires that EIAs be prepared for hydroelectric dams, along with budget estimates for environmental mitigation measures.
The Law on Natural Heritage, 2005	This law outlines the procedures for artifact discovery, archaeological excavations, and the rights of the Ministry of Information and Culture in the ownership and preservation of items of cultural, natural and historical heritage.
The Law on Water and Water Resources, 1996	This law outlines a similar approach with all water and water resources remaining the property of the State. If relevant approvals are gained by an applicant seeking to use water resources, individuals or entities may attain water use rights. Article 29 stipulates a range of responsibilities for all water users, including the preservation of water resources, the efficient use of water, and the responsibility to maintain water quality, including the environmental and aesthetic qualities of water bodies.

Most of the infrastructures will be located within Vietnam territory, and thus permits to be secured in the Lao territory is limited and is presented in Table 2.6 below.

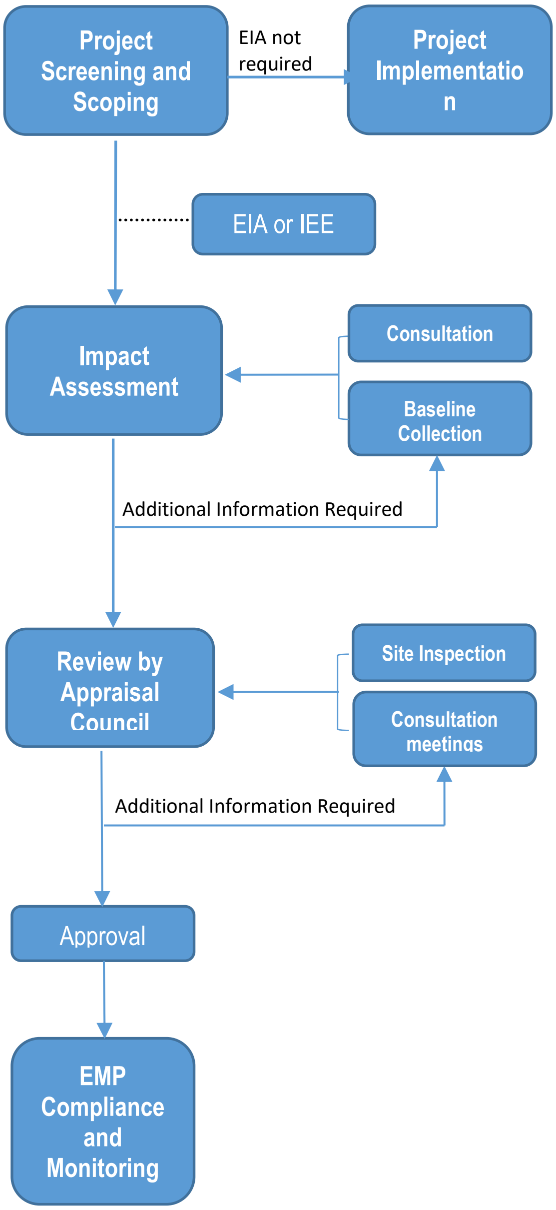
Table 2.6 List of permits and licenses required for the My Ly HPP in Laos.

No.	Permits and licenses	Required by:	Permit status (obtained /applied for/pending)
1	Environmental Compliance Certificate (ECC)	MONRE	In process
2	Forest conversion permit	MONRE	In process*
	Biomass removal plan/Tree cutting permit	MONRE	To be applied for once ECC is granted
3	Resettlement plan	MONRE and Provincial	To be applied for

* Part of the proposed area of the reservoir is within the Soppaen II Ko Protection Forest. Based on President Decree on Environmental Protection, (Revised Version) - Nº 026/POL 17-Jan-2013, the land use status needs to be converted from protection forest to "project reservoir" prior to project implementation.

2.3 Environmental and Social Impacts Procedures in Vietnam and Lao PDR.

The main steps of the GoV EIA are listed below.



Project screening and scoping

The Proponent (or its Environmental Consultant) determines if an EIA is required based on the screening criteria and project classification described in Decree 29/2011 ND-CP (and its update Decree No. 18/2015/ND-CP). This process is carried out during the feasibility study period.

MONRE is not involved in the screening and scoping phase and does not approve the Terms of Reference)TOR) for the EIA. MONRE's involvement in the process commence when the EIA report is submitted (Article 23).

Based on the complexity of the proposed project, it will be classified whether it will require an Environmental Impact Assessment (EIA) or an Initial Environmental Examination (IEE).

Impact assessment. Proponent/Consultant prepares the EIA report with reference to requirements of Decree 29/2011 and Circular 26/2011/TT-BTNMT. Baseline collection will be carried out to establish baseline environmental profile. Consultation with the commune will be done, where a copy of the EIA report will be submitted to the commune for their assessment. A response from the commune signifying their acceptance or denial of the Project is expected within **15 days** upon receipt of the EIA report.

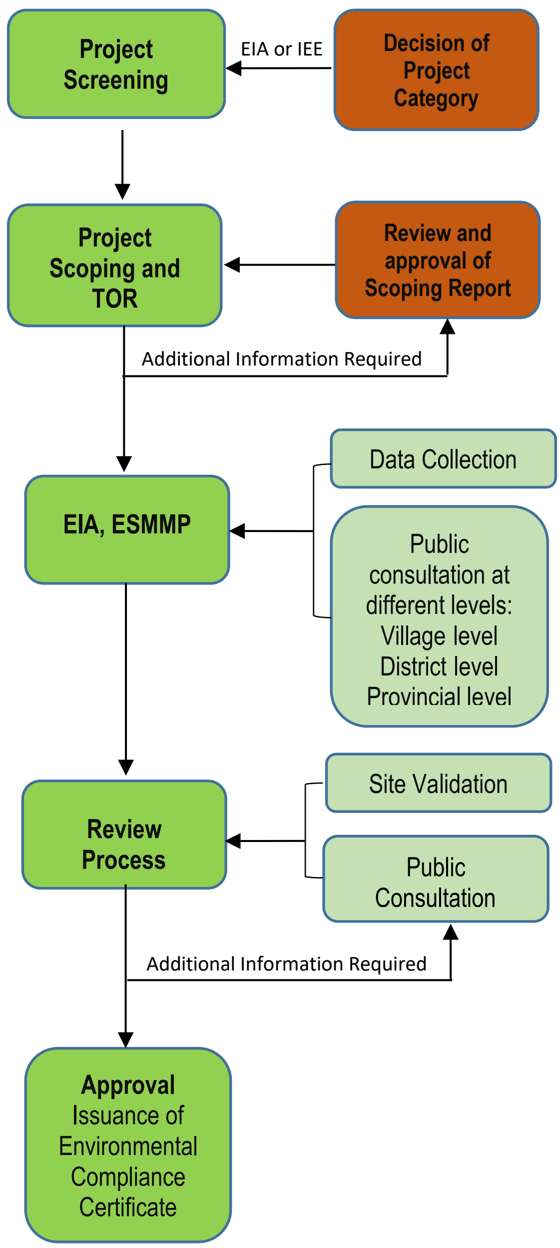
Review. There are two stages of review. First stage is by the appraisal authority (the EIA Report Assessment Authority, in this case MONRe), to determine the completeness of the document. Once approved by the Appraisal Authority, the Appraisal Authority convenes a committee (the EIA Report Assessment Council) for the final substantive review. The review process if appraised by MoNRE (as in the case of this Project) takes **45-60 days**. Once the EIA report has been appraised and deemed complete, decision must be provided within **15 days.**

Approval. If all requirements are met, approval is granted to the Project Proponent.

Environmental Monitoring Plan (EMP) Implementation. Once the project commences, the EMP is implemented, and monitoring for compliance is carried out all throughout the project cycle.

Figure 2.1. The EIA process in Vietnam

The EIA procedure in Lao PDR is presented below..



Project screening. The Project Developer (or its Environmental Consultant) submits an investment application to MoNRE, based on the criteria and project classification stated in Decree 112/PM. MONRE will issue a decision whether the Project shall undertake an EIA or an IEE.

Project scoping. The Project Developer prepares a Scoping Report and detailed Terms of Reference (TOR) for the preparation of the EIA/IEE for approval by MONRE. Within 15 business day, a decision of the approval of the TOR is issued.

EIA and ESMMP. Once TOR is approved, Preparation of the EIA Report, together with the Environmental, Social Management and **Monitoring Plan (ESMMP) commence.** Data collection is carried out to establish baseline profile, in conjunction with community consultations which starts at the village level. Continuing stakeholder consultation is being carried out at different levels, with the assumption that issues and concerns raised during these consultations are inputted in the draft EIA.

Review process. The review process includes an initial assessment to the completeness of the document. If deemed complete, within 10 days upon submission of one set of document, the Proponent is advised to submit at least 15 copies more of the document for substantive review. When Final EIA report is ready, a technical review is done and a final public consultation at the provincial level is carried out. The review process takes 95 business days.

Approval. When the EIA is satisfactory completed based on the guidelines, an Environmental Compliance Certificate (ECC) is issued. The ECC is valid for two years and therefore projects should be implemented within the period, otherwise a justification shall be made to request for an extension.

Figure 2.2. EIA procedures of the Government of Lao PDR

2.4 Resettlement guidelines and procedures in Vietnam and Lao PDR

The Land Law (2013) is the principal legal regulation that prescribes the land use rights and land management in Vietnam. It provides the regulations on unified management of land-uses, land ownerships, and land-use rights as well as the obligations of land owners/users.

Land are acquired for various purposes such as for national interest or economic development. The Land law also details guidelines on land acquisition, compensation, support and resettlement. There are two relevant decrees that further details regulation on resettlement and compensation namely Decree No 43/2014/ND-CP (01 July 2014) and Decree No. 47/2014/ND-CP (15 May 2014). The former regulates the compensation, allowances and resettlement in case of land acquisition while the latter spells out the regulations on compensation, support, and resettlement upon land expropriation by the State.

The Social section and Volume VI discuss the resettlement framework for the Project while Figure 2.3 shows a typical steps for land acquisition, compensation and resettlement process:

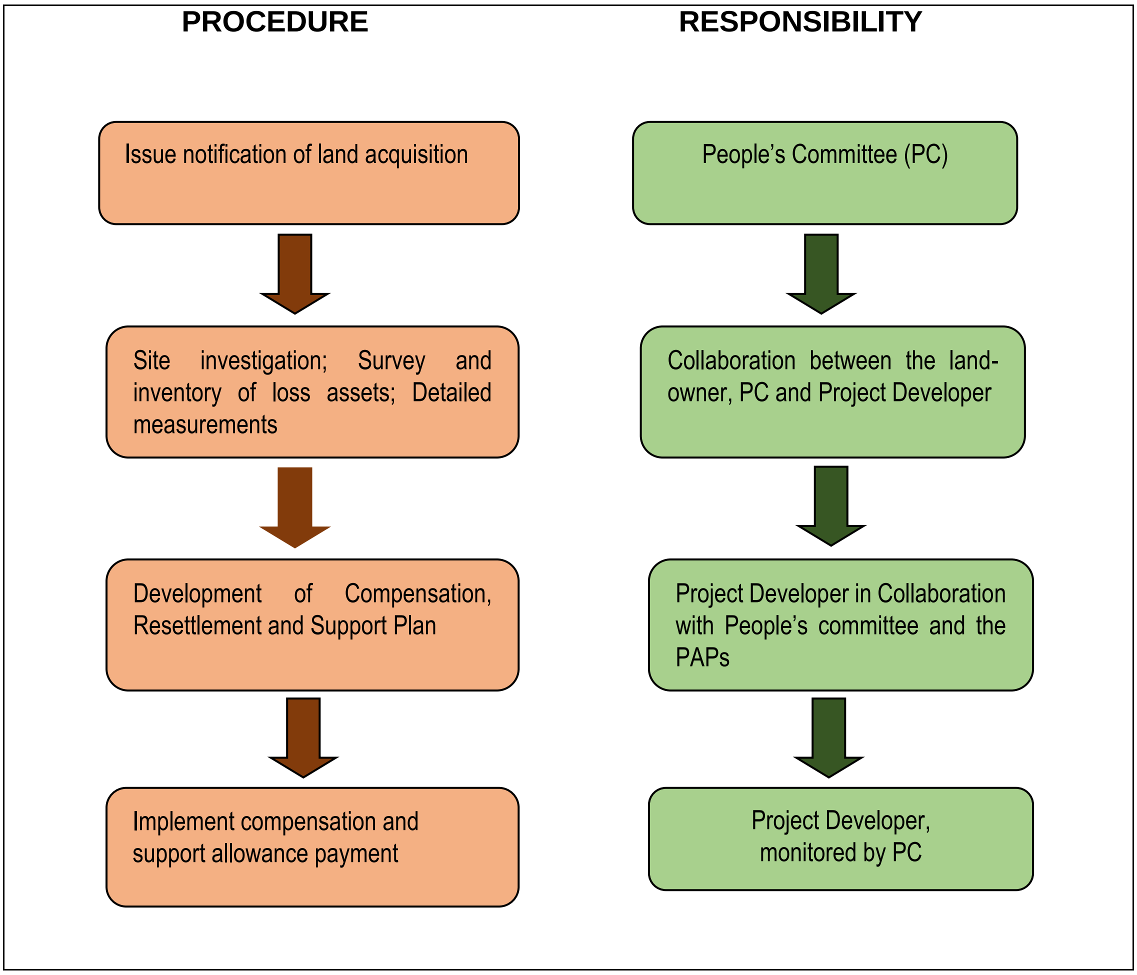


Figure 2.3 Land acquisition, compensation and resettlement process in Vietnam

In Laos, the main law that prescribes the compensation and resettlement for development projects is Decree No.84. This decree provides the principles, regulations and standards on management and monitoring of compensation losses as well as the management of resettlement activities. It aims to ensure that affected people are compensated, resettled and are assited with permanent livelihood alternatives, and therefore leads to improved living conditions, to be better off or to be at the same level as they were before the development. It also aims to ensure that the development project constibutes to a sustainable development of the community in particular and the nation in general. Figure 2.4 below presents the process of resettlement in Laos.

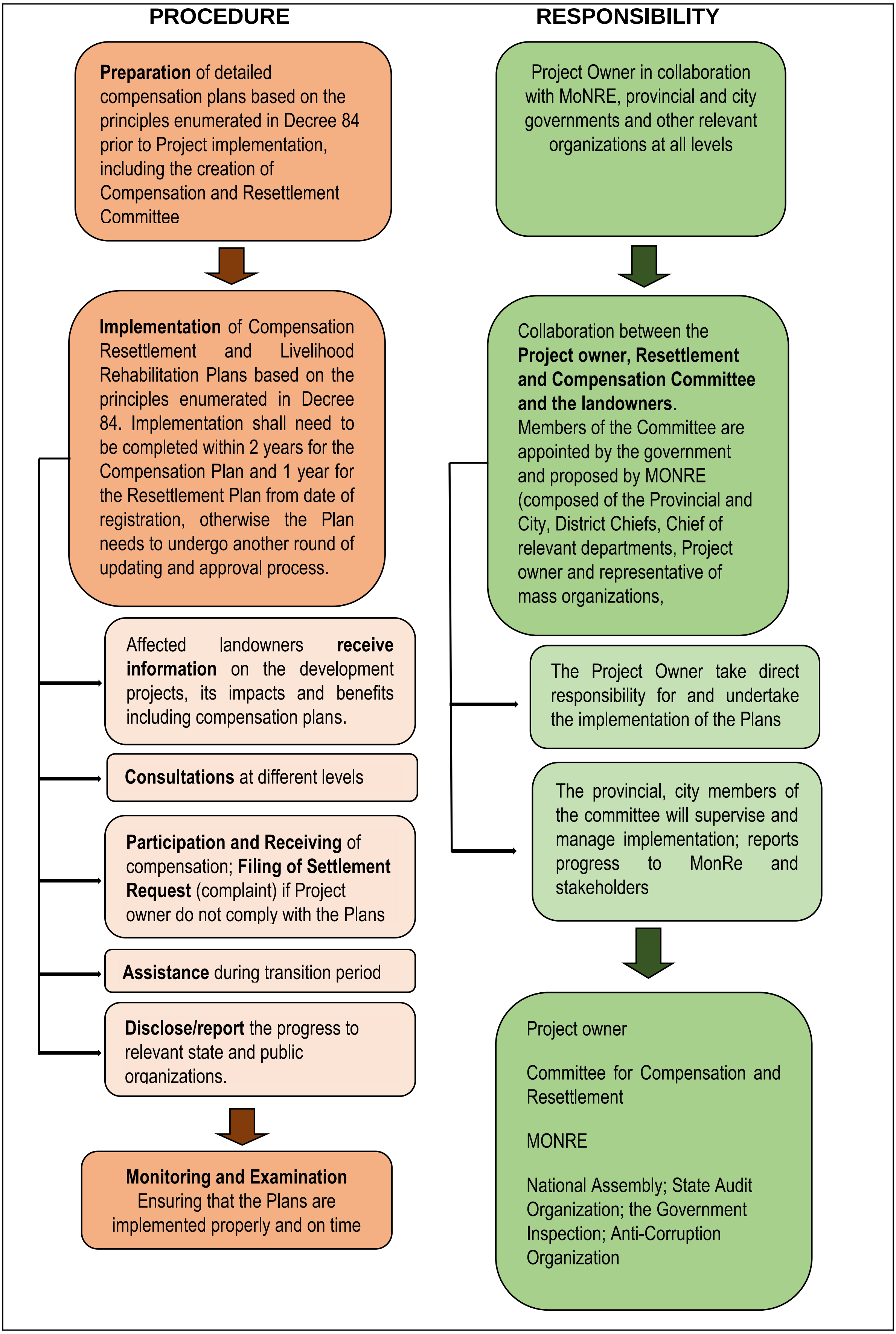


Figure 2.4 Land acquisition, compensation and resettlement process in Lao PDR

2.5 International Conventions ratified by Vietnam and Lao PDR

Vietnam is a party to the following conventions:

- The UNESCO World Heritage Convention (acceptance 19 October, 1987);
- Ramsar Convention on Protection of Wetlands (accession, 20 January 1989);
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (accession, 13 March 1995);
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES, also known as the Washington Convention) (accession,20 January 1994);
- Convention on Biological Diversity (ratification, 16 November 1994);
- Cartagena Protocol on Bio-safety to the Convention on Biological Diversity (accession, 21 January 2004);
- Kyoto Protocol to the United Nations Framework Convention on Climate Change) (ratification, 25 September 2002);
- Paris Agreement to the United Nations Framework Convention on Climate Change (Signatory, 15 April 2016);
- Mekong River Commission Agreement on the Cooperation for the Sustainable Development of the Basin (Entry into force, 5 April 1995); and,
- International Plant Protection Convention (Food and Agriculture Organization of the UN), (Contracting Party).

Lao PDR is a signatory to several international conventions and treaties. Those potentially relevant to the Project are listed below:

- The UNESCO World Heritage Convention (ratification 20 March, 1987);
- Ramsar Convention on Protection of Wetlands (accession, 28 September 2010);
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (accession, 21 September 2010);
- Convention on Biological Diversity (accession, 20 September 1996);
- Cartagena Protocol on Bio-safety to the Convention on Biological Diversity (accession, 3 August 2004);
- Kyoto Protocol to the United Nations Framework Convention on Climate Change (ratification, 6 February 2003);Paris Agreement to the United Nations Framework Convention on Climate Change (Signature, 18 April 2016) ;
- Mekong River Commission Agreement on the Cooperation for the Sustainable Development of the Basin (Entry into force, 5 April 1995);
- International Plant Protection Convention (Food and Agriculture Organization of the UN), (Contracting Party, 1955); and
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (accession, 1 March 2004).

2.6 Communication and public consultation

The Governments of both Lao PDR and Vietnam require consultations with PAP (see policies above). In practice, the degree of communication and sharing of information varies from almost none to simple provision of leaflets and a public hearing. In this Project, international practices was employed where sharing of information, two-way communication, representativeness among stakeholders and responsiveness to stakeholders was a core work approaches to the work. Meaningful consultations were held (see Communication section and Volume IV Annex 5). MIGA requirements serve as a key benchmark.

2.7 Institutional framework

Various government agencies at national and local level involved during project preparation and implementation of hydropower development projects in Vietnam and Lao are described here. National level agencies are described at ministerial and department level, and local agencies at district and commune level. Responsibilities of these agencies are briefly described and the major environmental and social activities of My Ly HPP are given in Table 2.7 for Vietnam, while

Table 2.8 describes those in Laos.

Table 2.7 Major environmental and social activities of My Ly HPP in Vietnam

No	Activities	Responsible organizations
1	Environment and social assessment and management	Ministry of Natural Resources and Environment (MONRE); *Department of Natural Resources and Environment (DONRE)*
1.1	ESIA preparation and approval	MONRE *DONRE*
1.2	ESIA implementation including monitoring	MONRE *DONRE*
1.3	Agriculture Development	Ministry of Agriculture and Rural Development (MARD) *Department of Agriculture and Rural Development (DARD)*
1.4	Forest conservation and improvement	MONRE, MARD *DONRE, DARD*
1.5	Fisheries	MARD *DARD*
2	Pollution prevention such as air, water and noise pollution control, hazardous material management, and waste management	Ministry of Trade and Industry (MOIT); MoNRE Department of Trade and Industry (DTI); DoNRE
3	Biodiversity conservation and natural resources management	MONRE
4	Health and safety	Ministry of Health (MOH) *Department of Health (DOH)*
5	Land acquisition, compensation and involuntary resettlement	Agency for Land Management *Peoples Committee*
6	Welfare of indigenous community	Committee for Ethnic Minorities Affairs Ministry of Education and Training (MOET) Department of Education for Ethnic Minorities
7	Preservation of cultural heritage	Ministry of Culture, Sports and Tourism
8	Labor working condition	Ministry of Labour –Invalids and Social Affairs (MOLISA)

		Department of Social Protection

Table 2.8 Major environmental and social activities of My Ly HPP in Lao PDR

No	Activities	Responsible organizations
1	Environment and social assessment and management	Ministry of Natural Resources and Environment (MONRE); Department of Natural Resources and Environment (DONRE)
1.1	ESIA preparation and approval	MONRE
1.2	ESIA implementation including monitoring	MONRE
1.3	Agriculture Development	Ministry of Agriculture and Forestry
1.4	Forest conservation and improvement	Ministry of Agriculture and Forestry
1.5	Fisheries	Ministry of Agriculture and Forestry
2	Pollution prevention such as air, water and noise pollution control, hazardous material management, and waste management	MONRE
3	Biodiversity conservation and natural resources management	Ministry of Agriculture and Forestry
4	Health and safety	Ministry of Health
5	Land acquisition, compensation and involuntary resettlement	
6	Welfare of indigenous community	Lao Front for National Construction (LNF), Department of Ethic Affairs
7	Preservation of cultural heritage	Ministry of Information, Culture and Tourism
8	Labor working condition	Ministry of Labour and Social Welfare

CHAPTER 3: PROJECT DESCRIPTION

3.1 General overview

The National Power Development Master Plan for the 2011-2020, which was revised and approved on 18 March 2016, pointed to the need for more power with higher reliability and competitive electricity prices in all regions of Vietnam. Based on the master plan, there will be approximately 235-245 billion kWh of commercial electricity in 2020 while the expected production required is to be 265-278 billion kWh. In order to ensure national energy security, mitigate climate change, protect the environment, and promote socio-economic development renewable power sources are to be prioritized.[14] Other main sources of power will include thermal, solar, wind and coal.

One of the sites identified for hydropower development is in the Ca River. Ca River is one of the largest rivers in Vietnam and originates from the Houaphanh and Xiangkhoang Provinces in Lao PDR, passing across Nghe An Province in Vietnam before it joins the eastern sea. Several studies have been carried out to determine the suitability of the river for hydropower development including the Master planning of a hydropower project cascade on Ca River by Power Engineering Consulting Joint Stock Company as early as 2001. In 2011, Vietnam-Laos Economic Co-operation Corporation was assigned by the Vietnamese government to identify private investors for the development of My Ly HPP as specified in letter No 8181/VPCP-QHQT (16/11/2011).

In the following year, My Ly - Nam Mo Hydropower JSC was formed by Vietracimex to develop the My Ly HPP and later engaged Hydropower Engineering Consultancy and Construction Company to prepare the Feasibility Study (FS) in June 2012.

An agreement between the GoL and the GoV was signed in 2016 stipulating the cooperation of the two countries to develop the My Ly HPP including its agreement terms on investment, construction, operation and management of the project. After this agreement, a more detailed FS has been carried out including procurement of primary permits such as national environmental clearances for both Lao PDR and Vietnam.

3.2 Project location and accessibility

My Ly HPP (180 MW) is located in the boundary area of Vietnam - Lao PDR on the Ca River. The main components (dam, powerhouse, spillway, intake, etc.) and auxiliary areas are located about 1.6km from the Vietnam - Lao PDR border in My Ly Commune, Ky Son District, Nghe An Province, Vietnam (Table 3.1 and Table 3.2; Figure 3.1). The catchment area down to the proposed dam site is 7100km^2 of which almost 20km^2 is located within Vietnam and 7080km^2 in Lao PDR.

The total length of the reservoir is approximately 42km. The first 1.6km long passage of the reservoir is located in Vietnam territory. The middle passage of the reservoir is 38.4km length and is located on Vietnam - Lao PDR boundary line, in which the right bank of the reservoir is located in Nghe An Province, Vietnam and the left bank of the reservoir is located in Houaphanh and XiangKhoang Provinces of Lao PDR.

[14]The Prime Minister of Government. (2016). Decision on the Approval of the Revised National Power Development Master Plan for the 2011-2020 Period with the Vision to 2030.

Table 3.1 Administrative areas and the number of villages affected by the planned My Ly HPP.

<table>
<tr><th>Country</th><th>Province</th><th>District</th><th>Commune</th><th>Number of villages affected by project/total number of villages in the commune (subject to resettlement/land loss)</th><th>Project Components planned in commune*</th></tr>
<tr><td rowspan="3">Vietnam</td><td rowspan="3">Nghe An</td><td rowspan="3">Ky Son</td><td rowspan="2">Keng Du</td><td>1 / 10 (resettlement)</td><td>Reservoir, Proposed resettlement areas</td></tr>
<tr><td>4/10 (land loss</td><td>Reservoir (right bank)</td></tr>
<tr><td>My Ly</td><td>3 / 12 (resettlement)</td><td>Reservoir, Main project works (dam site) and auxiliary work sites; Proposed resettlement areas</td></tr>
<tr><td>Lao PDR</td><td>Houaphanh</td><td>Kouan</td><td>None*</td><td>5 / 16 (resettlement)</td><td>Reservoir (left bank)' Proposed resettlement areas</td></tr>
<tr><td></td><td>Xianngkhoang</td><td>Noonghed</td><td>None*</td><td>3 (land loss only)</td><td>Reservoir (tail end) (has several planned HPPs)</td></tr>
</table>

***There is no commune level in Lao PDR.*

The tentative locations of the main project components are presented in Table 3.2.

Table 3.2. Dam and powerhouse location

Project Component	Latitude	Longitude	Location (Commune)
Proposed dam site	104.322482 104.326464	19.653480 19.652238	My Ly
Proposed powerhouse	104.321038 104.323018	19.650186 19.650334	My Ly
Tailrace outlet	104.322168 104.322358	19.649419 19.6494433	My Ly

Source: Feasibility study. 2015. Map of general layout of My Ly, PECI, 2015 (in Vietnamese)

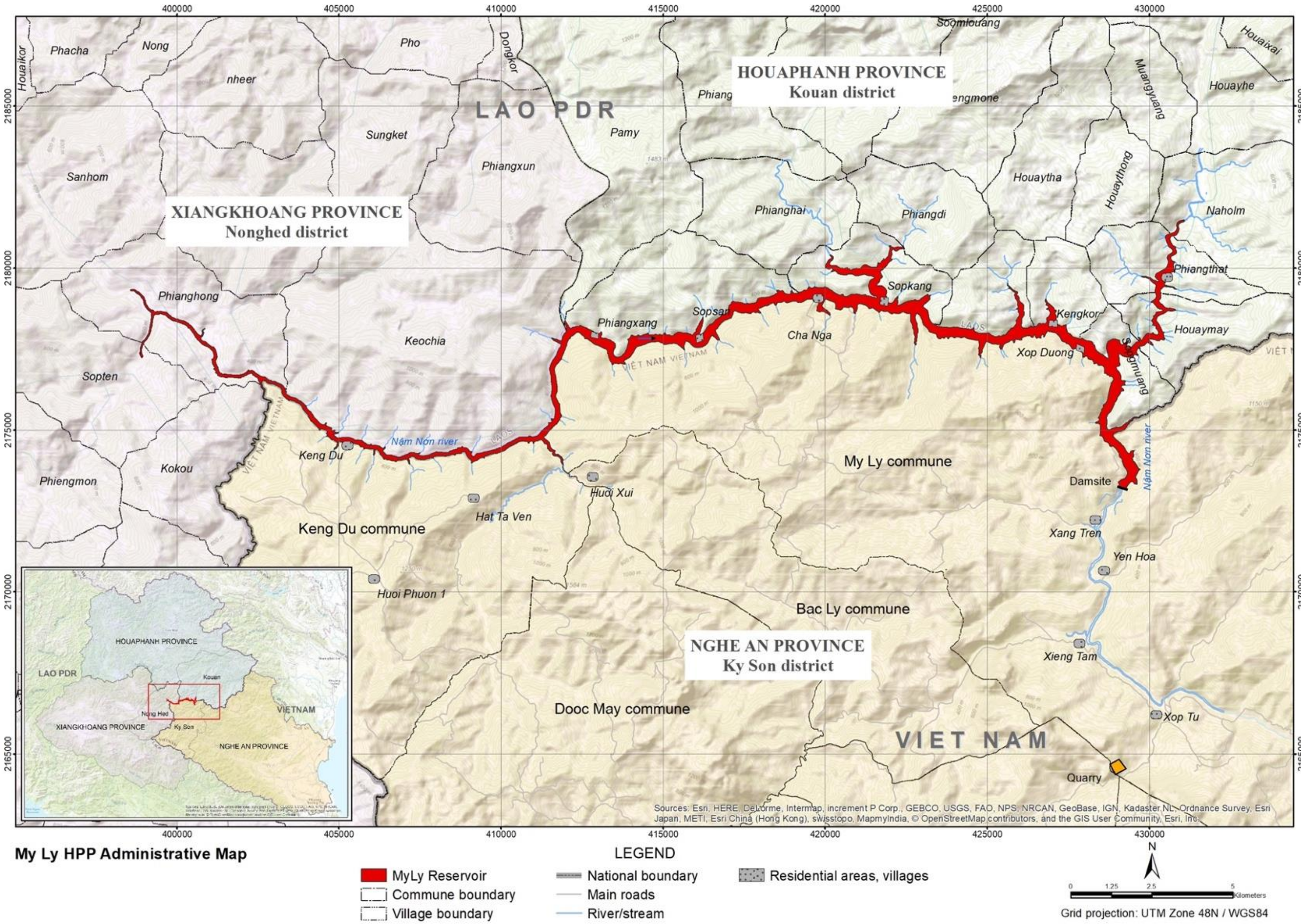


Figure 3.1 General map showing the project location and villages

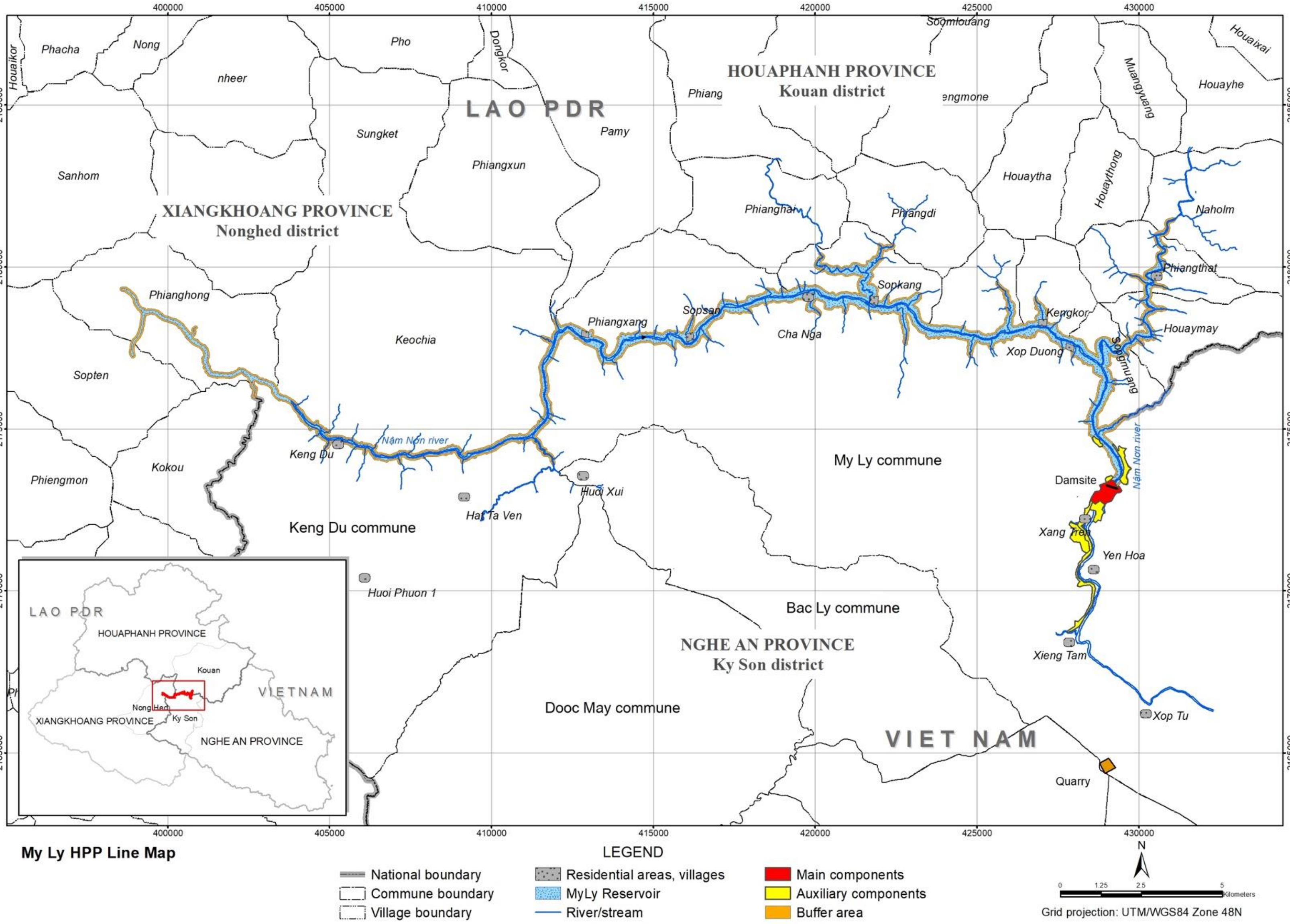


Figure 3.2 Line map showing the My Ly HPP reservoir and auxiliary area

3.3 Project location and areas to be affected

My Ly Hydropower Project with the planned dam site and all the Project works are located in My Ly Commune in Ky Son District, Nghe An Province. Added to My Ly commune, the upstream Keng Du Commune in the same district as well as five villages in Kouan District in Houaphan and in NOnghed District in Xiankhoang Province in Lao PDR will be affected by the HPP.

These areas are among the most remote and poorest ones in the two countries. They lie isolated in a forested mountainous international border area providing local people with few livelihoods options apart from upland cultivation and utilization of forest and aquatic resources. Social and livelihoods services delivery, trade and market access are deficient due to poor transportation infrastructure with most villages connected with earthern roads that are not vehicle accessible year-round.

Almost all the people in the Project areas in both countries originate from different ethnic groups/minorities[15] with their own identity, language and cultural features. The ethnic groups in Vietnam and Laos are related to each other, some people have moved across the national border and settled down on the other side, and villagers have regular social and economic interaction with each other over the border river.

3.3.1 Nghe An Province and Ky Son District overview

Nghe An Province is located in North-Central Region of Vietnam, bordering in the East to the South China Sea, in the West to Lao PDR, in the North to Thanh Hoa and in the South to Ha Tinh Province. Nghe An has a total area of 16,493 km^2, of which about 12,000 km^2 is forest. The area is administratively divided into 17 rural districts, 3 district-level towns and Vinh city which is the province capital and the economic and cultural centre of the North-Central region of the country, located about 300km south of Hanoi, the capital of Vietnam. The province population in 2014 was 3,037,400 people, making an approximate population density of 180 persons/ km^2. However, the province has vast remote forested areas where population density is very low, among them the My Ly HPP area.[16]

Nghe An is part of the Truong Son Mountain Range, and 83% of its area is mountainous terrain with a descending slope from North-West to South-East with many mountains, hills, rivers, streams, and small valleys. The highest point is Pulaileng Peak (2,711 m) in Ky Son District. The province area has an abundant system of rivers with a total length of 9,828km. The largest river is the Ca River (also known as Lam river and Nam Nho river), which originates in Laos. Nghe An has an 82km long coastline with many ports and significant industries around sea transport and fishery.

Ky Son is a rural district in the northwestern part of Nghe An Province, located along the national border to Kouan District in Houaphanh Province and to Nonghed District in Xiangkhoang Province in the Lao PDR. Ky Son is a remote and mountainous district with 21 communes and 70,061 inhabitants[17], most of them originating from the ethnic minority groups of Thai, Kho mu and Hmong. The total area is 2,095 km^2 consisting mainly of forest. Muong Xen town is the administrative centre of the district. Ky Son is among the 62 poorest districts of Vietnam and eligible for special government development programs for poor and underdeveloped areas. Great majority of the population is farmers living on upland cultivation and utilizing the available abundant forest resources. The mountainous terrain sets limitations to infrastructure development, and there are many remote villages without year-round vehicle accessible roads,

[15] In Vietnam, the Government recognises totally 54 ethnic groups, of which the Kinh (Vietnamese) is the majority population with 87% of the national population, and all the other groups are defined as ethnic minorities. In Laos the national population is divided into three broad categories of 49 ethnic groups, and the term ethnic minority is not used.

[16] https://www.vietnamonline.com/destination/nghe-an.html

[17] Data from 2013 provided in Nghe An Province official website: http://nghean.gov.vn/wps/portal/na_english

electricity and clean water supply. The most remote ethnic minority villages are living in extreme and persisting poverty.

3.3.1.1 My Ly Commune

My Ly Commune area has a total of 12 villages, three of which along the Ca River in the planned reservoir area. [18]According to the GoV classification[19], 81% of the population in My Ly is living under the poverty line and further 8% are near-poor, just above the poverty line. Nearly all the commune inhabitants are ethnic minority people; Thai is the largest ethnic minority group, followed by Hmong and Kho mu.

The total land area of the commune is 27,110ha[20],17,858ha (66%) of which is classified as agricultural land. Ninety nine percent of the agricultural land consist of forest, mainly (85%) of Protection forest and the rest is Production forest that is used for food crops cultivation, most importantly upland rice, maize and cassava. There is only 32ha of wet rice land in the entire commune, located mainly along tributary streams to the Ca River in the villages of Xang Tren, Yen Hoa, Xieng Tam and Xop Tu.

3.3.1.2 Keng Du Commune

Keng Du Commune is located upstream of My Ly Commune along the Ca River. The total population in the commune[21] is 4,329 people in 888 households (average HH size 4.9 persons). Keng Du is also one of the poor and remote communes in Vietnam. According to the GoV classification, 692 HHs (78% of the total) are poor and the rest are near-poor. All the inhabitants are Thai and Kho mu ethnic minority people. There are ten villages in the commune, and four of them are located or have land areas within the reservoir area of the planned My Ly HPP, among them the commune center in Huoi Phuon 1.

The total land area of the commune is 8,015ha[22], 3,452ha (43%) of which is classified as agricultural land and 3,353ha (42%) as forest land, which is mainly (96%, 3,204ha) Protection forest. Only less than 3% (99ha) of the agricultural land is used as production land for annual and perennial crops and paddy rice. Rotational upland swidden agriculture is practiced by local farmers as their major livelihood. Upland rice, maize and cassava are the most important cultivated crops. The total wet rice area in the commune is only 22ha and mainly located along tributary streams to the Ca River. Due to water shortage during the dry season, only one paddy crop per year can be produced.

3.3.2 Houaphan Province and Kouan District overview

Houaphan Province is located in the north-eastern Laos, and is one of the poorest areas in the country. The province area is 16,500km^2 with 289,400 people (Lao SCB, 2015) and borders to Vietnam in the North, East and Southeast, to Xiangkhoang Province in the South and Southwest, and to Luang Prabang Province in the West. The terrain is mountainous with large forest areas and many rivers. The province is divided into 10 districts. Kouan District lies in the south-eastern part of the province with border to Vietnam. The District has a total population of 25,098 people (2015) living in 67 villages. Laos has no commune administrative level like Vietnam, but villages are grouped into village groups and each village is allocated a rather large area under the district

[18] According to My Ly Commune Annual Report 2016

[19] The official poverty line 2016–2020 issued through the GoV Decision No. 59/2015/QD-TTg Promulgating multidimensional poverty levels applicable during 2016-2020 is for urban areas 900,000VND/capita/month and for rural areas 700,000VND/capita/month. 1USD=22,700VND

[20] Data from My Ly Commune Annual Report 2016.

[21] According to Keng Du Commune Annual Report 2016.

[22] Data from Keng Du Commune Land Use Report 2014.

administration. In Kouan District, 57 villages (85% of the total) are classified as poor[23] and 81% of the rural villages (54 villages) have no vehicle-accessible road. According to District statistics (2015), 55% (13,666 persons) of the population is Hmong ethnic people, while 29% (6,997 persons) are classified as Lao Loum, 12% (2,895 persons) as Lao Theung (Kho mu), and the rest as Tai.

3.3.3 Xiankhoang Province overview

Xiankhoang Province is located in the eastern Lao PDR. The total area is 17,315 km^2 and borders to Vietnam in the East, Houaphan Province to the Northeast, Bolikhamsai Province to the Southeast, and Vientiane in the Southwest. The terrain is mountainous with large forest areas and many rivers. Apart from floodplains, the largest area of level land in the country is located in the province's Xiangkhouang Plateau. This area is characterized by rolling hills and grassland with an average altitude of 1,300m. Phou Bia, the highest mountain peak in Laos (2,820 m), rises at the southern side of the plateau. In 2015 the population was 244,684 people. Phonsavan is the province capital. The province is administratively divided into 8 districts, among them Nonghed.

3.3.4 Direct impact area of the Project

There are three villages in Vietnam and five villages in Laos are expected to be inundated by the My Ly HPP reservoir and have to be relocated. In Keng Du Commune the village of Keng Du with 46 households and 183 people need to be relocated. In My Ly Commune Cha Nga Village with 435 people in 97 households and Xop Duong village with 224 people in 61 households need to be relocated. Additionally, Xang Tren Village in My Ly Commune with 688 people in 174 households is located by the planned dam site in the midst of the project construction areas, and consequently have to be relocated as well. Inhabitants in all these affected villages are Thai ethnic minority people.

In Kouan District in Laos, five villages will be inundated by the reservoir and need to be relocated. They are Phiangxang with 36 Kho mu ethnic minority people in nine households, Sopsan with 89 Thai people in 16 households, Sopkang with 320 Thai people in 48 households, Kengkor with 150 Kho mu and Thai people in 48 households, and Phiangthat village with 276 Kho mu people in 44 households.

All the households in the affected villages are extremely poor, under or just above the poverty line as defined by the GoV and the GoL. Table 3.3 below presents an overview of the villages that will be inundated in the reservoir area of the HPP. Table 3.4 presents an overview of the villages that will be inundated in the reservoir area of the HPP. Details on each village can be found in Chapter 8.3.

Added to the villages that will be inundated, land areas in the area of four villages in Keng Du Commune are within the reservoir area. In the Lao territory, the reservoir will affect land areas that belong to Keochia Village and Phianghong Village in Nonghed District in Xiankhonag Province. Additionally the very tail end of the reservoir according to the current design will affect a small area of Sopten Village. The riverbank here is very steep and no villages are located along the river stretch of the My Ly HPP reservoir.

[23] The official poverty line 2010–2015 issued through the Decree No.285/PO Poverty and development standard 2010-2015 is for country level 192,000 LAK/capita/month, for urban areas 240,000 LAK/capita/month and for rural areas 180,000 LAK/capita/month. 1USD≈8,300LAK.

Table 3.3 Villages in the expected reservoir inundation area and construction area of My Ly HPP to be relocated[24]

MY LY HPP Villages to be relocated			
Village	HH	Pop.	Ethnicity
Keng Du Commune - Vietnam			
Keng Du	46	183	Thai
My Ly Commune - Vietnam			
Cha Nga	97	435	Thai
Xop Duong	61	224	Thai
Xang Tren	174	688	Thai
Subtotal My Ly Commune	332	1,347	
Total Vietnam	378	1,530	
Kouan District - Laos			
Phiangxang	9	36	Kho mu
Sopsan	16	89	Thai (Lao Loum)
Sopkang	48	320	Thai (Lao Loum)
Kengkor	29	150	Kho mu, Thai
Phiangthat	44	276	Kho mu
Total Laos	146	871	
Total My Ly HPP	524	2,401	

Table 3.4 Villages in Keng Du Commune in Vietnam and in Nonghed District in Laos with land areas to be inundated

MY LY HPP VILLAGES WITH LAND LOSSES				
Village	HH	Pop.	Ethnicity	Status
Keng Du Commune - Vietnam				
Huoi Phuon 1	93	388	Kho mu	Land affected that is used for animal grazing
Huoi Phuon 2	138		Kho mu	Land potentially affected, status to be confirmed.
Hat Ta Ven	130	636	Kho mu	Land potentially affected, status to be confirmed.
Huoi Xui	138	564	Kho mu	Land affected, includes cultivation land
Nonghed District - Laos				
Keochia				Land by reservoir affected, riverbank very steep and no settlements along the river
Phianghong				
Sopten				The very tail end of the reservoir, no settlements along the river

[24] The population, poverty and ethnicity data is based on information collected during the baseline data collection in January 2017 from commune officials, village leaders and villagers participating in FGDs. Population data was reconfirmed during FPIC consultations in villages to be relocated in June 2017. The impact assessment is based on all the available information and observations made in the project areas.

3.4 Salient features of the project

Table 3.5 provides the salient features of the proposed My Ly HPP followed by the reservoir operation rules. The project works are located in the Vietnamese territory.

The main components and auxiliary work areas are all located in the My Ly Commune, Ky Son District, Nghe An Province, Vietnam. These were proposed through optimization studies including dam structure, installed capacity, number of powerhouse unit, water head, and quantity and dimension of spillway gate, among other technical features.

The main components of My Ly HPP are as follows:

- Reservoir: submerged land area corresponding to Full Supply Level (FSL) is 1,039.3ha and gross storage is 391.9 million m^3;
- Dam: Gravity rolled compaction concrete (RCC) with rock foundation (layer IIA). The dam has crest width of 8m and crest length of 270.86m. Dam height is 118.6.
- Spillway: Ogee type integral in dam with 6 bays, dimension of 10mx12m. Sill elevation is 288m with energy dissipation through flip bucket.
- Intake: It is a reinforced concrete structure integral in RCC dam on right bank with 2 bays with dimension of each bay at 6.0m x 6.0m. Each bay is equipped with maintenance gate and emergency gate. Sill elevation is at 264.5m while the elevation of intake floor is at 310.5m.
- Headrace tunnel: Two parallel headrace tunnels will be used made of reinforced concrete structured with steel lining. The tunnels will have a length of 375.38m and 396.57m with an inner diameter of 6m.
- Powerhouse: Surface type, reinforced concrete structured with 2 generating units (90MW each), with total installed capacity of 180 MW. The dimension of open part of powerhouse is 73.45m x 21m x 22.15m. Its operation will be based on a peaking regime.
- Tailrace channel is located behind the powerhouse: 72m long, bottom sloping 0%, bottom elevation 204m, bottom width 36.4m, and the channel slope is supported by concrete.
- Management and operational building: to be located on access road (3km distance) connecting from NR7 (National Road 7) to powerhouse.
- The 220kV out-door switchyard is located on right bank with elevation of 228.5m, and with a dimension of 95mx50m. The station includes 220kV switchgear, fire-proof equipment, cable trench system and internal road.
- The double 220kV Transmission Line (T/L) connecting from My Ly switchyard to Ban Ve HPP will be 68.5km long.
- Time schedule: The project is proposed to be constructed in five years including one year for preparation (detail design and environment and social planning and starting implementation) and four years for construction.

Details of the dam and spillway of My Ly HPP are shown in Figure 3.3 and main features are listed in Table 3.5.

Table 3.5 Salient features of My Ly Hydropower Project

Project Location	Vietnam	Lao PDR
Region	North-Central Vietnam	North – East
Province	Nghe An	Houaphanh XiangKhoang
District	Ky Son	Kouan Nonghed
Communes	My Ly, Keng Du	No commune unit is used in Lao PDR
Villages	Total of 4 villages to be relocated	Total of 5 villages to be relocated
Nearest national highway	NR7	NR7

Project area	
Hydrology at intake	
a. Catchment area	7100 km^2 (20km^2 in Vietnam and 7080km^2 Lao PDR)
b. Annual mean flow	107.2 m^3/s
c. Flood flow discharge with flood P = 0.01 %	13,270 m^3/s
d. Flood flow discharge with flood P = 10 %	2,760 m^3/s
e. Design discharge with flood P = 0.1 %	8,680 m^3/s
Other features	
Installed capacity	180 MW
Firm capacity	32 MW
Annual energy production	660.2GWh (660.2 million kWh)
a. Headworks	
Location Latitude / Longitude	My Ly Commune, left bank and right bank in Vietnam N : 19º39'10,2" / E: 104º19'27,3"
Dam type	RCC (gravity rolled compaction concrete)
Dam height (above existing river bed)	118.6/117.7m
Crest length / width	270.86 m / 8m
Approximate reservoir length	42km
Calculated head	80.6m
Reservoir gross storage (total reservoir volume including dead storage)	391.1 million m^3
Reservoir active storage	197.8 million m^3
Reservoir Full Supply Level (FSL)	300m
Minimum operating level (MOL)	280m
Reservoir area at FSL	12.47 km^2
Maximum powerhouse discharge	253.5m^2/s
Highest regulated water level	310.0masl
Lowest regulated water level	304.8masl

Surcharge Water Level with design flood P = 0.1%	304.8m
Surcharge Water Level with design flood P = 0.02%	308.3m
Surcharge Water Level with design flood P = 0.01%	310.0m
Spillway Weir total length Stepped spillway - Step height/width	77.5m 12m / 10m
Distance of powerhouse from dam site	350m
Distance of tailrace from dam site	350m
Potential total length of river expected to be affected due to reservoir	42km (length of reservoir) + 2.8km (low flow stretch) (+ 28.2 (Ban Ve HPP FSL to MOL stretch, see cumulative sections for details))
b. Headrace Tunnel	
Tunnel inlet elevation	264.5 masl

3.5 Main dam and related facilities

3.5.1 Main dam

The main dam shall be a gravity concrete structure using the RCC technology. Dam foundation shall be located on rock foundation (layer IIA) with the following specifications: Crest width is 8 m; slope of upstream face is 0.3 m from elevation 231m; slope of downstream is 0.88 m; crest elevation of dam is 338.5m, maximum length is 118.6m and crest length of dam is 270.86m. The dam foundation will be grouted by cement curtain. Grouting will be done to consolidate dam up to rock layer with 3 Lu[25]. Excavated slope of foundation pit is consolidated by masonry rock and rock excavated slope of foundation pit is protected by grout concrete (Figure 3.3)

[25] Lu (Lugeon): is coefficient of permeability. Usually processed to reach permeability performance (3Lu)

Dam site view, left bank geological studies on-going.

Figure 3.3 The main dam reservoir

3.5.2 Spillway

The spillway for the dam, which will provide controlled release of flows to the Ca River will be of the Waterways Experiment Station (WES) type and consists of six bays with dimensions of 10m (width) x 12m (height) and a sill elevation at 288m. It will be operated by a radial gate controlled by a hydraulic cylinder with an energy dissipater (flip bucket and plunge pool set at 183.9m elevation) to mitigate the impact downstream of the dam. The spill way is designed for 8,680m^3/s (1000-year probability) flood discharge in fully open conditions.

3.5.3 Diversion culvert

The diversion culvert is located at the bottom of dam section on right bank, along convex terrace of river, where the culvert foundation shall be laid on layer IIa. The diversion culvert has a reinforced concrete structure. The culvert comprises of three outlets with the following dimensions: a width of 5m, height of 7m and a length of 119.8m. The bottom elevation of the culvert will be designed at 205m with maximum calculated discharge at P=2% (frequency), 11,730m^3/s. Gates shall be erected by a mobile crane, after calibrating, it will be opened fully before closing the diversion culvert; a hydraulic cylinder will be used serving for lifting and closing the culvert.

3.5.4 Intake

Intake will be located at the right abutment of dam and partly on headwork, and shall be of a reinforced concrete. It comprises two bays divided into two inlet chambers into the tunnel. Each chamber of the gate shall be provided with a flat gate for maintenance and emergency access with dimension of 6m (W) x 6m (H). Each intake bay shall comprise of two sheets of trash-rack 6m (W) x 12.5m (H) where top of the intake has been designed at an elevation of 264.5m. Trash-rack shall be placed in vertical slots, lifting, and dropping by gantry crane.

3.5.5 Headrace tunnel

The headrace tunnel conveys the water safely to the powerhouse and is designed to have minimum head losses. It is designed with two separate but parallel tunnels and structure is mainly pressured tunnel excavated in rock. The parallel tunnels have a length of 375.38m and 396.57m and a diameter of 6m, divided into different structure sections including two elbows vertical shaft section, and a straight tunnel section with the length of 84.63m and 84.81m. Horizontal tunnel shall be designed with a length of 290.75m/281.76m.

3.5.6 Powerhouse

Powerhouse is located at the right bank of Ca River, about 350m downstream of the dam site at the end of headrace tunnel. Powerhouse has a reinforced concrete structure with foundation of layer IIA on the right bank. The powerhouse consists of two units, (90MW each) vertical shaft with Francis turbine, and a metal spiral case. Total installed capacity is 180MW.

3.5.7 Tailrace

The tailrace channels the used water from the powerhouse back to Ca River. Since the powerhouse is located adjacent to river bank, its length is approximately 72m.

3.5.8 Transmission line system and 220kV switchyard

Switchyard shall be placed at an elevation of 228.5m located on right bank along the access road to powerhouse. This location is rather flat so that excavation and embankment works are minimal. Outdoor switchyard has 95mx50m dimension. The 220kV transmission line of My Ly HPP shall be connected by double circuit 220kV to 220kV switchyard of Ban Ve HPP and is 72km long.

3.5.9 Management and operation house

The operational and management house will be located in the permanent operation road (NR7) about 3km from powerhouse.

3.5.10 Worker's camp

Temporary and permanent camps will be constructed to provide accommodation for the 3,400 construction worker's and later for the permanent employees. The accommodation will be located near the power station complex area. It will occupy approximately 1.857 hectares.

The accommodation will have to be designed in line with MIGA's standards, with reference to IFC/EBRD Guidance Note on Worker's Accommodation and shall provide basic services such as minimum space, water supply, lighting and ventilation, adequate sewage and garbage disposal system, appropriate protection against heat, cold, damp, noise, fire and disease carrying animals, adeaquate sanitary and washing facilities, cooking and storage facilities. In addition, basic medical facilities and road systems shall also be provided.

3.6 Auxiliary facilities

During the construction of the dam, the river will be diverted through a tunnel. In addition to the construction of the dam, the tunnels and the power house, the Project will need new roads/upgraded roads, spoil tip areas, sand quarry areas, rig areas, permanent housing, temporary and labour camps, and transmission lines, among other areas, to complete the development (see Figure 3.3). Some of these planned construction areas and structures will be permanent while others will be temporary. The project structures and activity areas proposed and those assessed in this ESIA are listed in Table 3.6. The potentially affected river stretch has been assessed for impacts particularly for river water quality, aquatic ecology and fisheries. Transmission lines will be the subject of a separate ESIA and thus has not been included in this assessment.

The construction areas (auxiliary works) are located clustered next to the dam site concentrating all activities. The only areas not located in the same area are the quarries. The construction layout map provides details on the location of all the work areas (Figure 3.4). It lists the auxiliary construction works and its specifications and the approximate areas each structure will occupy.

Table 3.6 Auxiliary construction works of the My Ly HPP.

No. on Construction Layout map	Salient parameters	Specifications	Area (ha)
1	Crushing facility for RCC and aggregate stockpile area (RCC – roller compacted concrete)	350 m^3/h	1.500
2	Crushing facility CVC (Conventional Concrete) (250t/h)	700.000 m^3/year	1.263
3	RCC facility	(350 m^3/h)	1.450
4	RCC conveyor system	(350 m^3/h)	-
5.1; 5.2	Concrete facility at dam, powerhouse areas	(180 m^3/h)	0.530
6	Steel reinforcement facility at headworks, waterway areas	44 ton/shift	0.254
7	Steel formwork facility at headworks, waterway areas	120 ton	0.081
8	Pre-casted concrete yard	-	0.300
9	Maintenance facility and parking area for construction equipment	80 trucks	0.264

No. on Construction Layout map	Salient parameters	Specifications	Area (ha)
10	Workshop for hydro-mechanic erection	4600 ton/year	0.378
11	Workshop for electrical-mechanic erection of the powerhouse	4200 ton/year	0.035
12	Laboratory of the headworks, waterway	-	0.070
13	Explosive dynamite warehouse for headworks, waterway areas	60 ton	0.010
14	Petroleum warehouse for dam, waterway areas	90 ton	0.230
15	Technical material warehouse (Project Management Board's (PMB) warehouse)	-	0.230
16	Water, power facilities for dam areas	-	0.230
17	Provision power	5000 KVA	0.100
18	Sand stockpile area at headworks, waterway areas	11,000 m^3	0.410
19	Rubble stockpile area	500,000m^3	3.00
20	Disposal area No.1		1.200
21A	Disposal area No.2		26.860
21B	Disposal area No.3		4.600
21C	Disposal area No.4		19.200
22	Substations	11.340 KVA	0.140
23	Technical water treatment station at dam, powerhouse areas	4,900 m^3/day	0.020
24	Technical water treatment station at auxiliary area	220 m^3/day	0.015
25	Pump & treatment station of household waste water	380 m^3/day	0.005
26	Office of Contractor at the dam, waterway workers	300 persons	0.277
27	Housing and office of PMB, Specialists, Engineer	-	1.260
28	Housing area for dam, waterway workers	3,000 persons	1.764
	Housing for CVC concrete batching plant workers	12 persons	0.013
	Housing for RCC concrete batching plant workers	60 persons	0.050
	Housing for CVC (250T/h) crushing plant workers	20 persons	0.013
	Housing for rock quarry workers	30 persons	0.017
29	Clinics at dam, waterway areas	20 wards	0.021
30	Post office	-	0.006
31	Police station	8 people	0.003
32	Fire station	2 trucks	0.013

Source: PECI, 2015. Feasibility study. 2015. General report of My Ly HPP, PECI (in Vietnamese)

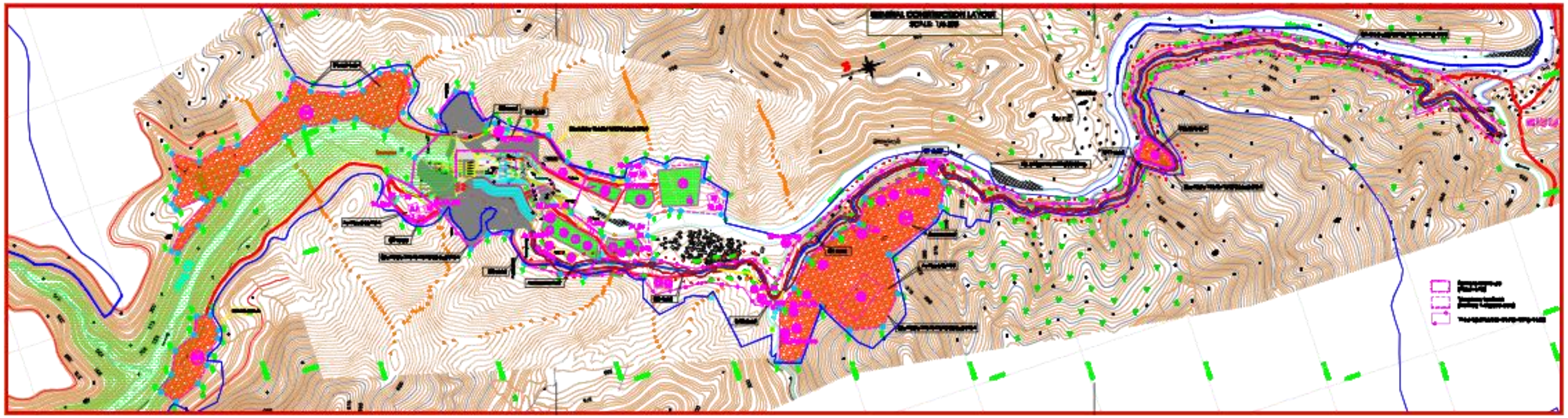


Figure 3.4 (a) Detailed construction project layout showing project structures and activity areas.

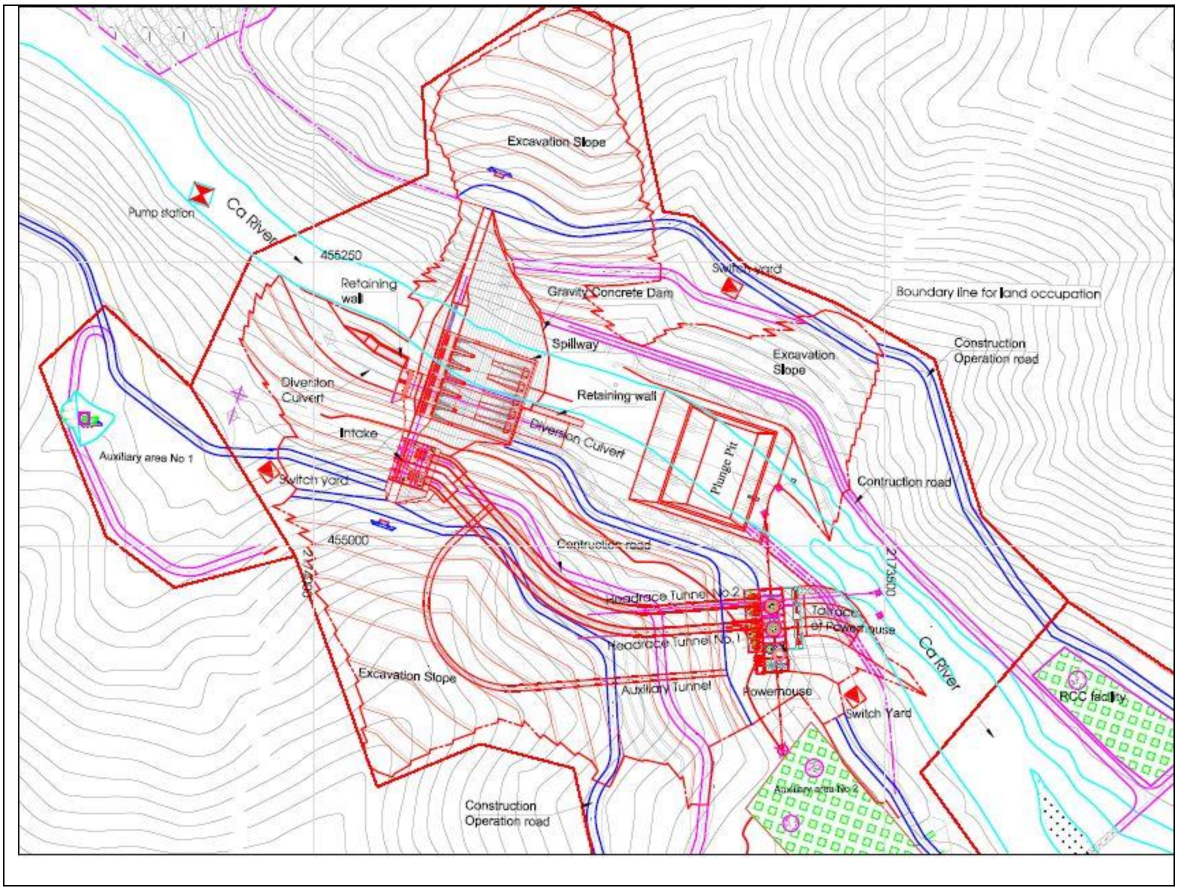


Figure 3.4 (b) Close-up of the construction site

3.6.1 Roads

Access to My Ly Hydropower Project area in Vietnam and Lao. In Vietnam, My Ly HPP is located in My Ly Commune, Ky Son District, Nghe An Province, about 295km from Vinh City via the (i) National Road No. 1A of 40km section and on to (ii) the National Road 7 (NR7). The NR7 goes through Do Luong town to Hoa Binh town, in Tuong Duong District, and is 201km before getting on (iii) 55 km of inter-commune, inter-village roads to the planned construction site. National Road No. 1A has been designed as having an III graded standard for the Delta. NR7 has a width ranging from 3.5 to 7m and has a surface of asphalt and graded aggregates. For the construction and operation phases of the Project, upgrading of route (50 km) from NR7 to Xieng Tam village at the construction site will be necessary. Access to the My Ly HPP in Laos is from Houaphanh Province to Kouan District to villages. Many of the roads are difficult to access by large vehicles, motorcycles are used in many cases especially during the rainy season.

Project site related roads. There are a number of district roads and local roads in the area that are linked to the main national roads. At necessary points in the Project DIA, new project access roads will be built and connected to the existing road system. Most of these will be permanent roads, some will be upgrading of existing roads, and some may be temporary for use during the construction period (Table 3.7).

Internal roads at the site (surface width is 5.5m, base is 7.5m) will have a total length of about 11.7 km, of which construction and operation road is 8 km (D1 to D3). These roads are planned to be used for the construction phase after which, it will be upgraded as operational roads. Road D1 has a length of 5.6km, connecting Xieng Tam village to the project site. D1 will be upgraded from being an inter-village road to a road for both construction and operation phases, connecting the site from beyond the project construction area, up to NR7. This road will be eventually used by the local communities.

Roads for the construction phase, namely D4 to D11, is 3.7km and shall be designed and constructed to serve all construction and transport activities, within the project site area (Table 3.7).

Traffic between the two banks shall be via a bridge with a load of HL93 (HL 93 Loading)[26] and length of 170m. The bridge will allow for movement for construction between the right and left banks during both flood and dry seasons.

Table 3.7 Project site related roads for the construction and operation phases

No.	Road name	Length (km)	Location of road and linkages	Status, needs for project / specifications
A	**Construction and operation phase roads (see Figure 3)**	**8.00**		
1	Road D1	5.6	Access road to powerhouse	Permanent; Existing inter-village road needs to be upgraded for project
2	Road D2	0.9	Road to crest dam (right bank), elevation 310.5m	Permanent New
3	Road D3	1.5	Road to crest dam (left bank), elevation 310.5m	Permanent New
B	**Construction road**	**3.7**		
4	Road D4	0.2	Connected from road Đ2 to 288.0m on right bank	Non-permanent New Within project site roads (specifications to be decided during the detailed design phase)
5	Road D5	0.5	Connected from road Đ1 to plunge pool on right bank	
6	Road D6	0.3	Connected from road Đ3 to EL. 276.0m on L/B	
7	Road D7	0.9	Connected from road Đ3 to EL. 226.0m on L/B.	
8	Road D8	0.3	Connected from road Đ1 to auxiliary area No.4 on R/B.	
9	Road D9	0.5	Connected from R/B to auxiliary area No.1	
10	Road D10	0.8	Connected from road Đ1 to Disposal area No. 2	
11	Road D11	0.2	Connected from road Đ1 to Disposal area No. 1	
	Total	**11.7 km**		

Source: PECI, 2015. Feasibility study, Chapter 12. Technical Summary Report, My Ly HPP (in Vietnamese).

[26] Bridge design load used in Vietnam (HL93 loading) in Bridge design standard 22TCN-272-05

Near the reservoir, dam area and power station complex area, permanent and temporary camps and infrastructure will be constructed, with corresponding existing access road systems. Along the Ca River valley, from the reservoir down to the outlet (350m) there are no access tunnels to the main tunnel that will be constructed.

Some of the existing roads are in need of repair, and an upgrading is envisaged. It is also anticipated that all roads will need maintenance and upkeep during the construction period, and that new permanent roads will be handed over to the district road department in good condition.

3.6.2 Quarry site

The Project will utilize the Sop Tu quarry for its source of rock aggregates. Rock aggregates will be needed as rockfill for the construction of the main dam, cofferdams and other infrastructure. It is estimated that the Project will need 1.45Mm^3 of aggregates and 0.45Mm^3 of crushed sand[27]. The proposed quarry area has an elevation range between 530 to 750m. Table 3.8 presents the basic properties of Sop Tu quarry.

Table 3.8 Basic properties of Sop Tu quarry

Properties	Specifications
Area	11 ha
Estimated reserve	3,067,989 m^3
Available resource	Aggregates and sand
Elevation	530 to 750 m

Location. The Sop Tu quarry is located downstream of the dam site, approximately 13.58km in distance, at the left bank of the Huoi Tu stream (Figure 3.5). It is part of Xop Tu village in My Ly Commune, Ky Son District Nghe An Province.

Access to the quarry is through the Tay Nghe An provincial road. The whole road stretch is a combination of rough and paved road with steep and sharp curves. Road surface will be rehabilitated to cater for delivery trucks to the project construction site. Currently, the road has a width of 5.5m and therefore land reclaim is not anticipated since the road Right of Way (ROW) is secured.

Three villages namely Xop Tu, Xieng Tam and Xang Tren in My Ly Commune are found along the access road to the quarry site.

3.6.3 Spoil disposal areas

The Project proposed four disposal areas with a total area of 31.36ha to accommodate the estimated spoil materials from the various excavation works for construction. Details on amounts needed will be assessed during the detailed design phase.

The disposal areas will be a temporary functional area of the Project, until the construction ends or until the area contains spoil at maximum volume capacity. Some of the disposal areas are designed to support structures (e.g., employees' accommodation will be built on disposal area No. 2) once the required height and flatness are achieved. The disposal areas will also be shaped and managed to maintain good and safe conditions such as slope, height and flatness.

[27] Source: PECI, 2015. Feasibility Study of the My Ly HPP; PECC2, 2016. Technical Design My LY HPP.

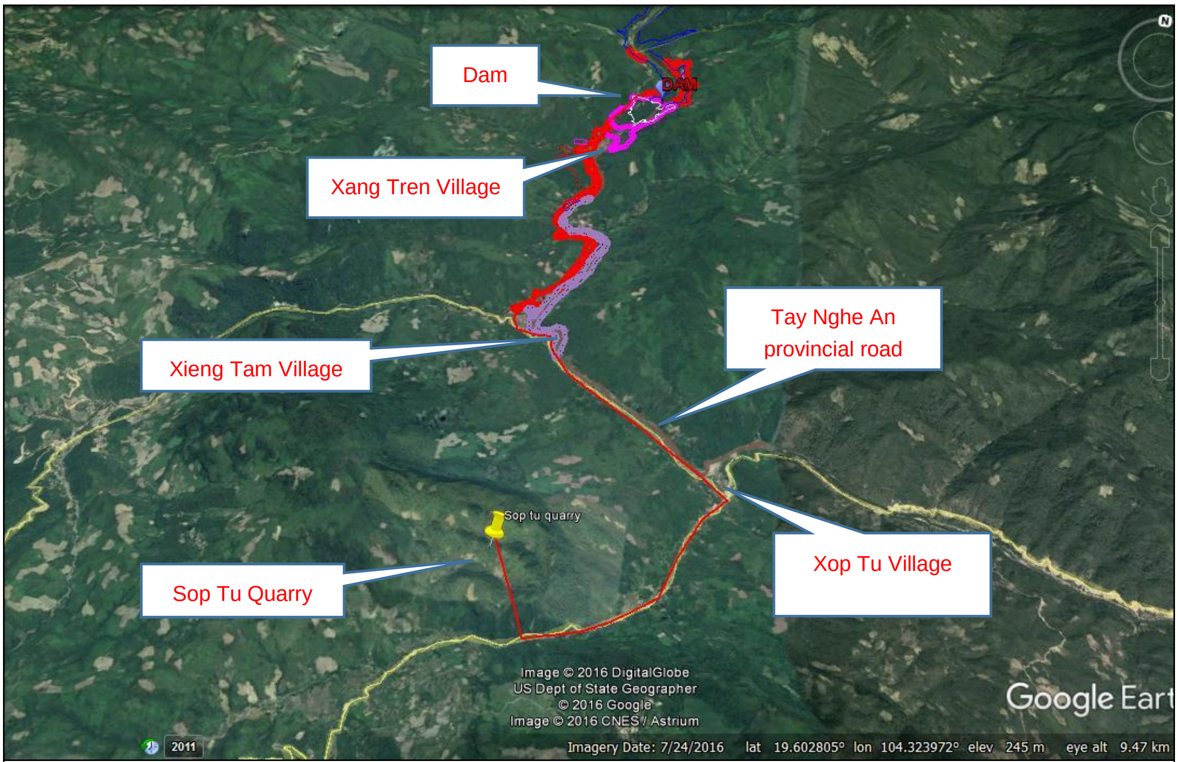


Figure 3.5 Location Sop Tu quarry to be used for the My Ly HPP

3.6.4 Transmission lines

The project will have a 220kV transmission line and will approximately run for 68.5km from the switchyard to Ban Ve HPP. The environmental assessment of the transmission route is covered in a separate EIA (GoV).

3.7 Operation of plant

My Ly HPP will be operated as peaking plant. It is envisaged that the Project will store excess water in a reservoir during high flow to be utilized during low flow. The height of the dam will be 118.6m above the existing river bed and the FSL will be 300masl creating a reservoir length of 42km with a total volume of 391.9Mm^3. The water will be diverted through a twin tunnel down to a power station located adjacent to the dam. The first tunnel (Tunnel no.1) is planned with a length of 375.38m while second tunnel (Tunnel no.2) is approximately 366.57m. The water will be released back in the river, 72m downstream of the power station and 350m of the dam site. The release comes 2.45km from the FSL of the Ban Ve HPP during the wet season and about 28-29km from the MOL of Ban Ve HPP during the dry season.

The plant is optimized for maximum energy generation throughout the year. During the dry season, the plant will run only as a peaking plant during daytime, while in the wet season, the Project will generate electricity approximately 24-hours at full capacity. Details on planned operation are provided in the next section on salient features.

The dam will create a reservoir that will extend up to 42km upstream of 12 villages (communes of My Ly and Keng Du of Ky Son District, Nghe An Province). The flow in the river between the dam and the outlet, will be considerably reduced, particularly during the dry season. Below the outlet, the river will be subject to daily flow fluctuations due to the peaking operation of the power plant. The detailed design of operation will determine the degree of fluctuation and length of the river that may have impacts.

The recommended Project is planned with installed capacity of 180 MW. Based on the planned installed capacity, the total annual energy generation in an average year will be approximately 660.2 GWh.

3.7.1 Basic criteria for reservoir operation

The basis for the income calculations is the value of the amount of energy which can be delivered during an average year. The base input in the modelling are as follows:

- The total installed power capacity is 180 MW, with 2 generating units at 90MW each.
- The energy production is simulated for maximum energy.
- There is no requirement for minimum generation per day or period[28] established at this stage of project development.
- Generation during day time (peaking price period) will be given priority. Generation during off-peak periods will only take place when there is more water than required for 12 hours generation at full capacity.
- The time for uploading and downloading will be determined during the detailed design phase.

My Ly HPP has an active storage of volume of 197.8Mm^3 and is a long-term regulation reservoir. Power production is calculated based on following principles:

Operation period 1: In flood season (from July to October)

In this period, the reservoir supplies water for power generation and stores water for use in the dry season. The plant shall operate in full capacity to take advantage of flow and reduce surplus water release to downstream. At the end of the flood season, the water level of reservoir is expected to be at FSL (at 300m).

Operation periods 2: Transition to low flood/dry season (from November to December)

During this period, transition to the low flood season, when there is still sufficient water available, the plant will be operated at a monthly capacity more than the firm capacity ensuring that to the end of dry season, the water level in the reservoir reaches annual discharge water level at 282m.

Operation Period 3: Low flood/dry season (From January to June)

During the low flood season with less water, the reservoir will provide additional water for the plant to operate normally, but ensuring the guaranteed level of 280m MOL. At the end of the dry season, the water level of the reservoir will be lowered under the annual discharge water level, the reservoir will be taken partially or fully based on the regulated storage to ensure supplying stable power at guaranteed level. In this case, the water level at the end of the low flood season will fluctuate between annual discharge water level at an elevation of 282m and MOL at elevation of 280m.

In case the water level of the reservoir at the end of the low flood season is lowered to the MOL, the power supply to the system may not achieve the guaranteed level

The operation of My Ly HPP is expected to be at 90% efficiency for it to be economically viable. The annual operation is divided into three operation periods. The periods will have to be adjusted each year to the actual flow situation.

[28] Now, will be required by MOIT in detail design phase.

Flushing period

There will be no flushing regime decided at this phase although sediment loads are predicted (see physical environmental chapter). In this Project, bottom culverts will be used in case of emergencies. No special flushing tools are prepared.

3.8 Activities during construction

This section provides an overview of the construction phase. Project activities related to the construction are:

- Road construction;
- Construction of camps (Permanent and temporary);
- Dam construction including excavation of loose overburden down to rock and major concrete works. The dam construction will require construction materials from sites located close to the river;
- Stabilization works in the reservoir area;
- Underground works – tunnel from intake to powerhouse;
- Excavation and concrete works at the outlet area;
- Installation of electromechanical equipment in the aboveground power house; and
- Construction of transmission line from the powerhouse area to 220kV Ban Ve substation (not a subject of this ESIA).

The works will be characterized by heavy construction machinery and trucks in the main Project DIAs, transportation of heavy equipment as well as cement and other construction materials.

Goods imported from overseas shall be transported by sea line to Cua Lo port, and then transported by road to the construction site on NR1A and NR7. Domestic goods depending on type of goods shall be transported by inland road railway or navigation way or sea line to Vinh city then transported to the project site

Aggregates and sand used for the Project will be exploited from Sop Tu rock quarry. Other materials such as steel, dynamite, petroleum, welding sticks, etc. shall be purchased from Vinh city and transported to the site.

3.8.1 Construction material

Suitable rock outcrops for construction materials has not been found within the Project AI There were no construction material sites observed along the banks of the Ca River. Sand demand for civil works on the whole project shall be about 570,000m^3. As there's no natural sand borrow area within the Project AI, this whole amount of sand shall be crushed from Sop Tu quarry and will be transported to the construction site.

The spoil from tunnel excavation will also be used for coarse aggregates and hard core dam materials. They will be utilized as aggregates for road building, construction material for the dam and other structures, as well as stabilizing masses in the reservoir. The balance will be deposited in pre-determined spoil areas (see Figure 3.1). Mainly, the materials are categorized as coarse aggregates (gravel and boulder materials), fine aggregates (sand) and clay materials (cohesive soils). Table 3.9 lists the estimated quantities of construction materials needed for the My Ly HPP.

Table 3.9 Quantities of construction material estimated for the My Ly HPP

No.	Material	Unit	Quantity
1	Concrete (RCC 0.677Mm^3, others 0.304Mm^3)	m^3	0.98M
2	Ballast	10^{3}m^3	1310,0
3	Rock utilized (from rock excavation at site)	10^{3}m^3	300,0
4	Sand	10^{3}m^3	570,0
5	Backfill soil	10^{3}m^3	500,0
6	Cement	10^{3}ton	185.22
7	Steel	ton	9000
8	Fly-ash (puzolan)	10^{3}ton	100,0

3.8.2 Construction power

For the construction phase it is necessary to establish a reliable temporary power supply to the site at all access points and construction areas. The total peak power demand has not been finalized but will be distributed along the site from the uppermost camps and the dam, down to the outlet. The supply must be reliable at all times, without power cuts which could delay the work progress.

The main power supply for construction shall be from 35kV transmission line (length of 12km) connecting with 35KV accessed at My Ly Commune. An existing 35kV line of about 45km will be connected to the My Ly Commune access center.

3.8.3 Construction manpower

The estimated required manpower for construction, including required accommodation facilities is shown in Table 3.10 below. In addition, an influx of new settlers and small businesses will normally establish themselves at such large construction sites. Unregistered persons and "camp followers" could come to the area, whose numbers should be held at a minimum.

Table 3.10 Assumed project personnel and building numbers for implementation

Staff and workforce:	Estimated number of individuals
Technical and administrative staff	310 people
Workforce, (temporary, migrating):	3130 people
Workforce (local):	10-15 % of the total work force (to be decided)
Total	**3440**
Required housing for project personnel includes :	
Permanent houses of various sizes and standards	More details at the detailed design phase.
Temporary housing *	
Social clubs	
Workshops and storage facilities	
Water supply and sewage treatment plants	
Guard houses / Police / Health	
Offices	

* It is assumed that a number of the temporary housing will mainly be erected with small rooms/ multiple beds for workers. These houses may be demolished, moved, or converted into other uses once the Project is completed.

** In addition, other structures related to the contractor's equipment, concrete mixing plants, storage areas, container parks, parking areas, buildings for explosives storage at several points and other various small service buildings.

It is assumed that all houses will have cooking facilities. All houses and major building will have water supply, toilets and sewage systems.

The worker's camp will be in line with the MIGA's standards, with reference to IFC/EBRD Guidance Note on Worker's Accommodation (See Chapter 3.5.10).

3.8.4 Construction schedule

Start of construction is assumed to be 2018, i.e. preferably at the beginning of the dry season, and will last for four years. The construction schedule is based on the construction procedures and corresponding rates of progress described in the Feasibility Report. The rates on which the scheduled rock excavations are based on assumption of two 8-hour shifts per day, seven days per week. Dry season at the project area is from beginning of Nov to end of June while flood season is only four months (July to the end of November).

During the first year of construction, water will be diverted via the natural river. On the second year, water will be diverted through a cofferdam to construct a diversion culvert. As rainy season commences, water will then be diverted through the diversion culvert. On the 3rd year, water can also be diverted through the uncompleted spillway at elevation 214m in addition to the diversion culvert. By the end of 4th year, the spillway is expected to be completed and will be fully used during flood season.

On the basis of the quantity of civil works and scheme for the construction diversion, the construction schedule is shown in Table 3.11 below.

The development of the hydropower Project will commence with detailed technical design of the Project works and dam and the elaboration of the environmental and social plans, including all safeguards at the pre-construction phase. The construction will essentially start once the resettlement implementation process in complete. It is possible that a staggered resettlement time-line may be employed with the households closest to the dam relocating before the construction commences, given that the ones further away will be affected when the reservoir is filled. Regardless of timing of physical relocation, all agreements for resettlement must be completed before construction begins.

Table 3.11 Construction schedule

Hydropower development: Detailed design, ESMP-REMLRP elaboration and construction activities	Pre-construction phase	Year 1	Year 2	Year 3	Year 4
Detailed design and elaboration of the ESMP and REMLRP					
Commencement of construction works					
Closing of Ca River					
Closing of diversion culvert - impounding reservoir					June
Commissioning of Generating unit 1					Sept
Commissioning of Generating unit 2					Oct

CHAPTER 4: ANALYSIS OF ALTERNATIVES

For greenfield developments like hydropower projects, alternative analysis is considered as an integral part of ESIA which is primarily governed by factors such as technical feasibility, economic viability and both permanent and non-permanent impacts to the biological and human environments, with the aim of minimizing environmental and social risks. The Proponent is to consider feasible alternative project designs to avoid or minimize physical and/or economic displacement, while balancing environmental, social, and financial costs and benefits, paying particular attention to impacts on the poor and vulnerable. The following rational and alternatives are considered for the development and ESIA study of My Ly HPP.

4.1 Growing Energy Demand in Vietnam and Project Province

In order to ensure national energy security, mitigate climate change, protect the environment, and promote socio-economic development, coal-fired electricity is imported less, and renewable power sources, including multi-purpose projects on hydropower source development, are prioritized. The Ca River basin is one of the main ones identified for hydropower development in Vietnam. Ca River is one of the largest rivers in Vietnam and originates from Houaphanh and Xiangkhoang Provinces in Lao PDR, passing across Nghe An Province in Vietnam before it joins the eastern sea at Vinh city.

The **National Power Development Master Plan** for the 2011-2020 (revised March 2016 calls for more power and reliability in supply all over Vietnam. The Master Plan projects approximately 235-245 billion kWh of commercial electricity in 2020. Particularly, the Master Plan proposes an increase in the total capacity of all renewal energy forms including hydropower (Table 4.1). The proportion of the hydroelectricity of the total energy source in the country is expected to rise to approximately 29.5% in 2020. Of all types of renewable energy, hydropower is expected to contribute to the share of production of approximately 20.5% in 2025 and approximately 15.5% in 2030[29]. Other main sources of power are planned to include thermal, solar and wind.

Table 4.1 Sub-targets for Renewable Energy: share of electricity production and installed

Type	Capacity and Production	2020	2025	2030
Wind	Total Capacity (MW)	800	2,000	6,000
	Electricity production (%)	0.8	1	2.1
Hydropower	Total Capacity (MW)	21,600	24,600	27,800
	Electricity production (%)	29.5	20.5	15.5
Biomass	Electricity production (%)	1	1.2	2.1
Solar	Total Capacity (MW)	850	4,000	12,000
	Electricity production (%)	0.5	1.6	3.3

[29]The Prime Minister of GoV (2016) Decision (18 March 2016, Decision No. 428/QD- TTg) on the Approval of the Revised National Power Development Master Plan for the 2011-2020 Period with the Vision to 2030 and summary information report "Vietnam Power Development Plan for the period 2011 –2020 Highlights of the PDP 7 revised (GIZ). The Prime Minister approved the adjustment of National Power Development Plan VII (referred to as PDP 7 rev) for the period of 2016 – 2030 with the vision to 2030. Compared to the PDP 7 of July 2011, the most obvious changes in the PDP 7 rev is a stronger emphasis on Renewable Energy development.

4.1.1 Energy demand forecast in Vietnam and projection based on current demand and consumption values

Demand Growth: During 2005–2014, average annual growth in electricity demand was 12.1%, electricity consumption increased from 45.6 terawatt-hours (TWh) to 128.4TWh, and peak demand grew from 9.5 gigawatts (GW) to 22.2GW. Per capita electricity consumption increased from 156 kilowatt-hours (kWh) in 1995 to 983 kWh in 2010 and to 1,415kWh in 2014. The total installed and operating generation capacity in Vietnam was 11.6GW in 2005 and 34.1GW in 2014, an average annual growth of 12.6% in generation additions[30].

In 2014, **power consumption** by sector was as follows: industrial (53.9%), residential (35.6%), commercial (4.8%), agriculture (1.5%), and other sectors (4.3%). The industrial sector is the largest consumer of electricity and also the most important sector economically, projected by 2015 to account for 41% of GDP, 29% of the workforce, and 87% of export revenues[31].

Demand Forecast: Demand for electricity is expected to grow at an average of 10.5% per annum during 2016–2020, and 8.0% per annum during 2021–2030. Electricity consumption is projected to reach 234.6TWh in 2020 and 506.0TWh by 2030, representing a fourfold increase by 2030 compared with the consumption in 2014. The peak demand is estimated to reach 42.1GW by 2020 and 90.7GW by 2030 to supply the projected power consumption. Table 4.2 shows key indicators with respect to power demand, production, and consumption for the period 2005–2014 (actual) and also shows projections up to 2030[32].

Table 4.2 Electricity deand: actual and projected

Electricity Demand: Actual (2005-2014) and Projected (2015-2030)

Item	2005	2009	2014	2015	2020	2025	2030
Annual demand (TWh)	45.6	76.0	128.4	141.8	234.6	352.3	506.0
Annual generation (TWh)	53.6	86.9	145.5	161.3	265.4	400.3	571.8
Maximum demand (GW)	9.5	13.9	22.2	25.3	42.1	63.5	90.7
Per capita consumption (kWh)	549.0	873.0	1,415.0	1,560.0	2,545.0	3,610.0	4,950.0

GW = gigawatt, kWh = kilowatt-hour, TWh = terawatt-hour.

Source: Government of Viet Nam. 2015. *Revised Power Development Plan 2011–2020*. Ha Noi.

Access to Electricity: Vietnam has made remarkable progress in expanding access to electricity, with percentage of households without electricity decreasing from 50% in 1995 to 2% in 2014. This has also been one of the drivers for rapid growth in the demand for electricity in the past. The communities that are not yet connected to the grid are mainly in

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[30] https://www.adb.org/sites/default/files/institutional-document/178616/vie-energy-road-map.pdf; Government of Viet Nam, Viet Nam Electricity. 2014. Annual Report. Ha Noi

[31] Government if Viet Nam, Ministry of Industry and Trade. 2015. Revised Power Development Plan for the 2011–2020 Period with the Vision to 2030 (Revised PDP VII). Ha Noi

[32] The Government of Viet Nam, Ministry of Industry and Trade. 2014. Report on Rural Electrification. Ha Noi. (in https://www.adb.org/sites/default/files/institutional-document/178616/vie-energy-road-map.pdf)

the less developed and sparsely populated mountainous areas. Providing universal access to electricity is a top priority of the government's power subsector development agenda[33].

4.1.2 Demand and consumption in the Nghe An Province

Energy demand in Nghe An Province in Vietnam is fairly high and has increased remarkably. According to Nghe An Power Company (EVNNPC-PC Nghe An), the province's consumption has raised from 1,063 billion kWh in 2007 to 1,485 billion kWh in 2011. Together with that, annual electricity loss has also grown, from 8.37% in 2007 to 10.75% in 2011[34].

Electricity consumption of Nghe An province has been increasing, especially in summer due to higher demand of cooling facilities such as air conditioners and fans. In August 2017, the consumption was 11,5 million kWh/day and maximum capacity of the power system was 567Mw. This was higher than the highest consumption and capacity in 2016 (10,1 million kWh and 499 Mw respectively)[35].

Currently, the national electricity system does not cover some remote regions in Nghe An Province (242 villages). With the plan of covering 100% villages by 2020 electricity consumption will be higher[36].

Power cuts and insufficiency frequently occurs, especially during the dry season, affecting livelihoods, production systems and wellbeing (for example, water pumps do not work to provide water for plant nurseries or to operate pumping fans in shrimp ponds; no domestic cooling or fans on hot days or cooking with electrical appliances especially for staples (rice) due to low or fluctuating power supply)[37].

The development of My Ly HPP will contribute to the demand for electricity first an foremost to the region and to Vietnam.

4.2 Without the project alternative

Under the "without project" scenario, there will be no contribution to the national energy requirements. The energy demands for economic development in Vietnam are high and increasing with time. Enhancing energy security requires installation of additional hydropower projects. The "without project" alternative would not be in-line with economic development planning and might hinder economic, environment and livelihood enhancement which is expected to result from the Project. Implementation of reservoir project like My Ly HPP will also mitigate hydrological and meteorological risks, e.g., flash floods. The reservoir may also help to humidify the environment in the river system particularly in the dry season.

Implementation of the My Ly HPP would make electricity available to rural areas and trigger local development activities and small-scale industrial development, and as a result may enhance local and regional economy contributing to the regional and national demand for electricity.

However, if the proposed My Ly HPP is not implemented, there will be no Project-induced loss of forest, cultivated area, habitat changes, relocation of villages and other Project-induced environmental and socio-economic impacts.

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[33] https://www.adb.org/sites/default/files/institutional-document/178616/vie-energy-road-map.pdf

[34] http://nangluongvietnam.vn/news/vn/bao-ton-nang-luong/nghe-an-tang-cuong-quan-ly-nha-nuoc-ve-su-dung-nang-luong-tiet-kiem-va-hieu-qua.html

[35] http://www.baonghean.vn/kinh-te/201708/nghe-an-nang-nong-san-luong-dien-tieu-thu-tang-ky-luc-2834423/

[36] http://www.baonghean.vn/kinh-te/201708/nghe-an-nang-nong-san-luong-dien-tieu-thu-tang-ky-luc-2834423/

[37] http://www.baonghean.vn/kinh-te/201706/dan-vat-va-ngay-nang-nong-vi-dien-qua-yeu-2818558/

4.3 Without forest loss and relocation of villages alternative

The “without forest” and “without relocation of villages” scenario will not allow for the implementation of this Project. This alternative would require to decrease the dam height and reservoir FSL significantly which would result in significant reduction of electric power generation and would be economically unsustainable. It means that the Project cannot be built without taking forested lands and avoiding the relocation of villages. If the HPP is not developed there will be less contribution to the electicity demands of the region and particularly to the less populated areas, projected in the national energy plan. The growing population in the region and development will not have enough power in the next decade and that may lead to out-migration and generally halting growth. The Project is required for continuing the economic growth in the region and Nghe An province, which remains home to some of the poorest communities in Vietnam.

4.4 Alternative forms of electricity generation

Besides hydropower plants, other forms of potential power generation include thermal (use of fossil fuels), biomass, solar and nuclear power. Thermal generation is not a good choice as fuel sources must be imported at high cost. In addition, the generation of greenhouse gases as a result of operating thermal power plants contributes to global warming and air emissions associated with thermal generation are problematic. Nuclear power is an expensive and very complex energy generation system with a number of technical, safety and environmental challenges. Currently, possibility of installing nuclear power plant in Vietnam is low. Renewal energy development is a priority of the GoV.

4.5 Alternatives to project design, structures, location and layout

4.5.1 History of project alternatives

The main feasibility report of My Ly 1 HPP dated January 2015 (PECI, 2015) presented alternatives. There were three alternatives proposed. The location of the river being at the Laos-Vietnam border is a primary consideration in terms of security, therefore all planned surveys (for alternatives), locations of planned alternatives for permanent and non-permanent infrastructure were agreed by the Proponent and design team that at least a 1 km-distance from the boarder would be maintained in the planning. The project design team also had to comply with the GoV Law on Forest and Forest Development of 2004 and related acts/regulations which called for minimizing forest land take. Similarly, the impacts on households living in the potential area of influence must be minimized.

4.5.2 Proposed alternatives

The Vietnamese EIA approved in 2015 was based on a given project design such as dam height, reservoir size, maximum water level in reservoir, etc. (presented as Alternative 2, the preferred alternative; see details in Chapter 3 of this Report). Downstream the alternatives for My Ly HPP, there is the operating Ban Ve HPP with an installed capacity of 320MW. The tail end of the Ban Ve HPP reservoir at FSL reaches just about 2.8 km downstream from My Ly dam site. Upstream, the planned My Ly HPP is also a planned HPP, the Lower Nam Non (15MW), with a completed feasibility study.

Salient features of Alternatives 1, 2 and 3 and their impacts on physical, biological and social environments are summarized in Table 4.3 based on that reported in the feasibility report (PECI, 2015).

Three alternatives were planned in locations with suitable topology and narrow stretch of the valley. The locations had significant differences due to the topography and the alternative located at the narrowest location was favored due to the geological stability. The report also compared other features of the alternatives. The Alternative 1 (upstream) is located 2km upstream from the Alternative 2 (recommended site) while Alternative 3 was located 1km downstream the Alternative 2. Both Alternatives 1 and 3 were in wider parts of the valley and had poorer geological features than Alternative 2. Alternative 2 was favored as it was in the Vietnamese territory, located at a safe distance, narrow valley section with stable geology and about 2.8km away from the FSL level of the downstream reservoir of Ban Ve HPP.

Economically, the benefits increase as the FSL is increased, however the increase from FSL 320 to 330 masl would result in only a marginal increase in economic benefits. Given the economic, physical, social and environmental features, Alternative 2 was the favored choice and thus the subject of this ESIA.

Table 4.3 Impacts on environment and social aspects of the alternative options

No	Features / Aspects	Project Alternatives and known specifications		
		Alternative 1	Alternative 2 [1/]	Alternative 3
1	Headworks and Reservoir			
A	Dam location	2 km upstream of Alternative 2	Recommended location. About 2.8 km from the Ban Ve reservoir tail end at FSL.	1km downstream of Alternative 2 Closest (at the fringe) to the downstream Ban Ve HPP reservoir at FSL.
B	FSL	325 masl	330 masl	335 masl
C	Dam type	RCC	RCC	RCC
D	Geological features	Wide valley with unsatisfactory geology	Sound geological conditions, narrowest location.	Wide valley with unsatisfactory geology.
E	Border location (security issues)	Located at the border where legal aspects would require special consideration.	Is located about 1 km from the Lao Border, giving no legal issues.	Is located 1.5 km from the Lao border giving no legal issues.
		Alternative abandoned due to above reasons.	*Compared further*	*Compared further*
F	Estimated area of reservoir and main civil works (ha)		2451.50	2680.79
	Reservoir area		2356.80	2586.09
	Main civil works area	94.70	94.70	94.70
G	Temporary work area (ha)	91.70	91.70	91.70
2	Households likely affected			
A	No of estimated households to be likely relocated (Initial assessment, this has been updated in this report)	168	200	321
3	Land cover			
A	Total land cover, total (ha). Based on vegetation maps, year not reported		2356.80	2586.09
	Water surface		133.28	160.27

No	Features / Aspects	Project Alternatives and known specifications		
		Alternative 1	Alternative 2 [1/]	Alternative 3
	Bamboo forest, mixed bamboo forest		903.90	936.26
	Secondary forest		517.74	547.74
	Grassland		124.67	185.10
	Shrubland		677.21	756.72
4	Environmental and social impacts compared			
A	Resettlement		No. of households to be resettled is lower than Alternative 3	
B	Forest land (including protection forest land)		Affected forests is less than Alternative 3	
C	Fishing		The river stretch affected is likely to be slightly shorter	Water surface area potentially use for fishing is more than Alternative 2

[1/] Considered during national EIA preparation, 2015 (EIA report for My Ly 1 HPP in Vietnam territory issued by PECI 8/2015 and was approved by Vietnam Government on 20/11/2015.

4.6 Technologies and implementation procedure

The power plant will be designed and built with sound technology. Construction methodology will be based on intensive technologies of construction equipment and maximum utilization of local resources to the extent possible. This is to ensure lowest possible cost for project development and the quality of works undertaken. Priority should be given to the recruitment of local people, which will minimize the need for large areas of temporary camps. It will also reduce firewood and timber requirements, enhance local skills development and the economy, and foster good relations between the Project and local people. Surface blasting will be conducted during daylight using detonators of limited capacity. This will minimize the impact on local topography, structural damages in nearby settlements, wildlife/domestic animal movement and other unnecessary disturbances to local communities. Locally available materials with simple engineering structures such as gabions will be used for slope stability.

4.7 Use of raw materials

The construction materials such as cement, iron and other materials will be supplied from within Vietnam, and materials such as aggregates, sand, and stones are available in the Project area. Other heavy machines and equipment, turbines etc. are to be imported and transported to the site which is connected by highway.

Sources for some aggregate materials have been located in the area (see section on quarry). Excavated materials such as from headworks and tunnels will be used as construction materials, if found suitable.

CHAPTER 5: APPROACH

5.1 Introduction and objectives of the ESIA

The ESIA report is prepared in accordance with the standards of the Multilateral Guarantee Investements Agency (MIGA), of the World Bank Group and international accepted practices. MIGA uses a process of environmental and social categorization to reflect the magnitude of risk and impacts of a project. Based on the categories, the My Ly HPP is classified under **Category A.** Category A Projects are business activities with potential significant adverse environmental or social risks and/or impacts that are diverse, irreversible, or unprecedented[38].

This study also refers to the IFC Environmental, Health and Safety (EHS) Guidelines (2007), also a part of the World Bank Group where their applicability was tailored to the hazards and risks established for the Project. The general EHS guidelines includes:

1. <u>Environmental:</u> Air Emissions and Ambient Air Quality (Ambient Air Quality, Green House Gases), Energy Conservation, Wastewater and Ambient Water Quality, Water Conservation, Hazardous Materials Management, Waste Management, Noise and Contaminated Land;
2. <u>Occupational Health and Safety:</u> General Facility Design and Operation, Communication and Training, Physical, Chemical, Biological, and Radiological Hazards, Personal Protective Equipment (PPE), Special Hazard Environments and Monitoring;
3. <u>Community Health and Safety:</u> Water Quality and Availability, Life and Fire Safety, Traffic Safety, Transport of Hazardous Materials, Disease Prevention, Emergency Preparedness and Response; and
4. <u>Construction and Decommissioning</u>: Specific guidance on prevention and control of community health and safety impacts on Environment, Occupational Health & Safety, and Community Health & Safety.

The purpose of the ESIA is to:

- Establish the baseline condition within the Project DIA;
- Identify and evaluate environmental and social risks and impacts of the Project;
- Adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize[39], and, where residual impacts remain, compensate/offset for risks and impacts to workers, affected communities, and the environment;
- Promote improved environmental and social performance of the Proponent through the effective use of management systems;
- Promote and provide means for adequate engagement using ICP processes with affected communities throughout the project cycle on issues that could potentially affect them and to ensure that relevant mitigation measures are proposed; and

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[38] Environmental and Social Policy and Procedural Guidelines for Projects in International Development Association (IDA) countries financed jointly by World Bank and IFC based on IFC Sustainability Framework (June 19, 2012).

[39] Acceptable options to minimize will vary and include: abate, rectify, repair, and/or restore impacts, as appropriate.

- Ensure that grievances from affected communities and external communications from other stakeholders are responded to and managed appropriately.

Figure 5.1 illustrates the ESIA process and timing in the project cycle.

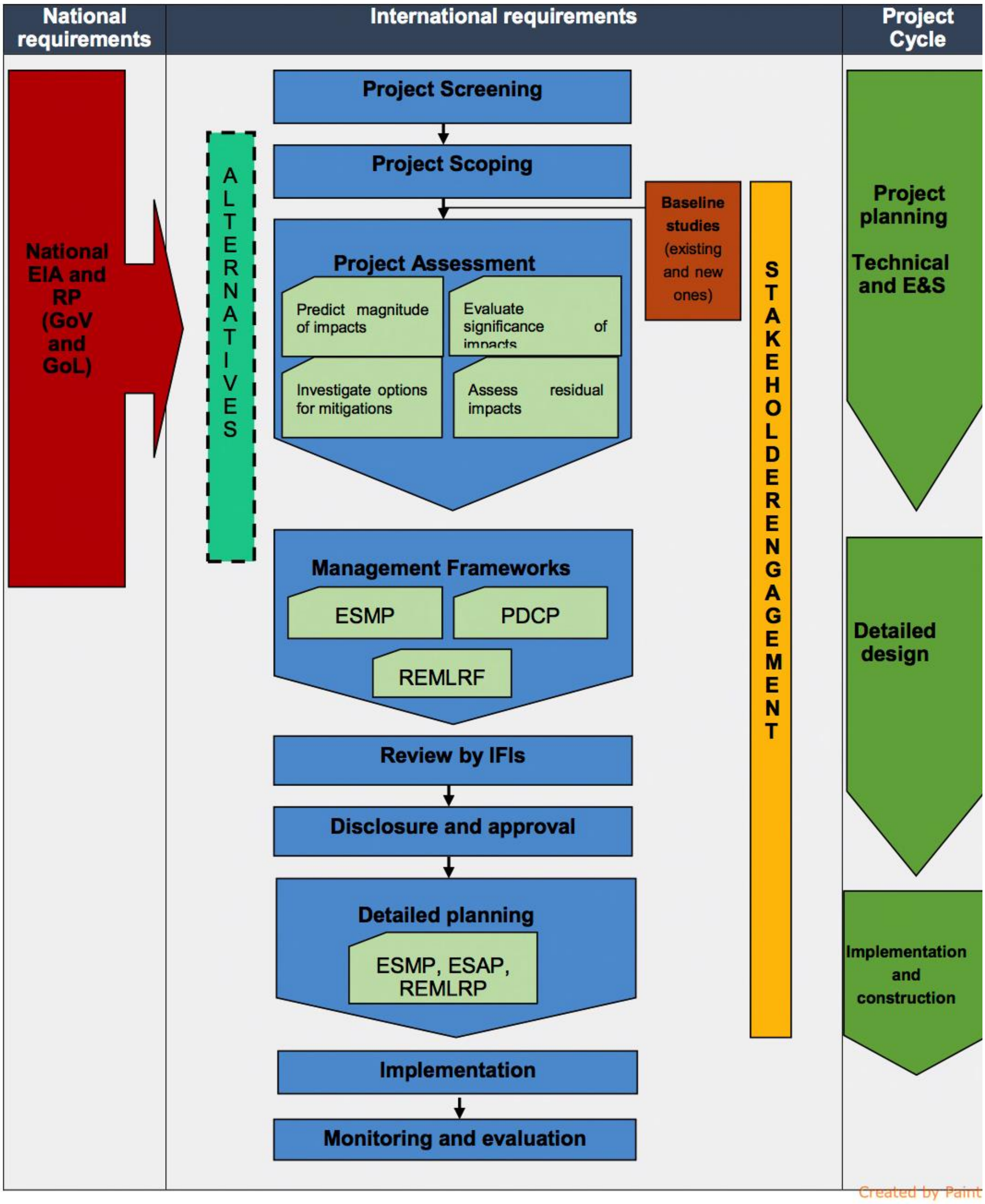

Figure 5.1 The ESIA process

5.2 Outlining of baseline and collection methods

Baseline characterization was based on review of existing reports/literature, review and gap analysis of previous studies reporting on the My Ly HPP (Table 5.1) and conducting field work and information gathering using participatory approaches in 2017. Existing baseline data and information of My Ly HPP were reviewed and a description of the data gaps and required work was prepared and included in a rapid Scoping Report[40]. Based on the Scoping Report, specific baseline data and information on environmental and social resources in the Project AI were collected for this ESIA and the Free, Prior, and Informed Consent (FPIC) process carried out in 2017 (Table 5.1). FPIC (MIGA PS 7) was carried out as indigenous people (ethnic minorities) will be affected by the proposed Project – subject to relocation, loss of land and assets, cultural/spiritual sites and livelihoods.

The key works reporting on baseline prior to 2017 are included in the Table 5.2 below.[41] The additional work in 2017 included gathering data on physical (e.g., land-use, water quality); biological (e.g., flora, fauna and aquatic) and social (e.g., economic and cultural characteristics).

Table 5.1 Field surveys and public consultation done for My Ly HPP

Subject /Theme	Date /Period	Location	Methods / Approach Sample size (no) / area (ha)	Where reported / How used (reference)	Conducted by
Physical characteristics					
Water quality	December 2015; April/May 2016 March 2017	Ca River	Grab sampling 3-4 sampling stations per sampling event	Section 6.8.2 Water quality section	PECI
Soil quality	December 2015	Upperstream of damsite; Xieng Tren village; quarry site	Grab sampling; 3 stations	Section 6.8.3 Quality of soil environment	PECI
Biological characteristics					
Vegetation survey	2012, May 2017	Within the proposed reservoir area following Ca River	Transect line 20 sampling sites	Section 7.3. Forest vegetation; Annex 2[42]: (this report)	PECI Institute of Ecology Biology Resources, Hanoi (IEBR)
Wildlife survey	2012 May 2017	MyLy and Keng Du Communes	Interviews and FGDs, Visual	Section 7.4 Wildlife resources	ASA PECI
Fisheries survey	May 2017	Along Ca River	13 sampling sites	Section 7.5 Aquatic ecology	PECI IEBR
Social characteristics					

[40] PECCI and ENVIRO-DEV. December 01, 2016. Scoping Report and Terms of Reference for ESIAs of My Ly and Nam Mo1 Hydropower Projects.

[41] ENVIRO-DEV. March 30, 2017. My Ly Hydropower Project, Progress Report of the ESIA.

[42] Institute of Ecology. April 2017. Biology Resources Report on Biology System.

Subject /Theme	Date /Period	Location	Methods / Approach Sample size (no) / area (ha)	Where reported / How used (reference)	Conducted by
Socio-economic features, general impacts and mitigation measures	2012, 2015	DIA in Vietnam	Statistical data collection, meetings with district and commune level representatives and village leaders	EIA 11/2015	PECI
Major socio-economic impacts on villages and proposed relocation and compensation in general terms	2015	Inundation area in Vietnam	Methodology reported: using maps, statistics, legal documents and development plans; meetings with gov staff; site survey, quick interviews with PAP	General Resettlement Plan 09/2015	Nghe An Forestry Planning Division
Baseline socio-economic and cultural overview and general project impacts, general principles of consultation	2016	Inundation area in Laos	Methodology reported: Village and household surveys, focus groups	ESIA 08/2016 contains very little and general information about the villages to be relocated, no reporting on consultations undertaken. Limited survey in each affected village as attached excel file.	ASA Consultant
Project and its impacts, GoV compensation policies; Socio-economic features of PAP	07/2016	DIA in Vietnam and Laos	(1) Meetings with commune and village representatives to present the Project and its impacts, Gov compensation policies, proposed mitigation measures, and to get participants agreement to the HPP. (2)Household baseline survey among 25% of	Summary table prepared for Project Scoping Report 10/2016 and Chapter 8 Annex 2 Table A in Progress Report March 30, 2017.	PECC1 and PO

Subject /Theme	Date /Period	Location	Methods / Approach Sample size (no) / area (ha)	Where reported / How used (reference)	Conducted by
			affected HHs, focused on land and assets.		
Social, economic/ livelihoods, health, education, cultural baseline information; PAP knowledge and views of the planned HPP	07–21 Jan, 2017	DIA in Vietnam and Laos	Baseline socio-economic and cultural information collection using participatory methods (5 thematic FGDs, 4 types of KIIs, and interviews with commune gov offices). All affected villages in DIA (reservoir and downstream) were sampled and commune offices were visited in all affected communes.	Volume I-Chapter 8 and Volume III in this ESIA.	NC (PECC1) under direction of IC (ENVIRO-DEV)
Communication – consultations[43]					
FPIC process	09-16 Jun, 2017	Inundation area in Vietnam and Laos	Participatory village consultation with all HHs invited in each village to be relocated and with village leader in each village losing land to reservoir; map, written and spoken information about the Project, its impacts and proposed mitigation provided and discussion with the PAP about them, HHs'	Volume I-Chapter 8 and Volume IV-Annex 5 in this ESIA.	Independent consultant group under direction of IC (ENVIRO-DEV)

[43] Communication in this table include only those consultations conducted where a two-way exchange took place and records are present. In the history of this project this ESIA study is the only process which included two-way communication including participatory and FPIC processes. Other details are provided in Chapter 10.

Subject /Theme	Date /Period	Location	Methods / Approach Sample size (no) / area (ha)	Where reported / How used (reference)	Conducted by
			views and concerns documented, agreement/ disagreement to relocation signed by village leader in each affected village.		

References: Institute of Ecology Biology Resources (IEBR). April 2017. Report on Biology System.

Since 2011, My Ly HPP have been subjected to a number of studies after the completion of the Plan of Hydropower Cascade Development in Ca River basin[44]. The Plan was approved by the Ministry of Industry and Trade (MOIT) of Vietnam. There were a series of relevant studies conducted to characterize the Project, presented below (Table 5.2). These studies have received legal permission/acceptance from both Vietnam and Lao PDR. These studies were reviewed in the scoping report and the data, where acceptable is used in this study.

Table 5.2 Chronology of key works performed on the My Ly HPP

No.	Month/ Year	Name of report	Status	Prepared by
I	**Technical documents:**			
I	12 / 2015	Feasibility Study Profile for My Ly hydropower project includes:	Submitted to MOIT, Vietnam	See below
1		*Volume 1: Summary report*		PECI, Vietnam
2		*Volume 2: Main report*		PECI, Vietnam
3		*Volume 3: Meteo-hydrological conditions*		PECI, Vietnam
4		*Volume 4.1: Hydro-energy, and hydro-economic analysis*		PECI, Vietnam
5		*Volume 4.2: Financial analysis*		PECI, Vietnam
6		*Volume 5: Total investment cost*		PECI, Vietnam
7		*Volume 6: Report on assessment of earthquake hazard level*		Geological Institute - Vietnam Institute of Science and Technology
8		*Volume 7: Transmission line from My Ly hydropower plant to Vietnam national power grid.*		PECI, Vietnam
9		*Geographical condition*		Geological professional - Institute of Drilling Technology, Vietnam

[44] Decision No. 6110/QD-BCT dated 23/11/2011 by Ministry of Industry and Trade (MOIT) on approving My Ly and Nam Mo HPPs of the Plan of Hydropower Cascade Development in Ca River basin.

No.	Month/ Year	Name of report	Status	Prepared by
II	Social and environmental documents:			
10	3/2017	Progress Report, ESIA My Ly HPP	Approved	ENVIRO-DEV
11	8/2016	ESIA My Ly HPP- ASA, Laos	In review by GoL	ASA consultant, Lao PDR
12	8/2015	EIA report My Ly HPP, Vietnam	Approved by MONRE, GoV 20/11/2015	PECI, Vietnam
13	8/2015	Resettlement Plan Report, My Ly HPP, Vietnam	In review by Nghe An Province, GoV	Nghe An consultant, Vietnam
14	5/2017	Biology report for My Ly HPP, Vietnam & Lao PDR	Completed	IEBR, Vietnam
16	6/2017	Water Quality Report for My Ly HPP, Vietnam and Lao PDR	Completed	PECI, Vietnam

5.3 Definitions used in this study

The ESIA process focuses where the Project involves activities that are likely to generate environmental and social impacts. These include construction of dam and its various associated structures, powerhouse and tail race facility, auxiliary facilities, quarrying, muck disposal, construction of waste storage, and other related activities as described in Chapter 3. There could be unplanned but predictable developments caused by the Project that may occur later or at a different location. Below are some of the terms and their definitions as used in this study.

Project Area of Influence (AI) - Environmental and social risks and impacts are identified in the context of the Project's AI. The Project areas identified are as follows:

- Direct Impact Area (DIA)

a) Project structure and activity area: These include construction and associated facility sites; access roads, quarry sites, spoil disposal area, and physically high risk areas. Both permanent and temporary areas used by the Project fall under this category.

b) Inundation area: This is the area covered by reservoir at operation level. This is a permanent impact area where the local inhabitants will lose their land and assets on land, and physical and productive infrastructure and facilities. There could be irreversible losses to natural resources.

c) Low flow area: It includes the stretch of the Ca River between the dam site and the tailrace outlet where the flow will be significantly reduced during Project operation. In My Ly HPP, this stretch is short (~350m) and impacts are assessed in relation to the aquatic ecosystem, natural habitat and the fisheries, and any river related livelihood and cultural activities. The stretch of low flow area although short in My Ly HPP, may have impacts expanding beyond the tailrace due to water fluctuation and the supply levels of the downstream Van Be HPP reservoir (see Cumulative impacts).

d) Water level fluctuation stretch: The riverine area between the tailrace outlet and the first river confluence is included in the 'high flow fluctuation stretch'. Since the precise operation is not finalized and will be done so during the detailed design phase this will need to be assessed later.

e) Safeguard Buffer Area: A buffer zone of at least 50m from the water body. No annual crops that could trigger soil erosion and landslides or mass movement should be grown in this buffer zone. Details of such a zone shall be designated during the detailed ESMP.

- Indirect Impact Area (IIA)

Indirect project impacts on biodiversity or on ecosystem services upon which livelihoods of affected communities are dependent. There could be some habitat fragmentation. Project districts and communes are categorized as indirect project areas.

I. Project Affected Persons (PAP)

Families or households in the direct or indirect impact areas whose land, properties or livelihoods may be affected due to construction or operation of project components are considered as 'Project Affected Families(PAF)'. The members of these families or households are considered as Project Affected Persons (PAP). In this ESIA the term "Project Affected Families" or "Project Affected Households" follows MIGA terminology and thus is not limited to those subjected to physical displacement. Project Affected Families include, depending on the case, those affected by:

a) the involuntary taking of land resulting in:

- relocation or loss of shelter;
- loss of assets or access to assets; or
- loss of income sources or means of livelihood, whether or not the affected persons must move to another location; or

b) the involuntary restriction of access to legally forested areas, designated parks and protected areas resulting in adverse impacts on the livelihoods of the displaced persons.

c) the involuntary restriction of traditional social-culture activities.

More detailed characterization of PAPs and PAFs is provided in the Resettlement and Ethnic Minority Livelihood Restoration Plan (Volume 6- REMLRP).

II. Tertiary Impact Area (TIA)

Along roads beyond the project impact areas. Tertiary impacts may be related to transport routes, boomtowns, camp followers (especially at small townships and villages), health and safety, and exploitation of natural resources.

Ecosystem services as defined by MIGA PS are the benefits that people including businesses derive from the ecosystems and includes four types: provisioning, regulating, cultural and supporting services. The most frequently described are those provisioning services commonly referred to as natural resources, e.g., water, food and fuel. The consideration of ecosystem services is a key requirement of the MIGA PSs. By definition, ecosystem services contribute to human well-being (de Groot et al. 2010[45]). But while some ecosystem services directly contribute to human well-being or project performance, others do so indirectly by supporting other services. For example, fish/cattle production —a final service—typically provides a direct value to human well being through income, subsistence, and/or culture. In contrast, fodder production—an intermediate service—contributes to

[45] de Groot, R., B. Fisher, M. Christie, J. Aronson, L. Braat, J. Gowdy, R. Haines-Young, E. Maltby, A. Neuville, S. Polasky, R. Portela, and I. Ring. 2010. "Integrating the Ecological and Economic Dimensions in Biodiversity and Ecosystem Service Valuation." Chapter 1: 9-40 in P. Kumar (editor) The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations. Earthscan.

human well-being indirectly by supporting livestock production. In the context of the My Ly HPP, ecosystem services may include:

- Land (grazing of livestock; places of cultural significance; agriculture; vegetation cover that provides for soil and slope stability);
- Water (fishing; irrigation; transport).
- Forest (food sources; medicinal plants; firewood, wood for crafts/construction).

Ecosystem services will be assessed through the ESIA process.

5.4 Impact and risk assessment approach

5.4.1 Risks and impacts

The risks and impacts identification process used in this study, is based on the recent environmental and social baseline data at an appropriate level of detail. It considered all relevant environmental and social risks and impacts of the Project. The risks and impacts identification process also considered climate, cumulative and potential transboundary effects.

Environmental and social risks and impacts due to project planning and implementation are grouped:

a) Beneficial environmental and social impacts

   Project benefits could include employment generation, local and regional economy enhancement, technical skills and know how, local development activities, social safeguards; biological enhancement, renewable energy, etc.

b) Risks and adverse impacts

I. Direct project impacts: change in both quality and quantity of environmental resources during construction and implementation phase;

II. Inundation impacts in the upstream of dam, low flow river area in the downstream of dam up to tailrace outlet and water level fluctuation in between tailrace outlet and the first river confluence, during operation phase;

III. Induced and indirect impacts from unplanned but predictable developments at a different location, both during construction and operation phase;

IV. Transboundary impacts; and

V. Cumulative impacts[46] that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted.

Components of environment and social assessment have included the assessment of impacts on environmental and social resources in the project area of influence. Various impact qualifiers have been employed to describe the impacts. Different qualifiers are used according to the social or environmental aspect affected by the project related activities and

[46] Cumulative impacts in this study is limited to the cumulative impacts of a cascade development in terms of water flows/availability.

ecological imprint, in order to best describe the nature of the impact. The range of impact qualifiers and their designations are listed below (Table 5.3).

Type can be defined universally. The designations (direct, indirect and induced) apply to all receptors/resources and associated impacts. There are several universally consistent designations, both extent and duration. These designations will vary according to the nature of the resource/receptor, for example, *long-term duration* impact can vary for ground water or noise from river-stretch impact. Then there are characteristics that are not assigned fixed designations, as they are typically numerical designations: *scale* and *frequency*. *Likelihood* pertains only to unplanned events. For all realistic and practical purposes, it is not a requirement that each of these characteristics be discussed for every impact identified. These characteristics are used (specific to receptor/resource) to assign each impact a *magnitude* (Table 5.3). The universal *magnitude* designations are *positive, negligible, small, medium and large*. In addition to characterizing the magnitude of impact, the next vital step is to assign significance for a given impact where significance requires the defining of the sensitivity/vulnerability/importance of the impacted receptor/resource (Figure 5.2). Impacts will be summarized in an Environmental and Social Impact Matrix (see Impact and mitigation section).

Table 5.3 Impact characteristics, definitions and designations

No.	Characteristic	Definition /Description	Designations and definition
1	Type	A descriptor indicating the relationship of the impact to the Project (in terms of cause and effect)	Direct Impacts that result from a direct interaction between the Project and a resource/receptor (e.g., land take, river stretches, between occupation of a plot of land and the habitats which are affected).
			Indirect Impacts that follow on from the direct interactions between the Project and its environment as a result of subsequent interactions within the environment (e.g., viability of a species population resulting from loss of part of a habitat as a result of the Project occupying a plot of land).
			Induced Impacts that result from other activities (which are not part of the Project) that happen as a consequence of the Project (e.g., influx of camp followers resulting from the importation of a large Project workforce).
2	Extent	The “reach” of the impact (e.g., the stretch of the river and tributaries, or that which is confined to a small area around the Project footprint, projected for several kilometers, etc.).	Local
			Regional (defined on a receptor/resource specific basis)
			International
3	Duration (defined on a resource / receptor specific basis)	The time period over which a resource / receptor is affected.	Short-term/temporary impacts are those lasting for short duration 3-5 years after Project completion
			Medium-term impacts are those lasting for 5-15 years after Project completion
			Long-term impacts are those lasting for more than 15 years

No.	Characteristic	Definition /Description	Designations and definition
			Permanent impacts that are a result of change, loss or due to the Project
4	Scale	The size of the impact (e.g., the size of the area damaged or impacted, the fraction of a resource that is lost or affected, etc.)	No fixed designations; intended to be a numerical value and relative comparison based on similar type coverage at a larger scale for example. Usually designated as Small, Medium, or Large
5	Frequency	A measure of the constancy or periodicity of the impact	No fixed designations; intended to be a numerical. Usually designated as Lower or Higher
6	Likelihood (pertains only to unplanned events, traffic accidents, operational leaks, strikes/ protests)	Using a qualitative (or semi-quantitative, where appropriate data are available) scale. A measure of the degree to which the unplanned event is expected to occur. It is not the degree to which an impact or effect is expected to occur as a result of the unplanned event (i.e., uncertainty).	Unlikely. The event is unlikely but may occur at some time during normal operating conditions. Possible. The event is likely to occur at some time during normal operating conditions. Likely. The event will occur during normal operating conditions (i.e., it is essentially inevitable).
7	Magnitude / Degree of Impact	Magnitude essentially describes the degree of change that the impact is likely to impart upon the resource/receptor.	Positive, Negligible, Small, Medium or Large Magnitude is a function of the following impact characteristics explained in the process of describing and defining the likely impact: extent, duration, scale, frequency and likelihood.
8	Sensitivity /Vulnerability /Importance	It describes the vulnerability status of impact	Small/Low, Medium or High
9	Significance (overall impact)	The significance for a given impact on resource/receptor	Negligible, Minor, Moderate or Major

		SIGNIFICANCE: Vulnerability, Sensitivity or Importance of resource/Receptor		
		Low	Medium	High
Magnitude/Degree of impact	Negligible	Negligible	Negligible	Negligible
	Small	Negligible	Minor	Moderate
	Medium	Minor	Moderate	Major
	Large	Moderate	Major	Major

Figure 5.2 Designation of magnitude and significance

5.4.2 Mitigation and enhancement

MIGA Performance Standards 1-8 ensure management of environmental and social risks and impacts due to Project implementation. Project shall avoid, or where avoidance is not possible, minimize, mitigate, or compensate, for adverse impacts on workers, affected communities, and the environment.

Mitigation measures are classified as:

Preventive measures: some potential adverse impacts may be reduced or eliminated before occurrence by introducing preventive measures which promote proven environment management techniques/practices such as health awareness and health programs.

Compensatory measures: actions that are undertaken to compensate for unavoidable adverse impacts such as release of compensatory flow, rehabilitation of displaced people, forest plantation etc.

Corrective measures: actions implemented to reduce adverse impacts to acceptable levels such as installation of pollution control device, construction of fish ladder.

The ESMP will consist of the set of mitigation measures, monitoring and institutional measures to be taken during project construction and operation to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels.

5.5 Communication

The Project has had a history of various parties having presence at the affected villages over time (since 2011 at least). Local communities have been subjected to surveys and received information from Proponents, government representatives, technical personnel (working for the proponents, e.g., surveyors, geologists) and those carrying out surveys for the GoV and GoL EIAs and national Resettlement Plans.

The ESIA IC for this study reviewed in detail all previous consultations available (where accessible and recorded). Most previous work focused on high level consultations (at the district level, commune) or village level committees and villages heads. Little was communicated to communities, particularly in the form that the ethnic minorities were informed. Informed Consultations and Participation (ICP) is not a requirement of the national EIA process.

Given this, the ESIA consultant opted to conduct a detailed set of participatory consultations for gathering baseline information. These consultations started with village information meetings leading into thematic focus group discussions (FGD) and key informant interviews (KII). These data and observations led to baseline characterization and verification, and the planning of the FPIC process. In discussion with MIGA, the FPIC process was carried out. This led to the development of the PCDP and planning for future project related consultations – covering the project cycle. The Proponent is responsible for carrying out all future consultations.

5.6 Proponent responsibility

The Proponent is responsible to manage environmental and social risks and impacts so that development opportunities are enhanced[47]. The Proponent will manage environmental and social performance including Land Acquisition and Involuntary Resettlement, Pollution Prevention, Conservation and Sustainable Management of Natural Resources, and Community Health, Safety, and Security. The Proponent will ensure that all the prescribed / recommended mitigation measures are implemented in time and their performance monitored.

Impacts on these resources by Project activities are quantified and proper mitigation measures are recommended to reduce adverse impacts and to improve quality of environmental and social resources. Accurate baseline data indicate changes brought by Project on environment resources. Additional data may be needed during the detailed elaboration of the environmental and social plans, often requiring specific meetings with the local/regional authorities and affected communities.

5.7 Limitations

The ESIA was able to address all themes that needed upgrading from the national EIAs. The limitations in social-economic, cultural, livelihoods and biological baselines were overcome by conducting field studies during January - March 2017 and verified where needed during June 2017.

There are some themes however which may have benefitted from more baseline data which were not possible to collect due to technical and time constrains. Some issues surfaced during the assessment of data collected for this study which were not possible to assess properly. Specific areas that require further addressing are (i) longer-term fish biology and adaptability knowledge in the reservoirs and river stretches downstream the dam (a study is proposed), (ii) climate change aspects, (iii) forest management techniques used and (iv) detailed physical mapping of villages. It is expected that these will be part of the detailed development of environmental and social management plans and safeguards which are proposed in this ESIA.

[47]Source: https://www.miga.org/projects/environmental-and-social-sustainability/performance-standards/, see also reference to IFC guidance notes linked to the performance standards listed here. These are similar to the ones of MIGA sister organization IFC.

CHAPTER 6: PHYSICAL ENVIRONMENT

6.1 Topography and land use

6.1.1 General topography

The Ca River basin within the Project stretch is characterized by a rugged terrain with sharp variation in elevation. The few flat or gentle-sloped lands by the river banks, are either used as settlements and/or cultivation areas. Most of the settlements and agricultural lands are on hill slopes and at flat highland areas. Areas with gentle slopes are often used for agriculture, while the steep areas are either used for grazing lands, for cropland or covered with limited secondary forests.

Within the Project Area of Influence (AI), the elevation ranges from minimum of 218masl to maximum of 403masl. The average elevation of the river stretch is 302masl. Slopes range from 15^o - 45^o.

The Ca River catchment develops in a NW-SE direction, gradually sloping towards the sea. Upstream of the catchment area within the Laos territory is very steep with an average elevation of more than 1000masl.

Geo-morphology in the Project area is characterized by the following types[48]:

<u>Erosive-denuded relief:</u>
This type of relief occupies almost all of the study area. This relief is developed mainly at the mountain slopes and on top of the mountains creating fairly a slope topography of 30º-50º. This relief is dissected strongly by faults and river networks.

<u>Karstic relief:</u>
The karstic relief found in the studied area is mainly limestone, distributed downstream of the Project area at Xốp Tụ limestone mountain and Cong Troi limestone mountain in Muong Long. The Xốp Tụ limestone is the proposed source of aggregates to be used during construction.

<u>Accumulated relief:</u>
This relief includes the non-classified alluvial and pluvial deposits (apQ) and non-classified Quaternary eluvia, diluvia formation (deQ)The former comprising of cobble, boulders, gravel, sand, loam and clay, distributed along river, stream sections and narrow valley where topography is rather flat, while the latter is comprised of aggregates, quartz, sand, siltstone, red clay that are lateralized irregularly.

6.1.2 Land use in the Project Area of Influence

The land use analysis shows that the Project Direct Impact Area and proposed buffer is highly influenced by human activities, 80% of the total DIA of 1333.8ha is vegetated. Approximately 21% of the vegetation cover to be taken by the Project comprises a combination of mixed forests (

Table 6.1 below summarizes the current land uses of the DIA.

[48] PECI, 2015, Feasibility Study for My Ly HPP

Table 6.1 Land use and main cover of Project Direct Impact Area (DIA)

No.	Land use and cover (land take of project)	Permanent Area (ha) - DIA		Temporary (ha)[1] in DIA	Total (ha)	Buffer Area (ha)
		Reservoir	Main works			
I	**Total Vegetated area**	**988.3**	**31.25**	**47.26**	**1066.51** (80%)	*692.8*
a	Forests	629.3	17.51	22.46	*282.2*	*150*
b	Scrub and grassland	327.0	13.44	17.60	*104.1*	*45*
c	Shrub/bamboo/cultivated/uncultivated land	32.0	0.3	7.2	*282.7*	*230*
II	**Built-up areas/residential/ others**	**51**	**0.2**	**3.4**	**54.6** (4%)	*12*
III	**River/stream**	**208**	**2.7**	**2.0**	**212.7** (16%)	*2.7*
Total		**1,247**	**34.1**	**52.7**	**1,333.8**	*707.7*

1-axilliary areas to be used during construction are included in total land take of project.

6.1.3 Topology and land use of the Project Area of Influence

Topology of the reservoir and buffer zone

The elevation range within the reservoir ranges from 201masl to 300masl while the elevation range of the buffer zone starts from 300masl up to 350masl. Essentially the buffer zone forms a 50m width riparian strip around the reservoir, except in the upper edges.

Topology of the Project structures and activity areas

The Project components are distributed at elevation 200masl up to 300masl. The elevation ranges of each of the Project components are presented below (Table 6.2).

The river basin at the damsite has a V-shaped form with the sloping and symmetric mountains on both sides. It is about 40m wide. The river-bed elevation is approximately 201masl. Some rocks are exposed along the river bank. Alluvial deposits are underdeveloped (e.g., thin covering layer) and only visible downstream of the damsite, particularly about 500m from Xang Tren Border Guards' Station[49]. The slope ranges from 40^0-50^0 which limits the deposition of alluvium.

[49]PECI, 2015. Feasibility Study for the My Ly HPP

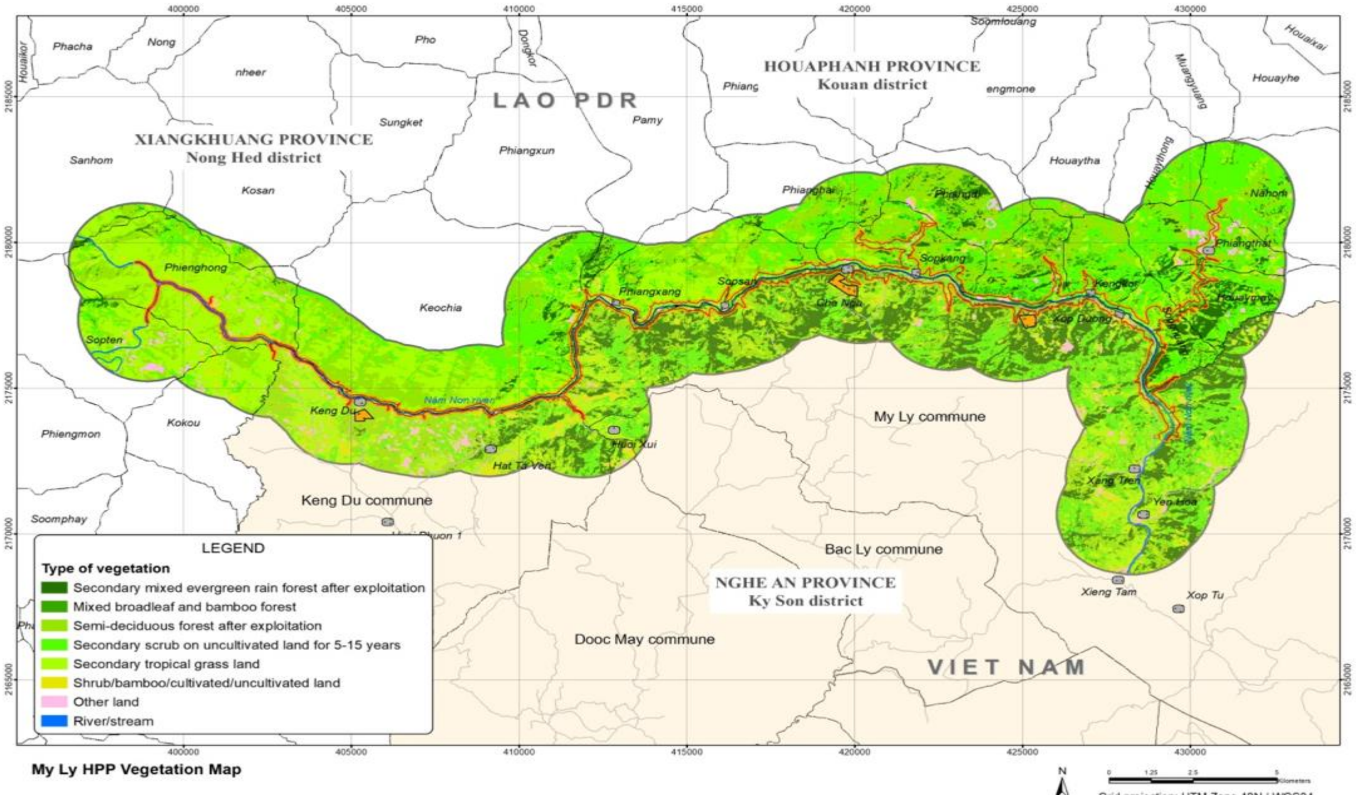

Figure 6.1 Land use map of My Ly HPP Project Area of Influence

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[50] Source: Cục Viễn thám Quốc gia, satellite image, 2014

Table 6.2 Elevation range of the Project structures and activity areas

No.	Code	Project structures and activity areas	Elevation masl	
			Min	Max
I	20	Disposal area No. 1	205	225
II	21B	Disposal area No. 3	260	330
III	21C	Disposal area No. 4	220	340
IV		Auxiliary area No. 1		
	5.1	Auxiliary area (AA)	305	320
	18	Sand stockpile area at headworks, waterway areas (AA) Right Bank	305	335
	23	Water treatment station at dam, powerhouse area	305	312
	24	Water treatment station at auxiliary area (UPS) Upstream	315	330
V		Auxiliary area No. 2		
	3	RCC facility	230	260
	5.2	Concrete facility at dam, powerhouse area	230	260
	10	Workshop for hydro-mechanic erection (LB) Left Bank	220	245
	11	Workshop for electrical-mechanic erection of the powerhouse (UPS)	213	225
	13	Explosive dynamite warehouse for headworks, waterway areas	223	238
	15	Technical material warehouse (Project Management Board's (PMB) warehouse)	235	244
	17	Provision power	230	240
	18	Sand stockpile area at headworks, waterway areas (AA-LB)	268	278
	19	Rubble stockpile area	220	280
	22	Substations (AA-LB)	268	278
	24	Water treatment station (AA-DS) Downstream	220	280
	27	Housing and office of PMB, Specialists, Engineer (UPS)	262	268
VI	21A	Auxiliary area No. 3 Disposal area No. 2	220	400
	9	Maintenance facility and parking area for construction equipment	238	257
	10	Workshop for hydro-mechanic erection (LB)	228	235
	11	Workshop for electrical-mechanic erection of powerhouse	239	263
	22	Substations (AA-RB)	240	250
	25	Pump & domestic waste water treatment station	222	242
	26	Office of the Contractor at the damsite and waterway area	247	254
	28	Housing area for dam and waterway workers	300	400
	29	Clinic at dam and waterway area	280	300
	30	Post office	255	270
	32	Fire station	255	270

No.	Code	Project structures and activity areas	Elevation masl	
			Min	Max
VII		Other auxiliary areas		
	12	Laboratory at headworks and waterway	240	262
	14	Petroleum warehouse at damsite and waterway areas	260	268
	25	Auxilliary area by the river	207	212
	27	Housing and office of PMB, Specialists and Engineers (DS)	232	238
	31	Police station (UPS)	220	230
	31	Police station (DDS)	220	228
VIII		Quarry	530	750

Source: PECC1, updated 20 May 2017

6.2 Meteorology

6.2.1 Vietnam

Vietnam has a remarkably diverse climate conditions because of its location where there is a wide range of latitudes and altitudes. The seasonal climatic pattern (e.g., distinct winter and summer seasons) is similar throughout the basin, differing only in degree due to the wide variations in elevation and exposure. Vietnam is divided into three climate zones, north, central and south. The south facing mountain slopes are warmer and attract more precipitation than those facing north. In winter, continental wind patterns are generally from the northeast and there is little precipitation.

Climatic conditions at the Project area

The Ca River catchment area in general, and the My Ly HPP catchment area in particular, are located within the tropical monsoon climate region where climate regime is influenced by the topographical conditions. Climate in the region falls under the North-Central Region influenced by the East Truong Son mountain range.

The moonsoon tropical climate is affected by the following:

- Asian continental air mass is active during the period from September to March. The weather is characterized by cold and dry air during winter months. Light rains starts during the middle until the end of winter season.
- The Equatorial Pacific air mass is active from May to October. The characteristic of this air mass is hot and humid, causing much rain.
- Tropical Indian air mass with Southwest wind is active in May, June, July and August, July being the windiest month. The weather characteristics of this air mass are hot, dry and little rain. This is also the period when wind from Laos acts the fiercest in the area.

Temperature

The nearest gauging station is in Tương Dương station (Hoa Binh town, Tương Dương District, Nghe An Province, Vietnam), which is about 87km from the Project site. The mean annual ambient temperature at this station is 23.7^{o}C. At Vinh station (Vinh City, Nghe An Province, Vietnam), which is about 299km from the Project site, mean annual temperature is 23.9^{o}C. Winter lasts from December to March, January being the the coldest month. Temperature during winter season ranges from 17^{o}C - 21^{o}C and absolute minimum is 1.7^{o}C (Tương Dương station 1/1974).

Summer lasts from May to August when temperature ranges from 27^{o}C - 29^{o}C, where the hottest month is July. The maximum temperature recorded at Tương Dương station was 42.7^{o}C (May,1966).

Table 6.3 Typical air temperature at Tương Dương Station

Characteristic	Temperature ^{o}C												
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Average	17.9	19.3	22.0	25.4	27.4	28.1	28.0	27.3	26.2	24.0	21.0	18.2	23.7
Max	36.7	37.8	40.8	42.0	41.6	40.0	41.2	39.0	36.4	38.2	36.7	36.0	42.0
Min	5.7	8.4	6.0	14.9	19.9	20.8	22.0	22.1	18.4	14.9	10.8	2.8	2.8

Source: PEC1, 2015 Feasibility Study for My Ly HPP

Rains

Rainfall is distributed in two seasons: The rainy season starts in May (usually periodic and light at the start, picking up gradually at the end of July/ early August) and ends in October with rainfall volume contributing to about 80% of the total annual rainfall. The rest of the year is referred to as the dry season, with November to February being the driest.

The mean annual rainfall in the Project area is estimated at 1400mm. History of flooding has been reported in Ca River basin (e.g, May 1989). Annual rainfall changes along the Ca River basin as indicated in the following records:

- 1100 - 1700mm - Upstream area, where the Project construction will be;
- 1800 - 2500mm - Middle reaches of Ca River; and
- Over 2500mm - Downstream reaches

Some of the highest rainfall records are 788mm at Đô Lương and 684mm at Dừa station (27 Sept 1978). The rainfall measured for three continuous rainy days reached 958mm at Đô Lương, 809mm at Dừa and 749mm at Yên Thượng stations, which resulted to the big flood in Ca River in 1989.

Wind

The predominant wind direction and wind probability was taken at the Tương Dương gauging station and presented in Table 6.4. The highest wind speed recorded is 25 m/s, in 1975. Higher records were, however, noted at Vinh station at 40 m/s in 1982, 1987, 1989 and1990.

The highest wind speed at Tương Dương station was used for the construction design. Wind speed with their respective frequencies at the directions to My Ly damsite are indicated in Table 6.5.

Table 6.4 Frequency of wind direction at Tương Dương weather station

	Calm	Direction							
		N	NE	E	SE	S	SW	W	NW
Frequency of wind (%)	54.6	2.35	4.06	15.2	9.76	1.54	1.23	6.60	4.66

Source: PEC1, 2015, Feasibility study

Table 6.5 Wind speed and its probability (frequency) at Tương Duong weather station

Probability (%)	Direction of wind (m/s)								
	N	NE	E	SE	S	SW	W	NW	Calm (no wind)
2	18.1	16.4	19.8	16.9	13.2	17.1	25.6	25.5	27.8
4	15.6	15.1	17.8	15.7	12.00	15.2	22.8	22.6	25.3
10	12.2	13.1	14.9	13.8	10.3	12.5	18.7	18.6	21.8
25	8.70	10.9	11.9	11.7	8.30	9.40	14.1	14.1	17.8
50	5.90	8.70	9.4	9.6	6.50	6.70	10.0	10.0	14.1

Source: PEC1, 2015, Feasibility study

Humidity

Similar to temperature, Tương Dương is slightly affected by the Northeast wind and rain patterns, therefore humidity is relatively lower than in other areas of the region. Annual relative humidity at

Tuong Duong weather station is 82%, while other nearby stations recorded relatively higher humidity: Vinh at 85.1%, Do Luong at 85.3% and Tay Hieu at 85.6%

Table 6.6 shows that the average humidity during dry months are the lowest. The humidity record at Tương Dương is similarly used for the construction design.

Table 6.6 Typical relative humidity at Tuong Duong Station (%)

Month	Relative humidity												
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Humidity (Mean)	82	80	79	79	79	80	81	85	85	86	85	83	82
Humidity (min)	21	20	19	23	20	30	33	40	34	37	27	26	19

Source: PEC1, 2015, Feasibility study

6.2.2 Lao PDR

Lao PDR has less variation in climatic conditions and is characterized by two distinct seasons, the wet and dry. Part of the Project reservoir area in Laos is dominated by both southwest and northeast monsoons forming the two climate regime, the wet and dry seasons. The southwest monsoon from Indian Ocean, brings the rainy season and is from May to September (largely overlapping with the seasons in Project area region. With the retreat of the southwest monsoon by October, rain decreases rapidly and signals the start of dry season from October to April. With the transition of the northeast monsoon from mainland China it also signals the start of cold months from November until February.

Table 6.7 shows the meteorology recorded at Kouan District, where part of the Project is located in Laos.

Table 6.7 Climatic characteristics of Kouan District, Lao PDR

Parameters	1 Jan 2016		1 April 2016		3 June 2016	
	07:00h	13:00h	07:00h	13:00h	07:00h	13:00h
Temperature (°C)	6	20	19	32	24	32
Wind (mph)	3 E	5 E	3 SW	8 WSW	2 SW	3 SW
Humidity (%)	94	37	77	31	86	57
Pressure (mb)	1023	1020	1011	1007	1009	1006
Rain (mm)	0	0	0	0	0.4	2.2
Cloud cover (%)	2	5	7	11	68	29

Source: ASA Power Engineering Co. Ltd, 2016, ESIA

Rainfall

The annual rainfall distribution is approximately 80% from May to September, 10% from October to December and about 10% from January to April. Average monthly rainfall at Xiengkhouang, Houaphanh and Luang Prabang is shown in Table 6.8. The distance from Xiangkhouang, Houaphanh and Luang Prabang provinces to the My Ly HPP are 120km, 91km and 230 km, respectively.

Table 6.8 Average rainfall in Xiengkhouang, Houaphanh and Luang Prabang, Lao PDR

Month	Rainfall (mm)		
	Xiengkhouang	Houaphanh	Luang Prabang
Jan	10.57	5.69	11.32
Feb	14.73	15.71	16.93
Mar	55.02	39.05	36.35
Apr	142.34	97.94	19.47
May	195.13	212.11	154.42
Jun	187.93	177.39	186.62
Jul	283.36	222.78	241.70
Aug	296.92	295.11	286.04
Sep	157.07	187.71	187.77
Oct	64.33	89.30	98.83
Nov	21.06	22.04	29.40
Dec	7.55	9.35	12.32
Annual	**1436.02**	**1379.18**	**1339.16**

6.3 Geology and soils

6.3.1 Geology

The Project site is characterized by the following geological strata:

(i) Nam Tam formation (D_{1-2}nt): The Nam Tam formation comprises of argillaceous schists, siltstone with, thickness of 900m.

(ii) Dong Trau formation (T_2a đt): The lower layer of this formation are composed of the conglomerate, tuff sandstone, siltstone, schist, eruptive brown purple, ryolite, ryodacite with thickness of 1000 -1100m while the upper layer consists of quartz sandstone of coarse grain size intercalated with siltstone, argillaceous schist, stripped dark siliceous schist and less tuff.

The headwork areas of the My Ly HPP is located within this region of Dong Trau formation (the lower sub-formation).

(iii) Lower Dong Trau Sub-formation (T_2a đt_1): The sandstone of medium to coarse grain size, brown siltstone, grist and agglomerate of grey, light grey color, lenses of lime contaminated sandstone, siltstone with thickness of 1000-1100m. Laying on two wings of an anticline whose axis runs in NW-SE direction.

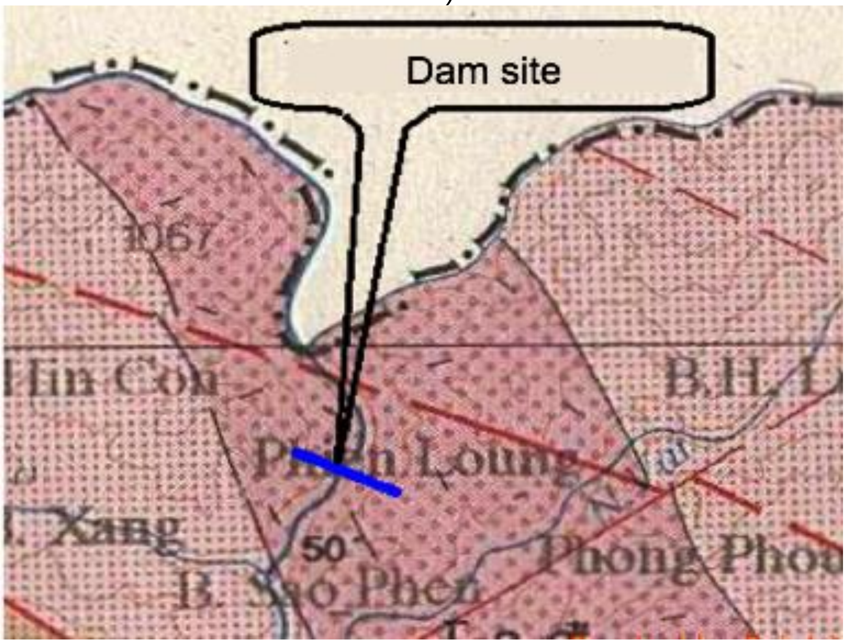
(iv) Undivided quaternary eluvia, diluvia formation (edQ): This formation comprise of heavy loam, clay mixed with grit, fragments of sandy- siltstone, concretion, being lateritized, loose, soft sandstone and pieces of quartz. It has an average thickness of 1-14m.

(v) Undivided quaternary alluvial, pluvial formation (apQ): This formation comprises the pebble, boulder, gravel, sand, loam, clay with thickness of 1-8m, distributed along the two banks of the river.

Figure 6.2 shows the geological map in the Project area.

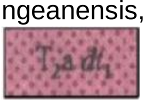
REGIONAL ECOLOGICAL MAP

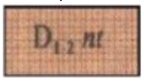
(Extracted from geological map, scale 1:20000, Muong Xen E-48-II, E-48-III)

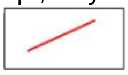


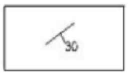
SYMBOLS

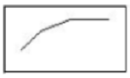
 Upper Dong Trau formation: siltstone, sandstone, gray shale, marl, limestone, 1100-1200m thick, consisting Costaria ngeanensis, Neoschizodus orbicularis.

 Lower Dong Trau formation: Basal conglomerate, tuffaceous sandstone, tuffaceous siltstone, magmatic rock, 1000-1100m thick, consisting of Costatoria chegarperahensis, Lima cf. costata.

 Nam Tam formation: gray shale, siltstone, 900m thick, consisting of Nowakia holymensis, Styliolina pisocrinus, Drepanophycus sp., Rhynia sp.

 Tectonic fault

 River, streams.

 Geological boundary

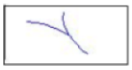
 Strike and dip angle

Figure 6.2 Geological map of the Project area

The Project area is within the Truong Son or Phu Xam Xum – Truong Son textural zone, north of Ca River. The characteristics of this textural zone in terms of tectonic and fault system are described as follows:

Ma River grade-2 fault zone: Main fault follows a NW-SE direction. There are some auxiliary short faults nearly parallel to it.

Ca River Neotectonic grade-2 fault zone: From NE side of Xiengkhouang (Laos), via Muong Xen town, along each river section of Nam Mo River and Ca River and expand to the sea. Mainly it has NW-SE direction to sub- latitude.

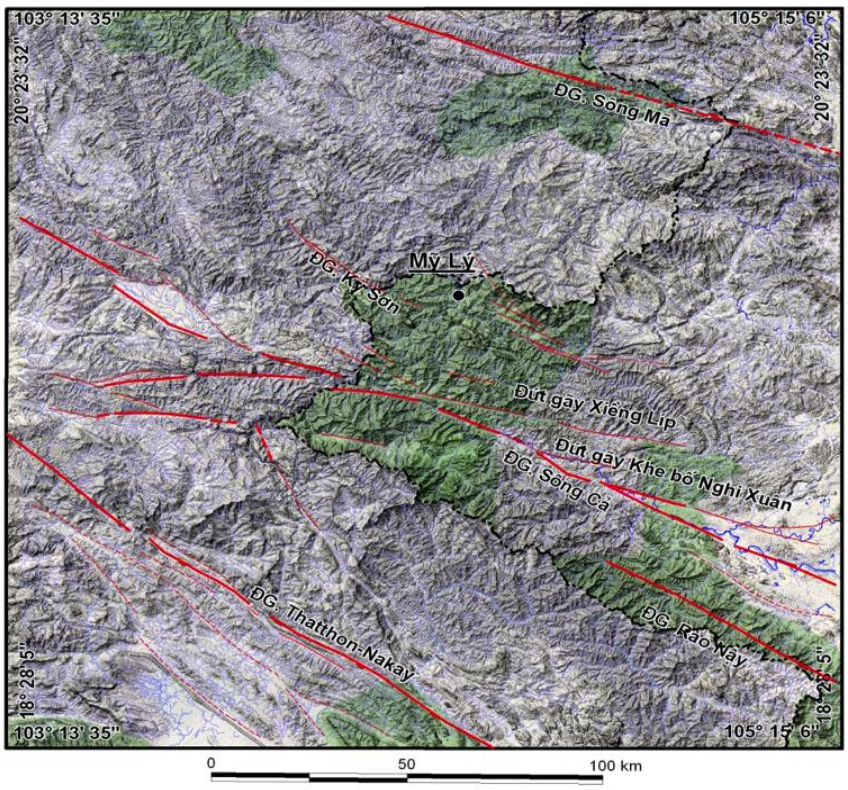
That Thon - Na Kay grade-2 fault zone is from Xiangkhoang to Quang Tri.

Khe Bo - Nghi Xuan grade-3 fault zone is separated from Ca River fault at Khe Bo with a NW-SE direction.

Rao Nay grade-3 fault zone in NW-SE direction, via Huong Son town to Cua Gianh seaport.

Ky Son grade-3 fault in nearly sub-latitude starts from the east side of Xiangkhoang to Ky Son, Vietnam and stops when meeting the Ca River fault.

Xieng Lip grade-3 fault is a branch of Ca River fault in sub-latitude.



Note:

Active faults (A: confirmed; B: assumed)

Proposed dam site

Figure 6.3 Textural characteristics and fault system in the Project area

The river bed is characterized by boulders, sand and pebbles, and uneven in thickness. Along the dam axis, thickness is up to 7- 8m. Strike of bedrock is mainly of 265-300∠50-80 and 50-60∠35-70. At the dam site, rock tends to dip towards U/S and inclining into left bank.

The proposed dam site is considered as the optimum location with favorable condition in terms of engineering geological conditions. The IIA rock zone can support the foundation at a design of 140m high concrete dam, where rock zone/layer to be excavated is not more than 10m. The permeability of overburden and bed rock also pass the design requirement.

The Project area also exhibits some tectonic broken zones, grade 3 faults, grade 4 faults as well as higher faults. The powerhouse base is founded on IIA hard rock (see next section for description). Since the soil/rock layer is weak and a failure zone exists, attention shall be paid to the stability of slopes and surface flow drainage into the foundation.

6.3.2 Geology at headworks area

The riverbed at the dam site is symmetrical and forms a V shape, with gentle slopes. Rocks are exposed on the two banks and terrestrial alluvium deposits are un-developed or very thin. The strata in the dam site area is characterized by a rather thin overburden, 2-4m in thickness and the bed rock is mainly moderate to coarse grain size sandstone, silt-sandstone, siltstone and containing limed induced sandstone.

<u>Covered layer</u>
Alluvial layer 1c: Mixture of boulder and pebble, gravel mixed with sand. Medium dense structure. The layer has its electric resistivity of about 100Ω.m. Seismic velocity rate is about 300-700m/s. The thickness is 2-4m. Originated from alluvial deposit (aQ).
Eluvial, deluvial layer and zone of intensively weathered rock (edQ+IA1): Clay-heavy loam, mixture of grit, fragments, in yellowish grey, yellowish brown, mixing with 5-40% grit, fragments of bedrock, quartz and boulders with dimension of 1-2m, very hard. Thickness is 2-5m.

<u>Bedrock</u>
Bedrock in the dam site area comprises of medium to coarse grain sized sandstone, brown silt/sand stone, locally containing lens of limed contaminated sand/siltstone. During mapping of the Project area, outcrop locations with specific petrographic composition were identified. The composition is not distinct displaying rock in specific lithological units to determining depth. Therefore, classification of weathered zones shall be done generally for types of rock.
Zone of strongly weathered rock (IA2): Weathered rock has been stained totally compared to fresh rock, weathered products are fragments which are poorly hard to soft weak, its color is similar to soil.

Weathered rock (IB): Rock is yellowish grey, brownish grey. Rock has been stained outside but the kernel may be still fresh. Rock is strongly fractured, joint's surface is normally opened and covered by oxidized Fe. Bearing capacity of rock is not regular.

Fractured rock (IIA): Rock is slightly weathered, fresh, almost not been stained or slightly stained. Rock is hard, shaped size, medium fractured. Durable strength of rock is not homogeneous.

Relatively intact rock (IIB): Rock is fresh, hard, shaped size. Rock is almost non-fractured, or slightly fractured.

6.3.3 Geology at waterway alignment

The waterway alignment is also along the fractured rock IIA foundation. At the powerhouse location, surface of the IIA rock is below the natural ground surface. The foundation of this component is almost completely located on IIA rock zone.

Due to the existence of weak soil/rock layer and a failure zone, attention shall be given to address the stability of slopes. A drainage will be constructed to divert surface flow into getting in the foundation works.

6.4 Erosion, landslides and slope stability

The geological mapping has shown that the slope stability in the reservoir area is mainly controlled by the geological structures, as would be expected. Steep areas with slopes in excess of 45 degrees will be at risk of erosion. Such areas can be observed within the Project DIA. There is however very thin overburden and rock foundation is considered stable.

6.5 Earthquake and hazard assessment

Based on the preliminary seismic investigation for the My Ly HPP[51], the fault lines within the Project area may generate an intensity 8 (MSK-64 scale) and trigger a 6.75 magnitude earthquake. The dam therefore has been designed to withstand the predicted earthquake magnitude, and the detail design will need to explicitly address this need.

Within the region, there are many tectonic fault zones that have shown seismic activities manifested at recent events such as: A 5.5 magnitude earthquake occurred in Ca River fault in 1957; a 4.6 and 4.7 magnitude in 2005 at the same Ca River faultline; and a 3.2 magnitude in Ky Son zone at Quy Hop in 2012.

6.5.1 Earthquake risk

The My Ly HPP (with maximum of water head of 100m) is located within the zone that is forecasted to possibly generate leve I-VIII tectonic earthquakes (on MSK-64 scale) with the maximum magnitude $M_{max} = 6 – 6.75$. Thus, when the early report on the earthquake-related stimuli for the dam was submitted, the preliminary research on seismic faults for My Ly HPP was carried out. Potential earthquake hazards to My Ly HPP and the condition of foundation in the damsite area have been studied. The design earthquake MDE is chosen with MCE of 10,000 years and M=6.75 of the seismic section SC2-3[a] (Imax = VIII -MSK-64), PGA (Amax) =0.2g = 196 cm/s^2 (because the peak ground acceleration (PGA) with the 950-year cycle of the seismic section QP3-2 is 0.1729).

The calculation of assummed increased stress for My Ly reservoir when impounding with the head of 100m has the following results δ_{xmax} within 6.9 bar; τ_{xymax} about 2.18 bar; d_{max} < 33.3cm.

Comparing with Hoa Binh reservoir: head 117m: δ_{xmax} =5.0 bar; τ_{xymax}=2.0 bar; d_{max} = 32.2cm (triggered earthquake M=4.3 - 4.8 had occured). The magnitude of the maximum triggered earthquake in this area is <5.3. The stress in fact leads to stone destruction and then earthquake in the upper layer of the crust without taking the lithosphere into consideration. It can change within 200-1000bar.

In comparison to these figures, the increased stress at the reservoir is quite small, about 1-2%. In addition, in accordance with the regional earthquake statistical results during the period before 2012 in the planed dam area and the new auxiliary area, there has been only one earthquake with the magnitude of 5.5. As a result, if earthquake happens in the reservoir area, it triggers less than the maximum earthquake magnitude of seismic section QP3-2.

Since the reservoir and damsite are core large (high dam wall) components of the Project, it would be necessary to study the potential of dam construction triggered earthquakes in detail.This should be done in the detailed design phase. A network of stations regularly monitoring seismic signals (rock deformation, landslide in the lake, electromagnetic fields, geothermal groundwater) would be required in order to follow the complex seismic changes to forecast earthquake risk

[51] Geology Institute – Institue of Science and Technology of Vietnam, December 2012

6.6 Hydrology and sediment transport

6.6.1 Hydrological features of Ca River

6.6.1.1 Topographic characteristics

The Ca River (Song Ca in Vietnamese while Nam Non in Lao) with an approximate length of 531km and an area of 27,200km^2 is a major river in mainland Southeast Asia. It originates from Mt Muong Mut in Lao PDR, flowing northeast - southeast crossing Lao PDR's Xiangkhouang Province, Vietnam's Thanh Hoa, Nghệ An, and Hà Tĩnh provinces and finally drains into the Gulf of Tonkin, on the North Central Coast of Vietnam. The coastal riverine lowlands have a relief features similar to those of the Red River - there's a wide stretches of alluvium and predominately with small undulation. There is a high population density in the river's delta region, particularly near Vinh city.

The Ca River, being a main river is fed by five tributaries namely Nam Mo, Giang, Hieu, Ngan Sau ang Ngan Pho rivers (see Table 6.9 and Figure 6.4). The highest point of the river is at 2620masl at Nam Mo tributary while its lowest point is at the river mouth in Cua Hoi at 0masl. It is bordered by the Chu and Bang river basins in the North, Mekong basin and Truong Son mountain range in the West, Gianh river basin in the South, and Bung river, Cam river basin and the South China Sea in the East. Of the total area of 27,200km^2, 17,730km^2 accounting for 65% is found in Vietnam. The rest (35%) belongs to Lao PDR territory.

Currently, there are existing reservoirs within the Ca River system and includes Ban Kok and Nhan Hac (in Hiue tibutary) and Thac Muoi (in Giang tributary). Along the main Ca River, there is the Khe Bo, Ban Ve , Nam Non 2, Lower Nam Non 1, Lower Nam Non and Nam Non. Some of these rivers are relatively proximal to the proposed Project and are therefore further discussed in section 11.5 Cumulative Impacts.

Table 6.9 Ca River and tributary system

Name of river	Length (km)	Catchment area (km^2)	Highest peak (m)	Slope (%)
Ca (main river)	531	27,200	1800-2000	18.3
Tributaries				
Nam Mo	173	3,970	2620	25.7
Giang	77	1,050	-	17.2
Hieu	228	5,340	2452	13
Ngan Sau	135	2,060	1047	28.2
Ngan Pho	70	1,070	1136	32.5

Source: http://hywr.kuciv.kyoto-u.ac.jp/ihp/riverCatalogue/Vol_06/VietNam-9_Ca_river.pdf

Figure 6.4 The Ca River Catchment

6.6.1.2 Vegetation cover

Vegetation in Ca River basin is quite diverse. The basin area covered by forests accounts for more than 50% mostly lying in Lao PDR's territory and the mountainous districts of Nghe An in Vietnam. The forests in Lao PDR have been protected and has limited human impacts mainly due to their small population and relatively slower economic activities. The forest area in Vietnam's territory decreases fast due to high population growth in the mountainous areas. Though the forest area declines, Ca River still plays a significant role in regulating flows in the basin.

6.6.1.3 River discharge

The annual mean flow upstream of Ca River reaches 20l/s per km^2 while 25-30l/s per km^2 at the downstream area. The maximum annual mean flow is recorded in Ngan sau and Ngan pho river basins (downstream of Ca River) at over 70l/s per km^2. The My Ly HPP has a total catchment area of 7,100km^{2,} with a mean annual flow of 107m^3/s.

6.6.1.4 Annual flow

Annual flow in the catchment is divided into two distinct seasons, the flood and dry. The hydrological study carried out in Ca River is discussed below.

To determine the annual flow of Ca River within the Project's catchment area, available records from Muong Xen, Cua Rao, Thach Giam and Khe Bo gauging stations (Figure 6.5) were used and is shown in the table below:

Table 6.10. Available data sets used to determine annual flow at MyLy damsite

Parameters	Moung Xen gauging station	Cua Rao gauging station	Thach Giam gauging station	Khe Bo gauging station
Water level	1969 -2011	1959 -1988	1984 -2011	1994-1997
Water discharge	1969 -2011	1959-1976		1994-1997

Source: PECI, 2015, FS for My Ly HPP

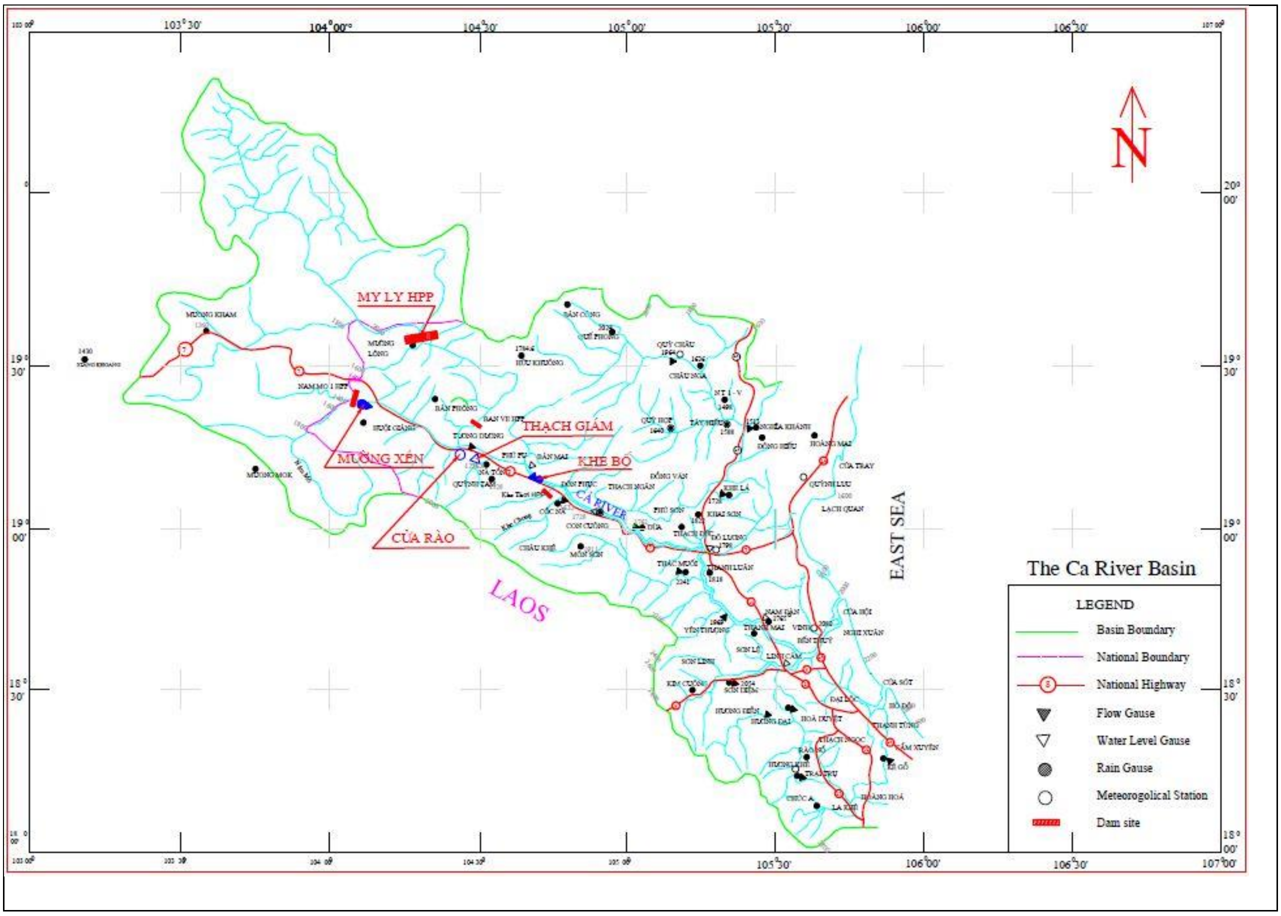


Figure 6.5 Locations of the Weather Stations

Annual flow at My Ly Hydropower Project site was estimated using the flow balance method following the formula:

$$Qmly = Qcrao - (Qmxen + Qkg1) \qquad (1)$$

Where:

Qmxén is the annual flow at Muong Xen hydrological station from the period 1960-2009.

Qkg1 is the discharge at middle area from Muong Xen station to Cua Rao station and My Ly site, defined by the similar catchment. Catchment at the middle area of Cua Rao – Khe Bo is taken to be a similar one through the equation:

$$Qkg1 = Qkg2 \frac{Fkg1}{Fkg2} * \frac{Xkg1}{Xkg2}$$

Where:

Qkg1 = Qcr - (Qmx+Qm.ly); Qkg2=Qkb-Qcr

Fkg1 = Fcrao-(Fmx+Fm.ly), Fkg2=Fkbo-Fcrao

Xkg1, Xkg2 are average rainfall of middle area (from Muong Xen station to Cua Rao station and My Ly site) and of middle area (from Cua Rao gauging station to Khe Bo gauging station).

Rainfall at the middle area is determined from four rainfall gauging stations (Muong Xen, Ban Phong, Huoi Giang, Cua Rao) and annual rain iso map. Its results are Xkg1 = 1450mm, Xkg2 = 1420mm.

Qcr is the annual flow at Cua Rao hydrological gauging station.

Qkb is the annual flow at Khe Bo hydrological gauging station.

Result from equation 1 (annual flow at Mỹ Lý site) for the period 1960-2009 is Qmlý = 107 m³/s.

Combining with operational document of Bản Vẽ reservoir from period 2010-2011, the flow series arriving to Mỹ lý damsite for period 1960-2011 is defined to be Qmlý = 107.2 m3/s.

Annual flow corresponding to various design frequencies are listed in Table 6.11 below:

Table 6.11 Annual flow at the My Ly dam site

Damsite	Qo (m^3/s)	Wo (10^6m^3)	Cv	Cs	Qp(m^3/s)		
					10%	50%	90%
My Ly	107.2	3381	0.27	2Cv	145.5	104.6	72.1

Source: PECI, 2015, FS for My Ly HPP

Note: **Qo (m^3/s)** - Annual mean discharge; **Wo (10^6m^3)** - Annual mean total runoff volume; **Cv** - Coeficient of variation; **Cs** - Coeficient of deviation and **Qp(m^3/s)** - Discharge corresponds to the designed frequencies.

6.6.1.5 Flood flow

To determine the flood flow at My Ly HPP, same data sets were used from the same gauging stations above.

Using the formula: $Q_{maxMyLy} = Q_{maxPCua\ Rao} \times (F_{MyLy} / F_{Cua\ Rao})^{1-n}$

Where:
Q_{max} is the maximum discharge
Q_{maxp} – the maximum discharge corresponds to the designed frequency;
F – catchment area;
n – 0.452, constant number taken from the Vietnamese Meteo-Hydrology Atlas (Atlas KTTV VN).

Based on the analysis done results of the maximum peak flood discharge at My Ly damsite are listed in Table 6.12.

Table 6.12 Design flood discharge, My Ly HPP

Damsite	Catchment (km^2)	Qmaxp (m^3/s)					
		0.02%	0.1%	0.5%	1%	5%	10%
Cua Rao	12,800	16,200	11,995	8,565	7,292	4,757	3,808
My Ly	7,100	11,730	8,680	6,200	5,280	3,440	2,760

Source: PECI.2015. Feasibility Study for My Ly HPP

Note: Qmaxp (m^3/s) - Maximum discharge corresponds to the designed frequencies

6.6.1.6 Contribution from downstream catchments to the flow in the Ca River

For use in the hydrological analysis, both for technical and environmental purposes, watersheds for the different discharge gauging stations, the proposed dam site, and most of the larger and more important tributaries have been delineated.

In several of the tributaries, due to absence of actual measurements, discharge were modelled to provide input in this ESIA study, especially for the evaluation and calculation of the residual flow downstream of the proposed dam site and power station outlet.

Table 6.13 presents the various tributaries located in villages downstream of the proposed dam and their discharge contribution.

Table 6.13 Tributaries downstream of the My Ly dam site and their discharge contribution

No	Tributaries located in downstream*	Annual discharge Qo (m3/s)
	At Mỹ Lý Dam	107.2
1	At Xàng Trên Village	0.53
2	At Yên Hòa Village	1.37
3	At Xiềng Tắm Village	3.17
4	At Xốp Tụ Village	0.75
5	At Xốp Tược Village	0.44
6	At Hòa Lý Village	0.29
7	At Tổm trên Village	0.09
8	At Piêng Mựn Village	1.60
9	At Xén My Village	1.33
10	At Tổm Village	0.06
11	At Cha Luân Village	0.27
12	At Xốp Pe Village	0.12
13	At Luân Mai Security Post	1.83

*Note: The tributaries are associated with settlements or a landmark, thus named accordingly.

Based on the table above, at the Lauan Mai Security Post, a total of 118.99m^3/s is estimated to currently feed unto the Ban Ve HPP.

6.6.2 Sedimentation

Due to the absence of a robust data set from a single gauging station, sediment flow at the damsite was estimated using a number of available data from various gauging stations (see Figure 6.5) proximal to the proposed damsite locations and are presented below:

Table 6.14. Available data set used for sedimentation analysis

Parameters	Cua Rao gauging station	Thach Giam gauging station	Khe Bo gauging station
Water level	1959-1988	1984 -2011	1994-1997
Water discharge	1959-1976		1994-1997
Sediment load	1959-1976		1994-1997

From the above empirical data sets, interpolation were carried out to construct new data points, by establishing the relationship between water discharge and sediment load among the gauging stations at various period. Note that analysis was only carried out until 2009 because a dam near Khe Bo gauging station (also called the Khe Bo dam) started to fill up in 2010, and therefore data sets beyond 2009 (e.g. water level, sediment load) has been altered by the impounding activities at that period, and considered not useful for this exercise.

From the mean daily discharge recorded at Cua Rao station from 1977-2009 (data set reconstructed from interpolation), the daily sediment load from this period is estimated using the equation below.

$$Qs = 0.0224 * Q^{2.1574}$$

In which: Qs is sediment load (ton/day)
Q is water discharge (m^3/s)

Based from this exercise The annual sediment load at Cua Rao station from 1961-2009 was estimated to be: R = 89.7 kg/s with turbidity at ρ=386.1 g/m^3.

The total sediment load at the reservoir every year is estimated using the equation:

$$W = W_{ll} + W_{dđ}$$

In which:

- Volume of suspended sediment (W_{ll}) is estimated by equation

$$W_{ll} = Ro * T$$

+ Ro is discharge of mean annual suspended sediment discharge (kg/s).
+ T is period of time in 1 year estimatedin seconds ($T = 31.54*10^6$).

- Volume of bed load ($W_{dđ}$) is estimated as 40% suspended load.

(β_{ll} is density of suspended load = 1.182 ton/m^3)

($\beta_{dđ}$is density of bed load = 1.554 ton/m^3).

Results of the sediment estimation are given in Table 6.15

Table 6.15 Estimated total annual sediment at My Ly dam site

Site	Qo (m^3/s)	ρ (g/m^3)	R (kg/s)	W_{ll} ($10^6 m^3$/year)	$W_{dđ}$ ($10^6 m^3$/year)	W ($10^6 m^3$/year)
My Ly	107.2	386.1	41.4	1.104	0.336	1.44

Note: **Qo (m^3/s)** - Annual mean discharge; **W_{ll} ($10^6 m^3$/year)** - Volume of suspended sediment; **$W_{dđ}$ ($10^6 m^3$/year)** - Volume of bed load; **W (106m^3/year)** - Total sediment load volume at the reservoir every year.

The sedimentation in Ca River basin in general and the sedimentation at the construction area in particular are smaller than in other basins in the North. The sedimentation declines from upstream to downstream. The sedimentation has changed in time and space. Analysis shows that sedimentation has changed in years since 1988. The buffer surface of the basin has been heavily exploited that erosion has increased over time.

Sedimentation process of the My Ly reservoir was assessed in different scenarios (e.g., FSL/MOL alternatives and without flood storage). Results of the study showed that: after 30 years of operations, total sediment volume can reach up to 28.2 million m^3, occupying about 3.06% of the reservoir storage. After 50 years of operation, total sediment volume will increase to 46.4 million m^3, occupying about 5.05% of the reservoir storage.

6.6.2.1 6.6.2.1 Back water curve

The back water curve (see Figure 6.6) was determined based on the FSL/MOL of the dam operation. Different scenarios were assessed based on the various discharges at the reservoir including high floods corresponding to a probability of P=5%. Cross secion of the river from the dam site up to the end of the reservoir was measured to determine the characteristics of the whole river stretch.

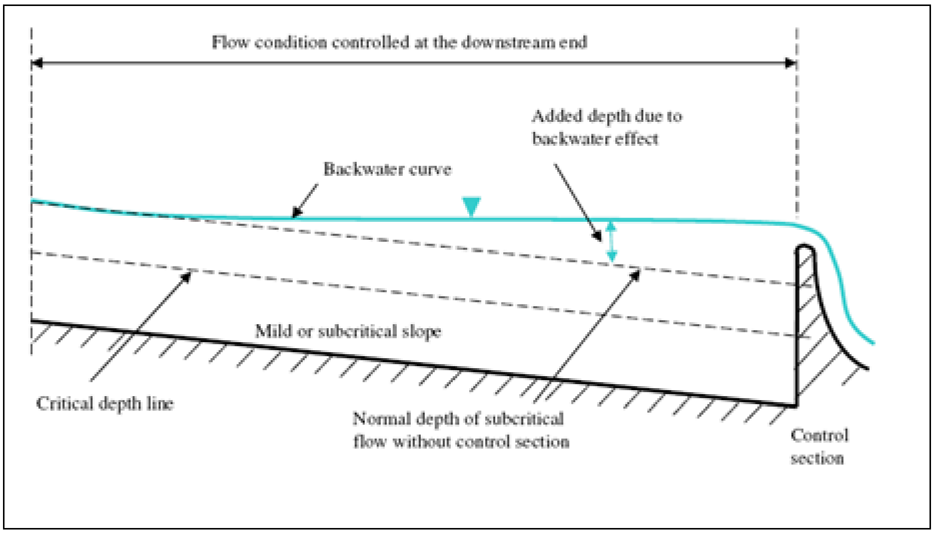


Figure 6.6 Schematic diagram of the back water curve

Table 6.16 shows the sediment estimate over the years once the Project is operational. Actual sediment measurements were taken at Ban Ve HPP and modeled to determine the sediment transport of the proposed Project. Based on the table, on the 50th year of operations, the reservoir is estimated to have been filled up by 9.15%.

Table 6.16 Sediment estimates in the My Ly reservoir

No.	Year	Volume of sediments in My Ly reservoir ($10^6 m^3$)			Percentage of filled volume in My Ly reservoir (%)		
		Total volume	Dead volume	Active volume	Total volume	Dead volume	Active volume
1	1	0.862	0.56	0.302	0.17	0.21	0.13
2	10	9.17	5.3	3.87	1.81	1.99	1.61
3	20	18.6	10.5	8.08	3.67	3.93	3.37
4	30	28.2	15.7	12.5	5.56	5.88	5.21
5	40	36.7	20.4	16.2	7.24	7.64	6.75
6	50	46.4	24.6	21.8	9.15	9.21	9.08
7	60	54.9	29.2	25.7	10.83	10.94	10.71
8	70	64.7	33.3	31.4	12.76	12.47	13.08
9	80	73.1	38.1	35	14.42	14.27	14.58
10	90	83	42.4	40.7	16.37	15.88	16.95

No.	Year	Volume of sediments in My Ly reservoir ($10^6 m^3$)			Percentage of filled volume in My Ly reservoir (%)		
		Total volume	Dead volume	Active volume	Total volume	Dead volume	Active volume
11	100	91.4	46.9	44.5	18.03	17.57	18.54
Volume of the reservoir		**391.9**	**197.8**	**194.1**	**100**	**100**	**100**

Source: PECI, 2015 FS for My Ly HPP

6.7 Flood risk assessment

A flood frequency analysis has been performed on annual maximum daily average flood values at the gauging station Cua Rao along the Ca River. Annual maximum values are shown in Table 6.17.

6.7.1 Flooding

There is a history of flooding in Ca River, partly attributed to its location, where the Red River Delta and North Central Coast are. The rainy season is from May to October, when flooding occurs. Low pressure areas/ typhoons that bring heavy rains results in large scale floods nearly all over the basin such as the floods in September 1978, October 1988, and more recently on the 25th of June 2011. The flood in 25 June 2011 had the highest peak in Ca River at Qmax = 3,680 m^3/s recorded in Muong Xen Station, 1.8 times higher than the largest flood recorded in 2005 (Qmax = 2,050 m^3/s). At the same event, Ban Ve HPP recorded Qmax = 3200 m^3/s at the damsite. Bản Vẽ reservoir had stored water to the height of 168.25m while its FSL is at 200m pointing to the dampening of the flood which did not require Ban Ve HPP to release water.

6.7.2 Flood peak volume

The flood peak volume of My Ly dam (Qmaxp_mlý) was calculated using the data at Cua Rao station, following the formula below:

$$Q\max\ p\_mly = Q\max\ p\_cr\left(\frac{Fmly}{Fcr}\right)^{1-n} \quad (2)$$

Where:

Fmly: basin area reaching My Ly dam;

Fcr: basin area reaching Cua Rao Meteorological-hydrological station;

Qmaxp_cr: design flood volume at Cua Rao station;

n – the coefficient of flood peak modulus extraction in area, n=0.452 in this document in accordance with the Atlas of the General Department of Hydrometeorology.

The chain of flood volume peak at Cua Rao is 51 years from 1960 to 2009, in which the period of 1960 and 1976 was measured, the period 1977-1988 was restored using the line Q = f(H) that the station compiled using the actual measured water levels in the period 1989-2009, and the one in 2011 was restored by using the data on Khe Bo.

Since Ban Ve reservoir did not release water during the June 2011 flood event, and in order to ensure safety in calculating the design flood for the My Ly dam, the volume of the water stored in Ban Ve reservoir was added to the flood volume peak at Khe Bo. The monitoring data at Ban Ve in 2010 was insufficient so there was no calculation. The frequencies of design flood peaks at Cua Rao station are computed using the Kritski-Menken method and the results are indicated in the table below (Table 6.17).

Table 6.17 Design flood volume at My Ly damsite

Dam	Catchment (km^2)	Qmaxp (m^3/s)						
		0.01%	0.02%	0.1%	1%	2%	5%	10%
Cua Rao	12,800	18,327	16,200	11,995	7,292	6,150	4,757	3,808
My Ly	7,100	13,270	11,730	8,680	5,280	4,450	3,440	2,760

Source: PECI, 2015, FS pp 19-20; Note: Qmaxp (m^3/s) - Maximum discharge corresponds to the designed frequencies

6.7.3 Design flood volume

The total design flood volume is designed based on the chain of total flood volumes measured during the period 1960-1986 at Cua Rao station in order to identify the relationship between flood peak and flood volume in the periods of 1, 3, 5, 7 and 9 days at Cua Rao station. The aforementioned relations are indicated by the equations below and Table 6.18:

$$W_{1max} = 0.0773*Qmax + 1.3384; \qquad R^2 = 9944$$

$$W_{3max} = 0.1529*Qmax + 55.472; \qquad R^2 = 9592$$

$$W_{5max} = 0.1865*Qmax + 133.24; \qquad R^2 = 8864$$

$$W_{7max} = 0.2099*Qmax + 214.98; \qquad R^2 = 8140$$

$$W_{9max} = 0.2447*Qmax + 265.57; \qquad R^2 = 7530$$

Table 6.18 Design flood volume, My Ly HPP

Dam	P (%)	Qmaxp m^3/s	W1	W3	W5	W7	W9
			10^6m^3				
My Ly Flv = 7100 km^2	0.01	13270	1026	2084	2608	3000	3513
	0.02	11730	907	1849	2321	2677	3136
	0.1	8680	671	1383	1752	2037	2390
	0.5	6200	479	1003	1290	1516	1783
	1	5280	408	863	1118	1323	1558
	2	4450	344	736	963	1149	1354
	5	3440	266	581	775	937	1107
	10	2760	213	477	648	794	941

Source: PECI, 2015, Feasibility Study pp 21

6.7.4 Design flood process

The typical flood is selected among flood events in 1963, 1971 and 1973 at Cua Rao station to establish models. These flood events are single floods having one peak and lasting for about 9 days. The peak and total flood volumes are the largest recorded in 51 years.

6.7.5 Flood flow for construction

According to the categorization of hydrological seasons at the damsite, dry season lasts from November to June. In order to calculate construction floods, the monthly peaks at Cua Rao station (Long 104^0 25'00" Lat 19^0 17' 00)" within 50 years were used. Floods in the period of 1960-1988 were measured and restored based on the water levels at Cua Rao station. The floods during the period 1989 -2009 were restored at Khe Bo station.

In order to design the temporary diversion works, the maximum discharges commensurate the frequencies of 5% and 10% in each month of dry season were measured and indicated in Table 6.19 below:

Table 6.19 River discharge (m^3/s) during construction phase (dry season) My Ly HPP

Month	Discharge Frequency	
	5%	10%
January	113	104
February	94.8	86.7
March	136	115
April	146	129
May	625	480
June	1296	998
Nov	501	391
Dec	167	150
Nov-June	1362	1065
Nov-May	736	581
Nov- April	503	393
Dec - June	1340	1040
Dec - May	632	486
Dec - April	174	159

Source: PECI, 2015, Feasibility Study of My Ly HPP

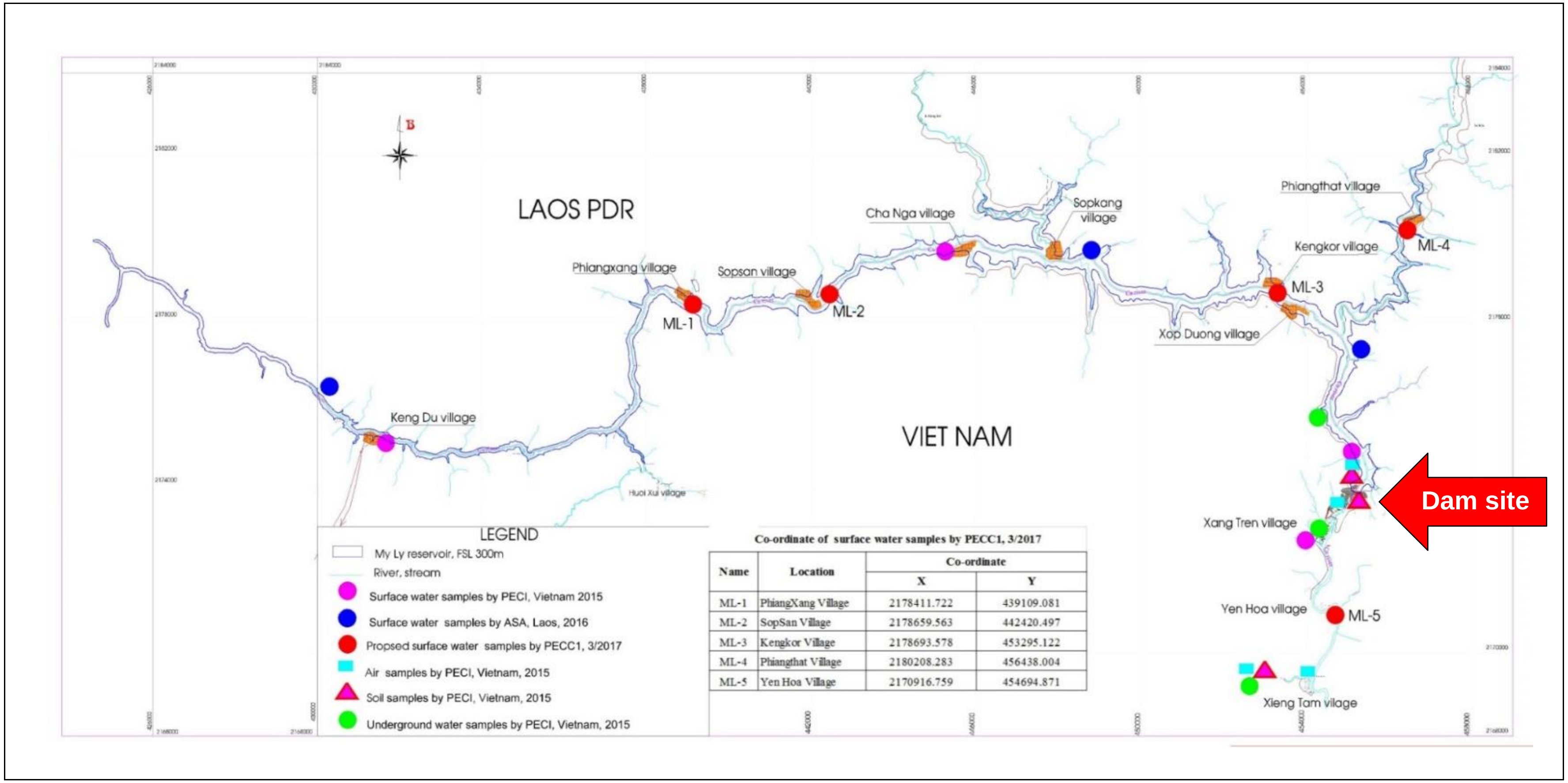
6.8 Water Quality

6.8.1 Surface water quality

The water quality of Ca River within the stretch of the Project AI has no indication of industrial pollution, except the tributaries coming from the Laos territory where elevated turbidity is visual because of the gold mining activities upstream of the river. Most of physo-chemical properties and heavy metal concentrations conform to the national water standards[52]. Total Suspended Solids (TSS) showed a slightly elevated levels although still within the allowable limit. Elevated levels of coliform against the national water standard was also reported. This is expected when domestic sewage is haphazardly disposed off along the rivers and stream. In addition, raising of animals along the river banks are also common at the Project site.

Three sampling events have been carried out to determine the water quality along the river stretch. Figure 6.7 shows the monitoring stations of the three sampling regime.

[52] National Technical Standard on Surface Water QCVN 08:2008/BTNMT



Name	Location	Co-ordinate	
		X	Y
ML-1	PhiangXang Village	2178411.722	439109.081
ML-2	SopSan Village	2178659.563	442420.497
ML-3	Kengkor Village	2178693.578	453295.122
ML-4	Phiangthat Village	2180208.283	456438.004
ML-5	Yen Hoa Village	2170916.759	454694.871

Figure 6.7 Location of water quality sampling stations for the three sampling events

Plate 6.1 Water sampling

Table 6.20, Table 6.21 and Table 6.22 show the summary results of the water sampling taken in December 2015 (both Vietnam and Laos side), in April/May 2016 (limited to Laos side) and March 2017 (Laos and Vietnam) to evaluate the water quality at Ca River (also see Plate 6.1). Figure 6.7 shows the location of the water quality sampling stations taken in both sampling events.

Table 6.20 Properties of surface water samples (December 2015)

Property	Unit	Sampling locations				QCVN 08:2008/BTNMT	
		NM1	NM2	NM3	NM4	A2[53]	B1[9]
		Mai stream in Laos	Ca River in Vietnam	0.9km upstream of damsite	Ca River at Xieng Tren village		
pH	-	7.4	7.1	7.4	7.3	6-8.5	5.5-9
DO	mg/l	6.15	6.0	6.1	6.56	≥ 5	≥4
TSS	mg/l	44.6	20	36.3	54	30	50
COD	mg/l	6.0	4.5	4.7	5.2	15	30
BOD5	mg/l	4.7	3.13	3.26	4.3	6	15
Amonnia	mg/l	0.02	0.04	0.024	0.04	0.2	0.5
Nitrite	mg/l	0.01	0.01	0.01	0.01	0.02	0.04
Nitrate	mg/l	0.26	2.61	3.6	3.72	5	10
Phosphate	mg/l	0.01	0.02	0.02	0.01	0.2	0.3

[53] QCVN 08:2008 Water use classification (sic):

A1 – Use for the purpose of supplying the running water and other purposes as:A2, B1 B2

A2 – Use for the purpose of supplying the running water after treating, preserving the aquatic life and other purposes as: B1 B2

B1 – Use for the purpose of irrigation and other purposes as: B2

B2 – Use for the purpose of river traffic and other purposes required the low quality water

Property	Unit	Sampling locations				QCVN 08:2008/BTNMT	
		NM1	NM2	NM3	NM4	A2[53]	B1[9]
		Mai stream in Laos	Ca River in Vietnam	0.9km upstream of damsite	Ca River at Xieng Tren village		
CN-	mg/l	UD	UD	UD	UD	0.01	0.02
As	mg/l	UD	UD	UD	UD	0.02	0.001
Zn	mg/l	UD	UD	UD	UD	1.0	0.05
Hg	mg/l	UD	UD	UD	UD	0.001	0.05
Total oil and lubricants	mg/l	UD	UD	UD	UD	0.02	1.5
E.Coli	MPN/100 ml	11	24	54	12	50	100
Total Coliform	MPN/100 ml	226	312	456	373	5000	7500

Source: Volume II, Annex 2; Note: UD – Undetected

Table 6.21 Results of the water quality sampling in My Ly HPP – Laos PDR, April/May 2016

Parameters	Unit	Sampling locations			Lao PDR No 2734[54]
		WQNL1	WQNL 2	WQNL 3	
		About 1km upstream of Vietnam – Lao border	*Sopsan village, Lao PDR*	*Phiang Hong village, Lao PDR*	
pH	-	7.25	7.36	7.36	6.5-8.5
Conductivity	µs/cm	293	262	362	<1200 µs/cm
Turbidity	NTU	50	47	7	<10 NTU
Color	TCU	-	-	-	<25 TCU
Iron (Fe)	mg/l	1.96	1.89	0.15	<1 mg/l
Manganese (Mn)	mg/l	0.124	0.137	0.022	<0.4 mg/l
Fluoride (F)	mg/l	0.33	0.36	0.12	<1.5 mg/l
Nitrate (NO_3)	mg/l	4.5	3.1	2.7	<50 mg/l
Nitrite (NO2)	mg/l	0.023	0.012	0.016	<3 mg/l
Arsenic (As)	mg/l	0.000	0.000	0.000	<0.05 mg/l
Total hardness	mg/l	60	60	60	<300 mg/l

[54] PDR No.2734/PMO MONRE – Agreement on Environmental Quality Standards of Lao PDR, 2009, amended 2010

Parameters	Unit	Sampling locations			Lao PDR No 2734[54]
		WQNL1	WQNL 2	WQNL 3	
		About 1km upstream of Vietnam – Lao border	*Sopsan village, Lao PDR*	*Phiang Hong village, Lao PDR*	
Total Coliform	mg/l	**35**	**31**	**9**	<10 mg/l
Fecal Coliform	mg/l	-	-		<10 mg/l
Chloride (Cl_2)	mg/l	-	-		<0.2 mg/l

Source: Department of Hygiene and Health Promotion, National Centre for Environmental Health and Water Supply, Ministry of Health, Laos June 2016

Table 6.22 Results of the water quality sampling in My Ly HPP, March 2017

No.	Parameters	Unit	Sampling locations					QCVN 08:2008/ BTNMT Column A2
			ML1	ML2	ML3	ML4	ML5	
			Phiangxang Village, Lao DPR	Sopsan Village, Lao DPR	Kengkor Village, Lao DPR	Phiangth village, Lao DPR	Yen Hoa Village, My Ly Commune	
1	pH	mg/l	6.86	6,89	6,76	7,52	7,57	6 – 8.5
2	BOD_5 (20°C)	mmg/l	0.96	0,96	1,16	1,04	0,88	6
3	COD	mmg/l	1.42	1,38	1,72	1,41	1,25	15
4	Dissolved Oxygen	mmg/l	6.3	6,4	6,0	6,4	6,3	≥ 5
5	TSS	mmg/l	18	15	14	14	12	30
6	Ammonia	mmg/l	<0.01	0.03	0.08	0.16	0.11	0.3
7	Chloride (Cl-)	mmg/l	1.62	1.62	1.45	1.62	1.45	350
8	Flouride (F-)	mmg/l	<0.05	<0.05	<0.05	<0.05	<0.05	1.5
9	Nitrite	mmg/l	<0.01	<0.01	<0.01	<0.01	<0.01	0.05
10	Nitrate	mmg/l	0.04	0.03	0.10	<0.01	<0.01	5
11	Phosphate	mmg/l	<0.01	<0.01	<0.01	<0.01	<0.01	0.2
12	Cyanide (CN-)	mmg/l	<0.01	<0.01	<0.01	<0.01	<0.01	0.05
13	Arsenic (As)	mmg/l	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.02
14	Zinc (Zn)	mmg/l	0.003	0.004	0.006	0.005	0.005	1.0
15	Manganese (Mn)	mmg/l	<0.01	<0.01	<0.01	<0.01	<0.01	0.2
16	Mercury Hg)	mmg/l	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.001

No.	Parameters	Unit	Sampling locations					QCVN 08:2008/ BTNMT Column A2
			ML1	ML2	ML3	ML4	ML5	
			Phiangxang Village, Lao DPR	Sopsan Village, Lao DPR	Kengkor Village, Lao DPR	Phiangth village, Lao DPR	Yen Hoa Village, My Ly Commune	
17	Iron(Fe)	mmg/l	<0.01	<0.01	<0.01	<0.01	<0.01	1
18	Oil and grease	mmg/l	<0.1	<0,1	<0,1	0,2	0,2	0.5
19	Total coliform	mmg/l	180	210	240	360	420	5000
20	E.coli	mmg/l	2	5	4	18	14	50

6.8.2 Ground water quality

Drinking water is sourced from creeks because water wells are not common in the area. Samples for groundwater were therefore taken from three mountain creeks. Table 6.23 summarises the water quality results from the three sampling stations.

Table 6.23 Result of ground water sampling, August 2015

Parameters	Unit	Sampling location			QCVN 09:2008[55]
		NN1	NN2	NN3	
		Mai stream, Vietnam	Xieng Tren village, Vietnam	Tom stream, Vietnam	
pH	-	7.5	7.4	7.5	5.5-8.5
Hardness	mg/l	92	105	120	500
TDS	mg/l	116	115	135	1500
COD	mg/l	0.07	0.12	0.26	4
Flouride	mg/l	UD	UD	UD	1
Cyanide (CN-)	mg/l	UD	UD	UD	0.01
As	mg/l	UD	UD	UD	0.05
Cd	mg/l	UD	UD	UD	0.005
Fe	mg/l	UD	UD	UD	5
E.Coli	MPN/100ml	2	1	1	Nil
Total coliform	MPN /100ml	11	21	16	3

Source: Center of Environmental Technology Development and Study, August 2015

Note: UD - undetected

The results showed that all the physical and chemical parameters which were tested for drinking water quality at the Project site fall within the limits set by the GoVN, GoL and WHO

[55] National Technical Regulation on Underground Water QCVN 09:2008/BTNMT

(see section on Aquatic Biology). COD index is low indicating that the groundwater is free from organic pollutants.

However, all the samples were contaminated with coliform bacteria which should be 'nil' to be considered being suitable for drinking water. The presence of faecal coliform in all samples indicates that contamination source is human excreta. The samples which showed biological aspects of higher levels occurred right downstream of the settlements/villages suggesting that sanitation is lacking.

6.8.3 Quality of soil environment

The Project area consists of the following soil groups[56]:

(1) Sediments – common type of soil formed and distributed along rivers and streams. This type of soil is suitable for planting crops and fruit trees.

(2) Feralite soil – this type of soil includes red-brown soil formed and developed from fine grain purple shale and is alkaline. The content of the top soil layer is rich and therefore suitable for agriculture and foresty. This is widely distributed on on hillsides.

PECI in co-operation with Center of Environmental Technology Development and Study, Union of Science and Technique Association of Vietnam took soil samples from three locations within the Project AI.

Results of the soil samples show low humus content in soil indicating no pollution. Soil samples taken at station D3 (Tom stream) are commonly distributed in semi-drought tropical zone. The two soil samples taken along the river are classified as clay soil.

Table 6.24 shows the results of the soil sampling carried out at the Project AI and compared against the national standards for soil quality (QCVN 03:2008/BTNMT) Results showed that all parameters are below its value limits.

Table 6.24. Properties of soil samples

No.	Parameters	Unit	Location			QCVN 03: 2008/BTNMT[57]
			Đ1 Upperstream of damsite	Đ2 Xieng Tren village	Đ3 Rock quarry	
1	pH	-	6.8	6.5	6.7	-
2	As	mg/kg	0.23	0.37	0.15	12
3	Cd	mg/kg	0.12	0.06	0.12	2
4	Cu	mg/kg	6.38	12.34	11.43	50
5	Zn	mg/kg	11.5	25.2	22.36	200

Source: Center of Environmental Technology Development and Study, August 2015, in PEC1 FS, 2015

[56] Document of New Rural Planning of My Ly commune (2015)

[57] QCVN 03:2008/BTNMT - National Technical Regulation on allowable limit of heavy metals in soil

6.9 Air quality

Project implementation and its associated activities such as drilling, blasting, quarrying, excavation works and the movement of small and heavy vehicles for the transportation of construction materials, will likely cause potential impacts in terms of ambient air.

To evaluate the baseline environmental quality at the Project AI, PECI in co-operation with the Environment and Clean Production Center, Union of Science and Technique Association of Vietnam conducted air quality sampling in the Project AI in August 2015 (Figure 6.7). The results gained from the sampling exercise were used to evaluate, assess, and forecast potential changes in air quality during Project construction phase.

Air quality at the Project AI is typical of a rural environment and no indication of air pollution. Among the three established air quality stations, two sampling sites, the village of Xang Tren and upstream of the proposed dam site, where traffic activities are still limited, air quality is clean and way below the national air standards (Table 6.25). At station KK3 where the proposed quarry is air quality parameters were all within the allowable limit of QCVN 05:2013.

Levels of total suspended particulates (TSP) ranges from 0.065-0.146 mg/m^3, lower than the allowable limit of 0.3 mg/m^3 for a 24-h averaging period. SO_2 ranges from 0.028-0.041mg/m^3; CO ranges from 1.07-1.623mg/m^3 and NO_x at 0.012-0.026mg/m^3 and are all lower than their respective allowable limits (QCVN 05:2013/BTNMT).

Table 6.25 Results of the air sampling, My Ly HPP, August 2015

Parameters	Unit	Sample symbol/Results			QCVN 05:2013/BTNMT[58]	WHO Ambient Air Quality Guidelines[59]
		KK1 0.1 km upstream of damsite	KK2 0.1km downstream of dam site at Xieng Tren village	KK3 Quarry site (Xieng Tam village		
Total Suspended Particulates (TSP)	mg/m^3	0.065	0.066	0.146	0.3	50*
CO	mg/m^3	1.07	1.213	1.623	30	100**
SO_2	mg/m^3	0.041	0.037	0.028	0.35	20*
NOx	mg/m^3	0.012	0.022	0.026	0.20	40***
Pb	mg/m^3	UD	UD	UD	1.5	

Source: Center of Environmental Technology Development and Study, August 2015, in PEC1 2015
NOTE: UN – undetected; *24hr averaging; **8hr daily maximum; ***one year averaging

6.10 Noise and vibration

Background noise in the Project AI is low and inherent to a rural area where population density is low with limited economic activity (e.g., limited traffic noise, absence of industrial and/or commecial activities).

[58] QCVN 05: 2013/BTNMT- National Technical Specification on quality of ambient air

[59] World Health Organization (WHO).Air Quality Guidelines Global Update, 2005

Levels of noise recorded at the three sampling sites ranges from 52.3 to 55.4dBA lower than allowable standard of 70 dBA according to the National Technical Regulation on Noise QCVN 26:2010/BTNMT. Table 6.26 below shows the comparison of the recorded levels (daytime records) against local noise standards and IFC daytime and night time limits.

Table 6.26 Sound levels (dBA) recorded in the Project AI

Location	Recorded levels (dBA)
KK1- Upstream of damsite	52.3
KK2 - Xieng Tren village	55.4
KK3- Quarry	52.5
QCVN 26:2010/BTNMT[60]	70
IFC Daytime limit[61]	55 70
IFC Night time limit[62]	45 70

Source: EIA Report. PECI. 2015, Field survey August 2015 by Center of Environmental Technology Development and Study

[60] QCVN26: 2010/BTNMT - National Technical Specification on Noise; 70 dBA (6a.m. to 21:00) in normal zone.

[61] IFC Noise level guidelines: Daytime (07:00 to 22:00) 55dBA for residential, institutional and educational while 70dBA for industrial and commercial receptors

[62] IFC Noise level guidelines: Nighttime (22:00 to 07:00) 45dBA for residential, institutional and educational while 70dBA for industrial and commercial receptors

CHAPTER 7: BIOLOGICAL ENVIRONMENT

7.1 Natural Resources in Vietnam and Lao PDR

7.1.1 Vietnam

Vegetation and land cover. Vietnam has experienced severe deforestation through the late 1980s; forest area shrank from 43.2% in 1943 to 28.8% in 1990 and then gradually recovered due to a change in forest policy and a drive for massive tree plantation[63]. As of December 2011, forest area in Vietnam was 13.515 Million ha, about 40.84 % of the total land area. Of which 10.243Mha (75.84%) were natural forest, 3.090 Mha (22.9 %) plantation forest and 0.180 Mha (1.3%) were non-designated forest[64]. Forests in Vietnam are classified by use as *Production Forests* 6.677 Mha (49.4% of the total forested area), *Protection Forests* 4.645 M ha (34.4%), *Special-use Forests* 2.011 M a (14.9%) and *Non-designated Forest* 0.182 M ha (1.3%)[65].

Between 1990 and 2010, Vietnam gained 47.4% of its forest cover as a result of forest rehabilitation and plantation[66]. However, primary or natural forests continued to be under pressure. In late 1980s and 1990s, forest lands and upland farm management were reformed. Forestland and agricultural land allocation was carried out allocating rights to forest land for planting and upland farming.

Production forests are mainly for production and trading of timber and non-timber forest products (e.g., natural and planted production forests, seeding forests) while *protection forests*, are mainly to protect water sources and land, prevent erosion and desertification, restrict natural calamities and regulate climate (e.g., headwater protection forests; wind and sand shielding forests, and tide shielding and sea encroachment prevention forests), thus contributing to overall environmental protection. Managed exploitation activities are permitted in protection forests, where both extraction and management activities are allocated to local communities or groups of families who receive payments referred to as Environmental Payments.

On the other hand, *Special-use forests* are for conservation of nature, forest biological gene sources, for scientific research, protection of historical and cultural relics as well as landscapes. It is also aimed for recreation and tourism in combination of environmental protection. Examples are national parks, nature reserves and species-habitat conservation zones including forests of historical or cultural relics, scenic landscapes and experiment forests. No exploitative activity is not permitted in Special-use forests.

Biodiversity. Vietnam's vegetation is richly diverse, reflecting the country's great range of climate, topography, soils and the varying effects of human habitation. According to the IUCN Vietnam is identified as the fifth biodiversity hot spot in the world, on account of its exotic flora and fauna thriving in terrestrial ecosystems, freshwater ecosystems, and marine ecosystems. About 13,766 floral species have been recorded and/or described by 1999 in Vietnam, including

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[63] Stephen J. LEISZ (2009). Dynamics of Land Cover and Land Use Changes in the Upper Ca River Basin of Nghe An, Vietnam, Southeast Asian Studies: Vol 47 No 3, December 2009.

[64] To Xuan Phuc, Tran Huu Nghi and Roderick Zagt (2012), Forest Land Allocation in Viet Nam: Implementation Processes and Results, Tropbenos International Vietnam, Info Brief –May 2013. *http://www.chainsawmilling.org/file.php/1284/fla%20info%20brief_web.pdf*

[66]Vietnam Forest Information and Data, 2011; http://rainforests.mongabay.com/deforestation/2000/Vietnam.htm. The Food and Agriculture Organization of the United Nations' Global Forest Resources Assessment (2005 & 2010).

11,373 vascular species and 2,393 non-vascular species of which about 10% are endemic. There are 160 species providing vegetable oils, 76 aromatic species, and 181 medicinal plant species[67].

Vietnam is also home to 310 species of mammals, 296 reptile species, 162 amphibian species, 889 species of birds, 310 species of land mollusks, 1,028 freshwater species of fish and 2,000 species of marine fish of which 100 birds and 78 mammals are endemic[68]. Recently, six mammals and one bird species have been discovered. Poaching and hunting wild animal for food and medicine have posed great threats in Vietnam - serving as food, aphrodisiac-medicinal, cultural, cultural use, collectors and export. The number of endangered plant and animal species are estimated to be 1,056, including 139 endangered plant species. By 2006, due to afforestation programs, some species that were threatened to extinction in the wild have had significantly regenerated, e.g., *Chukrasia tabularis* (Indian mahagany), *Aquilaria crassna* (agarwood or aloeswood), and *Panax vietnamensis* (Vietnamese ginseng).

Nghe An Province and Ky Son District

Nghe An province is situated in the North Central Coast Region of Vietnam. Nghe An has a total forest area of 972,910 ha of which, Production Forest is 501,635ha, Protection Forest 302,069ha and Special-use Forest 169,207ha. Bamboos are a significant source of raw materials for forest exploitation and the development of forest-based industries.

Ky Son is a rural district in western Nghệ An Province and it covers an area of 2,095km^2. The district had a population of - 70,061 in 2015[69]. Kyson district is located in the upper Ca River basin, along the border with Laos and is the poorest district within the province. The topography of the district varies from flat valley plains to steep mountains. The Ca river is used extensively for transportation. Source of livelihood are mostly agriculture. The farming systems vary from subsistence long duration swidden/fallow system (fallow period up to 10 years or more) to medium duration (fallow period up to 5 years) in the mountainous areas near the Laos border while irrigated paddy and other crops and plantation forestry in the low land parts of the Ca river basin.

A study conducted in the upper Ca river basin including Ky Son district indicated that forest cover with mature trees significantly increased between 1993 and 2003 while overall natural forest cover with “herbaceous in transition to tree dominated forest ” decreased. This was attributed to rampant land use change as a large area of “transitional forest” was converted to new agricultural land, residential and built-up areas[70]

Project Influenced Communes
My Ly commune

My Ly commune has 17,730ha of forest land, of which 2,520 is classified as Production Forest and 15,210ha as Protection Forest (Table 7.1). Production forest area, primarily for production of

[67] MONRE (2008). 4th country report Vietnam’s implementation of the biodiversity convention (draft), Report to the biodiversity convention secretariat, Ministry of Natural Resources and Environment, Environment administration, Han Noi 2008.

[68] MARD (2008) Report on the Review of Vietnam's Wildlife Trade Policy, the CITES Management Authority of Vietnam, Forest Protection Department, Ministry of Agriculture and Rural Development (MARD), Hanoi 2008.

[69] (Nghe An Portal (2017); Statistical Department of Ky Son District (Phòng thống kê huyện Kỳ Sơn), 2010; Statistical Documentation and Service Centre, 2015).

[70] Stephen J. LEISZ. 2009. Dynamics of Land Cover and Land Use Changes in the Upper Ca River Basin of Nghe An, Vietnam, Southeast Asian Studies: Vol 47 No 3 (December 2009).

timber and forest products, has been allocated to households for planting trees. The fast growing *Acacia sp.*, teakwood species, *Chukrasia tabularis* (Indian mahagany) and *Erythrophleum fordii* are usually planted. However, most of the Production Forest area has been converted and now farmed with rain-fed upland paddy, maize and cassava due to the lack of arable land in the area. Protection Forests officially maintained for preservation of watersheds on the other hand are of poor quality due to illegal exploitation which started many years ago and now are covered with secondary forest and tropical grassland. Local households collect wild vegetables, bamboo shoots, mushrooms, *Auricularia auricula-judae* (Jew's Ear) and edible fungus, and herbal medicines such as "củ xa nhân", smilax roots and *Ganoderma lucidum* from Protection Forest. The community also hunt wild animals such as wild boars, birds, wild chickens, squirrels, *Muntiacus muntjak* barking deer and mice for food, although wild boars and barking deer are now very few. Mice are usually catch for consumption on a fairly regular basis.

Table 7.1 Forest area in My Ly project influenced communes in Ky Son district

Land-use/Type of forest	Commune	
	My Ly	Keng Du
Forest land	**17,730**	**3,353**
Protection Forest	15,210	149
Production Forest	2,520	3,204
Total land area	**27,110**	**8,015**
Households	1,247	888
Population	5,595	4,349

Source: Defence Security 2016. Decision Approving Land Use Plan 2020. Keng Du Commune's five-year land use plan (2011-2015). My Ly Commune's Report on the Socio-Economic Development Tasks for 2017.

Aquaculture in My Ly is not developed. Fisheries are limited to the natural fish resources of Ca river and its tributaries. Fishes commonly caught in the Ca iver are *Anguilliformes* (eel), *Bagridae* (cat fish), *Bagarius bagarius* (devil catfish), *Cyprinus carpio* (common carp), and *Trionychidae fitzinger*. The community also catches small fishes, snails, shrimps, *Caridina flavilineata*, *Brachyura* and tadpoles. In addition, they collect seaweeds and mosses during dry season for food.

Keng Du commune

Keng Du commune has approximately 3.353ha of forest cover, of which 3,204ha is Protection Forest and 149ha is Production Forest (see Table7.1). Protection Forest has been allocated to households and groups of households as community-based forest. Forest exploitation in terms of tree felling and slash-and-burn agriculture is high and forest quality has degraded. These are secondary forest with patches of broadleaf mixed bamboos. Non-timber forest products (NTFP) are also harvested from the forest. About 149ha Production Forest was allocated to households for tree plantation where *Styrax benzoides* and *Styrax benzoin,* some trees of *Acacia* and *Melia azedarach* are planted.

Similar to My Ly commune, the households collect wild vegetables, bamboo shoots, mushrooms and other edible items including medicinal plants. They also hunt wild animals from the forest, and catch fish and shrimp from the Ca River and its tributaries. *Anguilliformes (eels), Cyprinus carpio* (common carp) and small fish are frequently caught while *Hemibagrus guttatus* (bagrid catfish), *Bagarius bagarius* (devil catfish) and tortoises are less frequently caught.

7.1.2 Lao PDR

In Lao PDR, forest area (defined as land spanning more than 0.5 hectares with trees higher than 5 meters and a canopy cover of more than 10 percent) with more than 10% tree canopy was estimated at 15.8M ha in 2010 which is about 67% of the total land area[71]. Forest cover as well as forest quality is reported to have declined drastically in the last couple of decades. Forest area declined from 16.4Mha in 2002 to 15.8 million ha in 2010. Roughly 1.49ha is classified as primary forest.

It is a highly diverse country with 8,286 higher plant species, 172 mammal species, 212 bird species and 165 species of amphibians and reptiles (IUCN, 2006). Illegal trading of wildlife has threatened the survival of wildlife species in Laos.

Forest. Lao PDR with an area of 236,800km^2 is a thinly populated country; it had a population of 6.492 million in 2015 at a density of 26.7persons/km^2. Just over 80% of the land is composed of hills and mountains and the climate is typically tropical to subtropical influenced by monsoons. According to the last reconnaissance survey of forest cover in 2002, the total area of Lao PDR covered by natural forest (canopy density of higher than 20% and height of above 5 metres) was 9.825 Million hectares (Mha). This made up roughly 41.5% of the total land area, while the dry lands (lowland dry dipterocarp forest) covered approximately 1.317Mha or 13.9% of the total land area[72].

Forest cover declined continuously from 1982 to 2010 due to various land-use practices, such as shifting cultivation, commercial logging, commercial agriculture and tree plantation. The loss of forest cover was very high between 1992 and 2002; forest cover was 11.637Mha in 1982, 11.168Mha in 1992 and 9.825Mha in 2002. In 2010, the Department of Forests estimated Lao PDR's forest cover at 9.5Mha or 40.3% of total land area[73].

The national *Forest Strategy* aims at increasing forest cover to around 70% by 2020 through sustainable forest management and restoration. However, this goal may be unattainable based on the current rate of legal and illegal forest conversion. Up to 80% of the Lao population depends on forests and forest products, and 73% of rural citizens rely on small-scale agriculture and forestry for their livelihoods. In some rural communities, more than 50% of a family's income is derived from non-timber forest products[74]. Forest conversion to other uses including farming has increased significantly; agriculture land increased from 0.936Mha in 1998/1999 to 1.623Mha in 2010/11 at the cost of forest cover[75].

The major forest types are mixed deciduous forests, dry evergreen forest, mixed coniferous forest and mixed bamboo forest. There is a huge potential for forest development in un-stocked forest areas which are over-harvested, mostly degraded and currently used for shifting cultivation[76].

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[71] FAO. 2010. Global forest resources assessment 2010. Country Report, Laos PDR. FRA 2010/112. Rome.

[72] Forest cover and land-use changes in Lao PDR according to the National Forest Reconnaissance Survey, Department of Land Planning and Development, National Land Management Authority, Lao PDR, FAO Study. http://www.fao.org/3/a-l1067e/l1067e01.pdf

[73] Forest Conversion in Lao PDR. Implications and Impacts of expanding land investments, Forest Trends Policy 2014.

[74] Ketphanh S., Foppes J., et al. 2012. Economic Valuation of Dry Dipterocarp Forest Ecosystem Services in Lao PDR: *Preliminary* lessons learned. Presentation to FIP scoping mission Vientiane, Department of Forestry.

[75] **Lao PDR.** Lao Census of Agriculture 2010/2011; Analysis of selected themes, Ministry of Agriculture and Forestry, Vientiane, October 2014, FAO.

[76] Forest cover and land-use changes in Lao PDR, FAO Study.

Biodiversity. The forests and watersheds, and wetlands are important habitats for all species of wildlife and aquatic animals. These habitats are home to many rare and endangered species. There are 178 mammal species in Laos, of which four are critically endangered, eight are endangered, 23 are vulnerable, and two are near-threatened[77]. The avifauna includes a total of 701 species, of which two have been introduced and eight are rare or accidental, and 25 species are globally threatened[78]. There are 189 species of reptiles and over 40 species of amphibians in Laos[79].

Fisheries are an integral part of the lives of rural people which account for more than 75% of the population. People traditionally live beside rivers and streams and they harvest fish and other aquatic foods which provide animal protein and micro-nutrient intakes as well as contribute to secondary income for their livelihoods. More than 481 fish species have been identified in Lao PDR, including 22 exotic species. Among other aquatic animals, about 37 amphibians, seven species of crabs and ten species of shrimps have been recorded[80].

7.1.3 Houaphanh Province, Kouan District

The left bank of the reservoir is situated in two provinces Houaphanh and Xiangkhoang in Lao PDR. Houaphanh Province is located in the north-eastern Laos, and is one of the poorest areas in the country. The province area is 16,500km^2 with 289,400 people (Lao SCB, 2015) and borders to Vietnam in the North, East and Southeast, to Xiangkhoang Province in the South and Southwest, and to Luang Prabang Province in the West. The terrain is mountainous with large forest areas and many rivers. The province is administratively divided into ten districts. Kouan District lies in the south-eastern part of the province with border to Vietnam. The District has a total population of 25,098 people (2015) living in 67 villages.

The Nam Et-Phou Louey National Biodiversity Conservation Area (NBCA) and the Nam Xam National Biodiversity Conservation Area are found in Houaphanh Province and there are also some Important Bird Areas within the province[81]

7.1.4 Xiangkhoang Province, Nonghed District

Xiangkhoang Province located in the Xiangkhouang Plateau, north-east of the country covers an area of 15,880km^2 and has a mountainous topography[82]. The population of the province as of 2015 census is 244,684 with a density of 15 persons/ km^2. Nonghed is one of the seven districts in the province, where My Ly is located.

The Nam Et-Phou Louey is a National Biodiversity Conservation Area (NBCA) is found in this province which covers a total area of 5,959 km^2. The NBCA is mountainous, with altitude ranging between 336 and 2,257 metres, has a number of rivers and has high level of biodiversity.

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[77] IUCN (2007) The IUCN Red List of Threatened Species: Mammals of Laos". *IUCN. 2001*.

[78] Lepage, Denis (2007). "Checklist of birds of Laos". *Bird Checklists of the World. Avibase*.

[79] Biodiversity Data Journal (2013) New country records of reptiles from Laos; 2013; (1): e1015.

[80] Phonvisay Singkham (2013) An introduction to the Fisheries of Lao PDR. Mekong Development Series No. 6, 62 pages. Mekong River Commission, Phnom Penh, Cambodia. ISSN 1680-4023.

[81] "Important Bird Areas factsheet: Phou Louey". *BirdLife International*.

[82] "Provinces of Laos". Statoids.com.

7.2 Field survey

Twenty sampling sites were established to collect data and close observations on the vegetation within the Project AI. Each sampling plot was a 20mx20m sized quadrat. Twelve sampling sites were located within the proposed reservoir, three sites at the proposed headworks and powerhouse locations and five sampling sites within the auxiliary areas (Figure 7.1). Several transect walks were taken to sample and observe birds and wildlife. All the sampling sites are located in Vietnam territory. However, vegetation on both banks along the river from dam site to upper reaches of reservoir at Keng Du village was investigated.

Information on the occurrence of wildlife and bird species in the Project area of influence (AI) was gathered through interviews and focus group discussions with the local people as well as site investigation at surveyed locations at Sop Tu, Xieng Tam, Xop Duong and Cha Nga villages in My Ly commune and at Keng Du village in Keng Du communes. Wildlife species reported in EIA Report of My Ly HPP, 2015 (PECI) were verified and referred.

Fish samples in Ca River were collected at 13 sampling sites, eight at the proposed reservoir area, three at the damsite and auxilliray areas and two downstream of the dam site (Figure 7.2). One of the fish sampling site near Phiangsang village is in Laos. Various types of nets were used to collect fish samples.

Samples of phytoplankton and zooplankton were collected at eight of the total 13 fish sampling sites including a site near Phiangsang village in Laos; six sites are at the proposed reservoir area, one at dam site, and one downstream of the dam site. Various types of nets were used for sampling phytoplankton and zoobenthos.

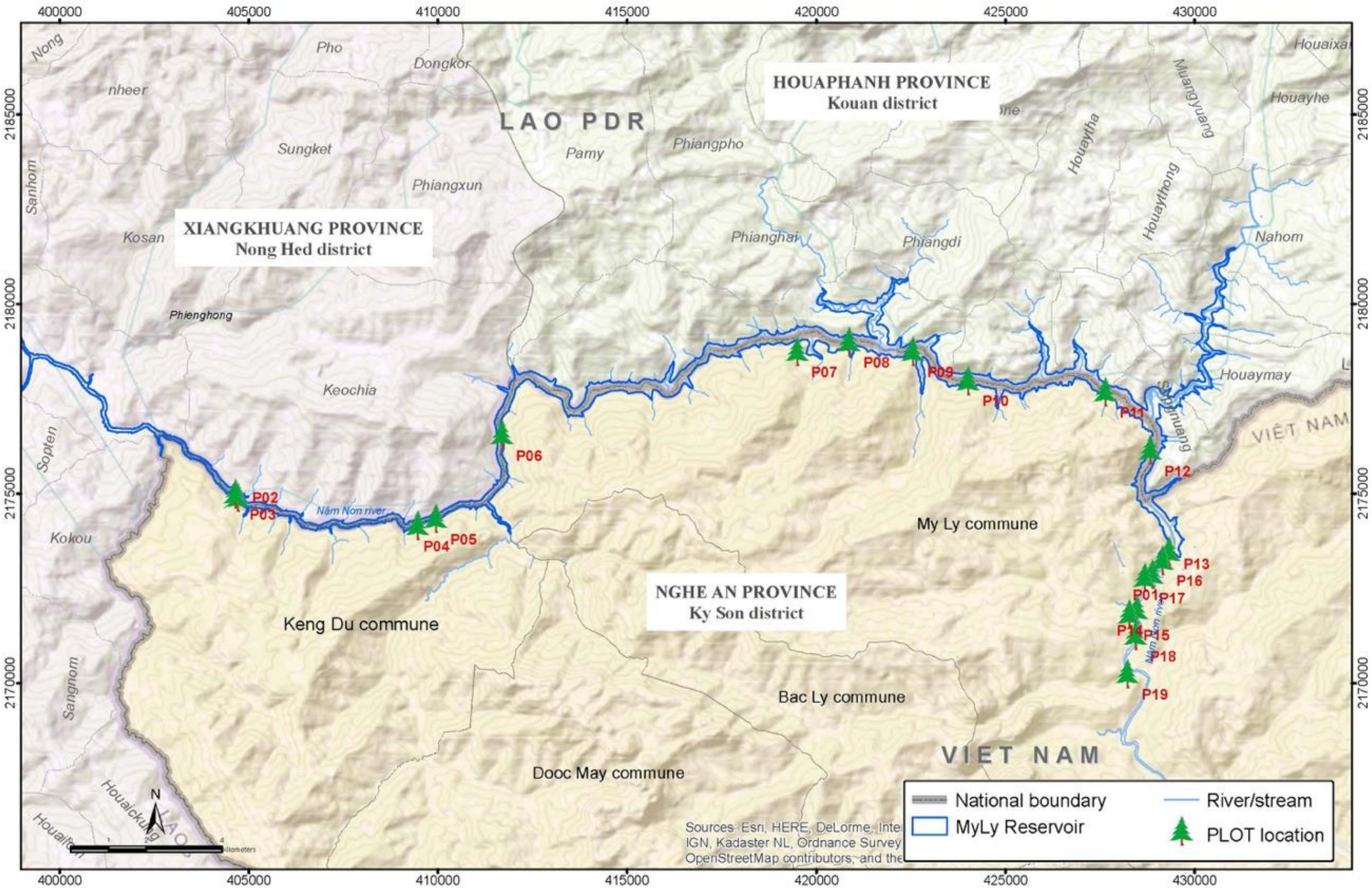

Figure 7.1 Location of vegetation sampling stations

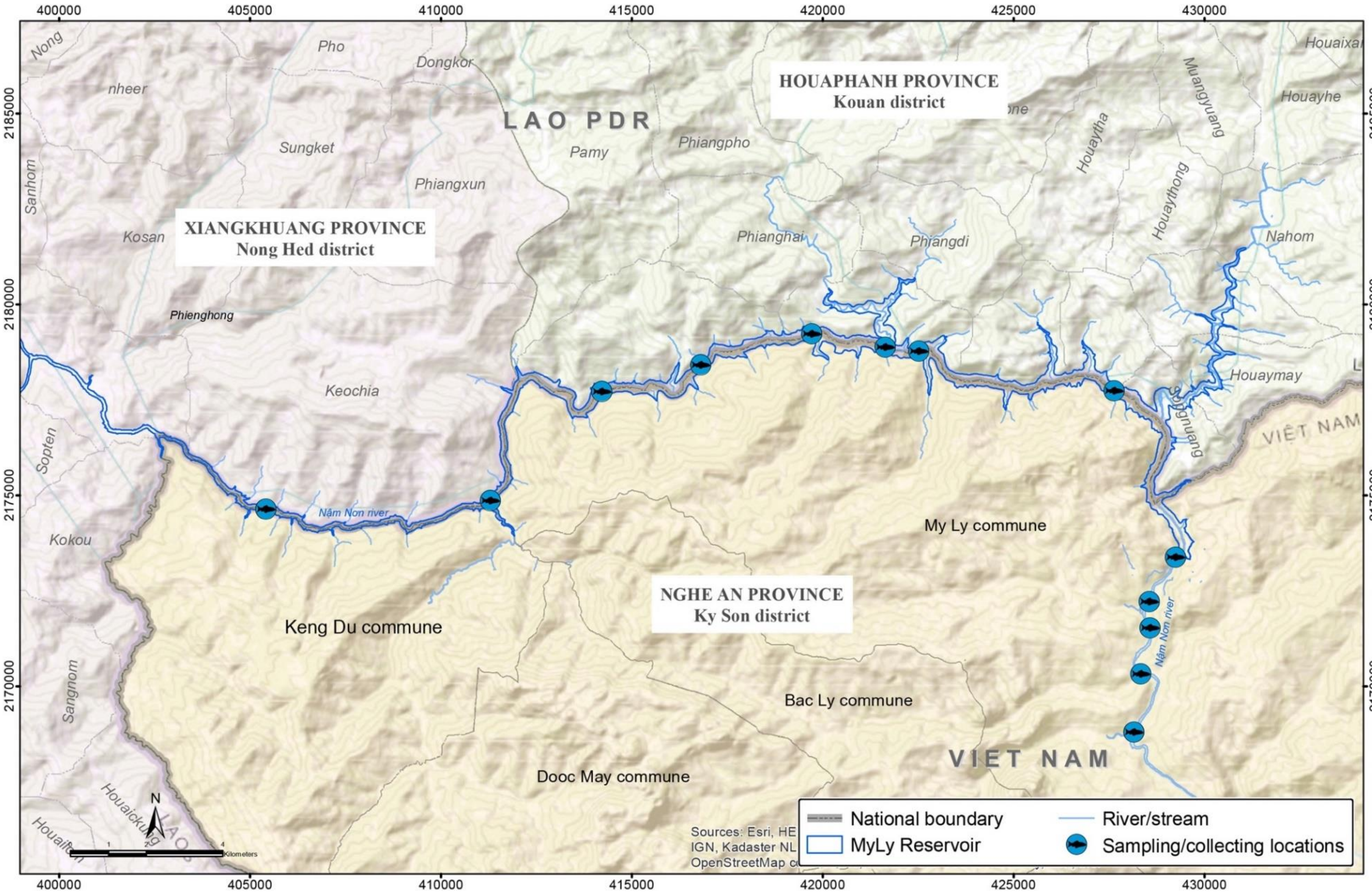

Figure 7.2 Location of fish sampling stations

7.3 Forest resources

7.3.1 Forest vegetation systems in the Project AI[83]

Forested areas close to the settlements and near the Project AI were heavily exploited and farmed without terraces using the traditional swidden agriculture system. Typical for swidden agriculture systems is that once soil fertility diminishes, the villagers abandon the farm and move to a new tract of land and the exploited once forest land is left to regenerate and restore naturally. Such areas gradually turn into grassland, scrubland and eventually secondary forests.

Similar types of forest vegetation were observed on both banks of Ca River e.g. semi-deciduous forest and secondary evergreen forest after exploitation, mixed broadleaf and bamboo forest, and secondary scrub and grassland on uncultivated or abandoned land. The forest stand is better on the left bank, Laos than on the right bank, Vietnam primarily due to low level of human pressure and interface.

The different forest vegetation systems within the Project AI and its adjacent areas are described below:

The Forest Growth after Exploitation

The types of forest growth after exploitation are classified into four in this study, namely Mixed Evergreen Rain Forest, Semi-deciduous Forest, Mixed Broadleaf and Bamboo Forest and the Bamboo Forest. **Feil! Fant ikke referansekilden.** describes each forest type and **Feil! Fant ikke referansekilden.** shows photos of the different types of vegetation existing in the area. Mixed Evergreen Rain Forest and Semi-deciduous Forest types are the result of regenerated after exploitation.

Mixed Evergreen forest has broadleaf trees of timber species; the most dominant species are *Celtis philippense* (sếu), *Aphanamixis polystachya* (gội nước), and *Streblus asper* (ruối). However, these types of forests are very few within the area. The vegetation found in different layers of these two forest types is given in **Feil! Fant ikke referansekilden.**

Table 7.2 Types of vegetation growth after exploitation

Four types of vegetation growth after exploitation		
1	The secondary Mixed Evergreen Rain Forest (local names given where known)	
	Dominant layer	Broadleaf tree species, about 15-20m tall including *Celtis philippense*, *Aphanamixis polystachya* (gội nước), *Streblus asper* (ruối), *Machilus odoratissimus* (kháo), *Machilus odoratissimus* (kháo), and *Archidendron lucidum* (Mán đỉa trâu),*Streblus asper*, *Machilus odoratissimus*, *Bombax malabaricum* (gạo), *Castanopsis spp*, *Shorea chinensis* (wang hsie)*Syzygium* spp., and *Cinnamomum sp*. Close to river edge species are *Ficus racemosa* (sung) and *Pterocarya stenoptera* This type of forest has little cover within the Project AI.
	Sub-dominant layer	Small trees, scattered, less than15m tall

[83] The forest system classification is based on the Report on Biology Systems in My Ly 1 HPP, Ky Son District, Nghe An Province, Vietnam, by PEC1 and Institute of Ecology Biology Resources, Hanoi, April 2017 and the Environmental and Social Impact Assessment of My Ly 1 HPP in Lao PDR territory, August 2016.

Four types of vegetation growth after exploitation		
	Scrub layer	Regenerated premature trees and species of *Antidesma bunius*, *Tabernaemontana bovina* and *Melastoma septemnervium*.
	Shrub layer	Mainly fern and creeper species
2	Semi-deciduous Forest	
	Dominant layer	It includes semi-deciduous, 15 – 25 m tall, timber tree species. The dominant species are *Lagerstroemia tomentosa* (Săng lẻ), *Pterocarpus indicus* (đinh hương), *Streblus asper* (ruối), *Artocarpus rigidus* (mít rừng), *Endospermum chinense* (vạng trứng), *Dracuntomelon duperreanum* (sấu), *Sumbabiopsis macrophylla* (nàng nàng) and *Aphanamixis polystachya* (gội nước).
	Scrub layer	It includes species of *Randia spinosa* (vạng trứng), *Vitex tripinnata* (bình linh) and *Dimocarpus fumatus* (nhãn rừng)
	Shrub layer	Mainly fern species
3	Mixed Broadleaf and Bamboo Forest	
		This type of forest is also limited within the Project AI. It is a combination of some broadleaf timber species, as high as 10-15m, and bamboos. The major species are *Cinnamomum* spp., *Aglaia* spp., and *Mallotus* spp.
4	Predominant Bamboo Forest	
		Bamboo Forest is usually formed after timber forest has been exploited, burned and left uncultivated after slash and burn activities. The predominant bamboo species recorded in the Project AI is *Neohouzeaua dulloa* (nứa). The lower ground layer comprises of fern species and some other species of the *Poaceae* and *Cyperacea* families. There are various less developed variants to this classification, thus referred to as Shrub/bamboo /cultivated/ uncultivated and eventually if stable develop into predominantly bamboo forest.

The Progressive Forest Succession on Uncultivated Land

This type of forest system is created when natural regeneration occurs on abandoned uncultivated land. There are two types under this forest system namely the Scrubland and Secondary Forest and Secondary Tropical Grassland (Table 7.3) describes this type of forest growth systems.

Table 7.3 Forest succession on uncultivated land

Forest succession period on uncultivated land		
1	Scrubland and Secondary Forest	
	This type of vegetation is found all throughout the Project AI. It is characterized based on the number of years left undisturbed.	
	3-5 years	Secondary scrub - Relatively simple vegetative structure in recovery process; Dominated by scrub mixed with herbaceous species; shrub layer of *Eupatorium odoratum;* creeper species; few timber trees which were planted earlier; seedlings of tree species emerge.
	5-10 years	Secondary scrub - Relatively simple vegetative structure; very few immature trees and saplings of species such as *Melia azedarach* (xoan), *Rhus chinensis* (muối), and *Apurosa dioca* (thàu táu); dominated by scrub mixed herbaceous species such as *Breynia fruticosa* (bồ cu vẽ),and *Glycomis pentaphylla* (cơm rượu). Shrub layer are dominated by some species of fern while creeper species serve as limb layer.

Forest succession period on uncultivated land		
	10-15 years	Secondary Forest - Timber species, 5-6m tall, in 2-3 layers such as *Macaranga denticulate* (Mã rạng), *Apurosa dioca* (Thàu tau) and *Ficus spp* as the first layer in between *Castanopsis annamensis* (Dẻ gai)*, Pterospermum heterophyllum* (Lòng mang) and *Lagerstroemia tomentosa* (Săng lẻ); scrub layer dominated by *Euphorbiaceae* and *Myrsinaceae;* fern and creepers.
	More than 15 years	Secondary Forest - Vegetation is characterized as tropical monsoon forest with evergreen rain forest in low hills; the upper layer contains 15-20m tall trees of species *Lagerstroemia tomentosa, Engelhardtia roxburghiana* and*, Peltrophorum dasyrrhachis*; foliage layer is species of broadleaf evergreen trees of 10-15m tall such as *Lithocarpus* spp., *Cinnamomum* spp., *Lisea spp*. etc; the scrub layer is secondary tree and scrub species such as *Euodia lepta and Psychotria* spp.; shrub layer consisting of ferns and other species of family Poaceae and Cyperaceae; the sub layer includes ferns and wild pepper species.
2	Secondary Tropical Grassland	
	Sub-tropical grasslands are formed on sloping land left uncultivated for 3-5 years and later on, scrubs emerge on some patches of these grasslands. Such grasslands occupy most of the Project AI. Grass species such as *Imperata cylindrica, Phragmites karka*, *Saccharum spontaneum* and *Thysanolaena maxima* are found growing on less degraded slopes while *Heteropogon conturtus, Paspalum conjugatum*, *Cymbopogon caesius, Arundinella nepalense* and *Themeda triandra species dominate the grassland.* Dominance of *Imperata* species indicates low soil fertility.	

Vegetation on rocks along the streams

The river banks have exposed riverside rocky terrain with small sand hollows/lanes which allow for the growth of different types of riverine vegetation. The wetland species grown along the river bed include *Acorus gramineus*, *Elaeocarpus hainanensis* and *Ficus subpyriformis* while on the river banks, major species such as *Pterocarya tonkinensis, Ficus* species and *Syzygium* spp were noted.

	
Semi-deciduous Forest after exploitation	Secondary Mixed Evergreen Rain Forest after exploitation.

	
Secondary Scrub on uncultivated land for 3-5 years	Secondary Forest on uncultivated land for 5-10 years
	
Secondary Forest on uncultivated land for 5-10 years	Secondary Forest on uncultivated land for more than 15 years
	
Broadleaf Mixed Bamboo Forest	Predominant Bamboo Forest

	
Forest vegetation on rock along streams	Secondary Tropical grassland

Plate 7.1 Photos of the vegetation types found within the Project IA, My Ly HPP

Vegetation map of My Ly HPP

Vegetation map of My Ly HPP is prepared using remote sensing and GIS methods. It describes the six major types of secondary forest vegetation namely Secondary Mixed Evergreen Rain Forest, Semi-deciduous Forest, Mixed Broadleaf and Bamboo Forest, Secondary Scrub on uncultivated land, Shrub/bamboo on cultivated and uncultivated land and Secondary Tropical Grassland (Figure 7.3).

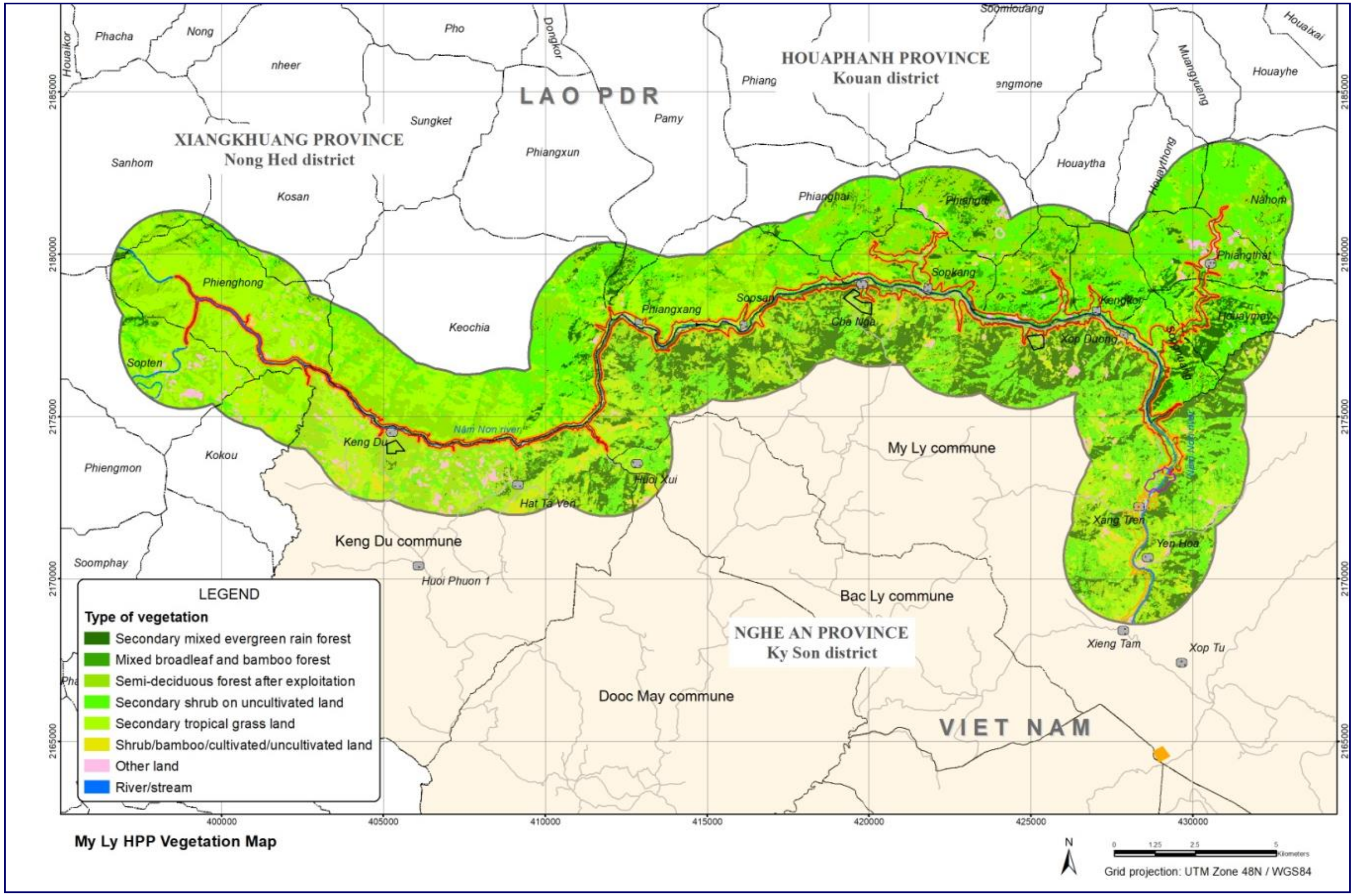

Figure 7.3 Vegetation map of My Ly HPP

7.3.2 Type of vegetation in the reservoir and construction areas

Forest vegetation in the proposed reservoir area and construction areas is given in Table 7.4 Vegetation types and land use in the Direct Impact AreasTable 7.4 (also see Appendix 7.1, Volume II). Area of the proposed reservoir is 1,247ha, of which 272ha is covered by Semi-deciduous Forest, 259ha Secondary Mixed Evergreen Rain Forest, 166ha Secondary Scrub, 161ha Subtropical Grassland, 98ha Mixed Broadleaf and Bamboo Forest, 32ha Shrub/bamboo /cultivated/ uncultivated land and 208ha of river and streams. The Project will acquire 1,334ha of land and about 80% of this total area is forested or has some forest vegetation. About 75% of the 708ha proposed buffer zone area has secondary forest vegetation, 149ha is grassland and land under cultivation is less than 17 ha.

Table 7.4 Vegetation types and land use in the Direct Impact Areas

No.	Land use	Permanent area (ha)		Temporary (ha)**	Total (ha)	Buffer zone area (ha)
		Reservoir	Main works*			
Vegetated area		**988.3**	**692.8**	**31.25**		
I	Secondary mixed evergreen rain forest	259	11.6	11.6	282.2	150
II	Mixed broadleaf and bamboo forest	98.3	2.1	4.0	104.1	45
III	Semi-deciduous forest	272	3.8	6.9	282.7	230
IV	Secondary scrub	166	8.2	11.5	185.5	102
V	Secondary tropical grassland	161	5.2	6.1	172.3	149
VI	Shrub/bamboo /cultivated/ uncultivated	32	0.3	7.2	39.5	17
Built-up areas/residential/others		51	0.2	3.4	54.6	12
River/stream		208	2.7	2.0	212.7	2.7
Total		**1,247**	**34.1**	**52.7**	**1,333.8**	707.7

*Main project works include the associated structures, powerhouse and permanent Project facilities.
**Temporary area includes the disposal sites 1-4, auxiliary area 1-3, and roads.

7.3.3 Biodiversity status and biomass

Biodiversity status

There are at least 447 vascular plant species from 341 genus and 124 families recorded in the 20 sampling sites. These include 429 flowering plant species (325 genera), 14 fern species (12 genera), 3 species from the Lycopodiophyta phylum – the oldest lineage of living vascular plants, and one conifer species. The forest types and stages of growth in the reservoir area and various construction areas (e.g., headworks and powerhouse area, disposal area and auxiliary area) are given in Appendix 7.2. These secondary forests in the Project AI are dominated with pole size trees and few some mature trees.

Secondary forests, e.g., mixed evergreen rain forest, semi-deciduous forest and mixed broadleaf bamboo forest have regenerated after exploitation, and some progressive forest succession has taken place on abandoned uncultivated land during the last 3-15 years. These growing forests are still disturbed due to grazing and occasional conversion to upland farming.

Biodiversity in the Project AI is poor (low in numbers) since most of the vegetation has been disturbed. The secondary evergreen mixed rain forest has medium diversity while the secondary forest grown on uncultivated land, mixed broad leaf bamboo forest and predominant bamboo forests are of low biodiversity value. In general, tree species richness is higher in the reservoir area than in the proposed auxiliary sites and construction areas (Table 7.5). Species abundance is higher in ferns than among tree and shrub species (Appendix 7.2).

Table 7.5 Density of forest vegetation in the reservoir and construction areas

Forest vegetation	Reservoir area	Headworks, Powerhouse	Auxiliary 2
No. of species			
Tree	42	12	28
Density no./ha			
Trees	154	250	245

7.3.3.1 Regeneration, standing volume and total biomass

Regeneration in secondary forests is occurring and progressive. The hardwood species that have regenerated in the reservoir area include *Aphanamixis polystachya, Celtis philippense, Cipadessa baccifera, Clausena excavate, Cratoxylum cochinchinensis, Canthium horridum, Dimocarpus fumatus, Diospiros sp., Eurya spp., Ficus spp., Lithocarpus corneus, Mallotus hookerianus, Melia azedarach, Randia spinosa, Rinorea virgata, Schizostachyum dullooa, Streblus asper, Streblus ilicifolius, Sterculia lanceolata, Sumbabiopsis macrophylla, Trema orientalis,* and *Vitex tripinnata.*

Regeneration in the construction areas is lower than in the reservoir area due to the area being more human dominated and disturbed. Species regenerated include *Canthium horridum, Celtis philippense, Cratoxylum formosum, Dimocarpus fumatus, Ficus spp, Helicteres hirsute, Mallotus hookerianus, Machilus odoratissimus, Pterospermum truncatolobatum, Rinorea virgata, Sumbabiopsis macrophylla, Streblus asper, Toxicodendron succedana.* There is a species similarity between the two Project AIs, with an exception of few species which were not recorded in reservoir area.

Table 7.6 summarizes the type of forests and the estimated organic biomass at the proposed reservoir and auxiliary areas.

Table 7.6 Estimated organic biomass above ground in the reservoir area

Type of forest	Reservoir		Buffer zone		Headwork /powerhouse	
	Area (ha)	**Biomass** (mt)*	**Area** (ha)	**Biomass** (mt)	**Area** (ha)	**Biomass** (mt)
Secondary Mixed evergreen rain forest and Semi-deciduous forest	531	29,140	380	20,500	15.4	880
Mixed broadleaf & bamboo forest	98	2,949	45	1,350	2.1	63
Secondary Scrub/ grassland /shrub/cultivated /uncultivated	359	2,796	268	2,173	13.7	120
Total	988	34,885	693	24,023	31.2	1,063

*million tons

<u>Species of conservation interest</u>

There are two species of concern namely the Gu Sui Bu (*Drynaria fortunei),* a basket fern species native to Eastern Asia including eastern China and *Pterocarpus indicus*, a hardwood species found in South East Asia, recorded within the Project area. The former is listed as endangered species in the Red Data Book of Vietnam, 2007 while the latter is recorded as regionally extinct by the IUCN[84], *Drynaria fortunei* is known as traditional Chinese medicine for bone healing while *Ptercarpus indicus* is a good source of timber. Both are heavily exploited for their uses.

7.3.4 Ethno-botanical status and forest ecosystem services

Ethno-botanical status
Out of the total 447 vascular plant species recorded within the Project AI, 149 of them are either medicinal/poisonous plant species, timber and fuelwood species, edible plant species, ornamental or used as rattan and others. Appendix 7.3 lists the ethnobotanical characteristics of these plants. There are 70 plant species having medicinal value, 56 species of timber and fuelwoods and 20 species have food value.

Ecosystem services
The terrestrial ecosystem, mainly forests and grasslands in the Project AI, provides tangible products such as food, construction materials, medicinal plants and non- tangible items like tourism and recreation. The Millennium Ecosystem Assessment[85] defines *ecosystem services* as the benefits people obtain from the ecosystems. MIGA PS6 (see also Chapter 4-Approach) identified four types of ecosystem services namely provisioning, regulating, cultural and supporting services. Two types, the provisional and cultural ecosystem services are evident within the Project AI.

The villagers have always used the forest as a source of fuel-wood, timber, fodder and forage, medicines, religious rituals and food. There are several medicinal plants of high value. There are also several poisonous plants naturally growing in the forest like *Croton tiglium* purging croton (Ba đậu), *Millettia pachyloba* (Dây mật) and *Engelhardtia roxburghiana* (Chẹo) which may be used in hunting and fishing. The bark of Purging Croton is poisonous and its seeds have a purgative effect.

Table 7.7 Plant species with their uses

Use of plant species	Species
Medicinal /poisonous plants	There are 61medicinal and poisonous plant species naturally growing in the Project AI (Appendix 7. 3)
Timber and fuel-wood plants	There are 58tree species used for timber and fuel wood (Appendix 7.3).
Edible plants	*Ananas comomus*, *Antidesma bunius*, *Callipteris esculenta*, *Canarium album*, *Carica papaya*, *Crateva magna*, *Curcuma longa*, *Dracuntomelon duperreanum*, *Houttuynia cordata*, *Mangifera indica*, *Musa paradisiacal*, *Paederia scandens*, *Pentaphragma sinense*, *Peperomia pellucid*, *Piper lolot*, *Pouteria sapota*, *Spondias lakoensis, Syzygium zeylanicum, Zanthoxylum nitidum* and *Zingiber officinale* (at least 20 species)
Ornamentals	*Acampe ochracea, Asplenium nidus, Belamcanda chinensis, Bulbophyllum affine, Calanthe clavata, Costus speciosus and Cymbidium aloifolium* (7 species)

84 IUCN – International Union for Conservation of Nature – IUCN Red list of Threatened Species

85 Millennium Ecosystem Assessment (MA). 2005. Ecosystems and Human Well-Being: Synthesis [1]. Island Press, Washington. 155pp.

Use of plant species	Species
Rattan and bamboo	*Bambusa blumeana, Calamus faberi, Calamus rudentum, Calamus salicifolius, Caryota mitis, Rhapis gracilis* (6 species). Local people use their fibers for cloths.
Other uses	There are 14 species recorded in the Project AI

7.3.5 Forest protection and management

Management of Protection Forest is specified in the Protection Forest Regulation issued together with Decision No. 17/2015/QĐ-TTg dated 09/06/2015 of the Prime Minister.

Protection Forest

The provincial-level Forest Protection Department and Forest Protection Management Board is in charge of Protection Forests and Special-use Forests. Forests are allocated to groups of households or village communities so that they manage and protect it under the supervision of the forest protection force station. The villagers are not allowed to collect wood and rare animals in accordance with the laws but are allowed to collect non-wood forest products. The households and the communities participating in forest protection receive protection remunerations in accordance with the State's regulations, which is 180-200,000VND for each ha of Protection Forest. Part of it is used to protect forests, and the rest is shared among the households participating.

Productive Forest

Productive forest protection and management is provided in Productive Forest Regulation issued together with Decision No. 49/2016/QĐ-TTg dated 01/11/2016 of the Prime Minister.

The commune's Production Forests are allocated to households or groups of households for planting trees and protecting it. They get forest use certificates and they are required to develop the forest protection plans and organize forest protection by themselves. Local Forest Protection Offices and Commune People's Committees coordinate and support forest development, and prevent and fight forest fire according to the National Law. Concerned households could utilize Non-Timber Forests Products (NTFP) in allocated Production Forest area, develop NTFP, agriculture and fishery production program with less than 30% of the allocated area. However, due to the lack of arable area in the mountain areas, production forests have been converted into land for staple crops, such as rice, maize and cassava.

In Laos, as observed in the field studies and satellite images the My Ly reservoir will affect mainly protection forest (unstocked/ dry evergreen forests) that have experienced encroaching and use. This forest (estimated to be about 268ha) are part of the Soppaen II Ko National Protection Forest. This forest as per Laotian laws will need a permit for allowance for use for this project (see Chapter 2 for permit status). The proposed buffer zone here will add to increase the tree cover and diversity of species in this forest stretch.

7.4 Wildlife resources

7.4.1 Habitat

The dominant habitats (forest types) in the Project AI are the secondary forests where growth is based on natural regeneration after the forest has been exploited or left abandoned after cultivation. They are predominantly the Mixed Evergreen Rain Forest, Secondary scrub forest developed on uncultivated land in the past 7-15 years, Mixed Broadleaf and Bamboo Forest and Secondary Tropical Grassland. Forest close to the villages in the Project AI is thinly covered and over exploited, providing poor wildlife habitat. However, some favorable forest habitats are observed along the river course. The animal species reported are also known to villages who regularly use several of them as food.

Mixed Evergreen Rain Forest

The wildlife species observed in this type of habitat are: yellow monkey (*Macaca mulatta)*, wild pig (*Sus scrofa)*, muntjac (*Muntiacus muntjak)*, wild cat and big bamboo rat (*Bandicota indica)*. It is also habitat for bird species from the families of drongo, crow, fly eating bird, honey eating bird, Chinese laughing-thrush, cock and turtle bird. Reptile and amphibian species that are found here include *Physignathus cocincinus*, *Varanus nebulosus*, cobra (*Naja naja)*, *Trimeresurus albalabris*, species of family tortoise *Emydidae*, and Gecko (*Gekko gecko)*.

Secondary scrub forest

This forest type provides a good habitat for small mammals like rodents and bats; bird species, reptiles and amphibians like *Physignathus cocincinus*, *Ptyas mucosus*, *Bungarus fasciatus*, *Bungarus candidus and Naja naja*.

Habitats along the Ca river, streams, swidden farming area and the village area

Areas along Ca river and the adjacent streams, swidden farming areas, settlement areas and along road alignment provide habitat for mammals such as the black tail rat (*Crocidura attennata)*, mosquito eating bat (Java *Pipistrellus javanicus)*, mice (*Rattus flavipectus)*, rat (*R. norvegicus) and* bird species such as milky stork (*Egretta garzetta)*, fly stork (*Bubulcus ibis)*, milky necked stork (*Amaurornis phoenicurus)*, big kingfisher (*Megaceryle lugubris)*, small kingfisher (*Ceryle rudis)*, wolly necked stork (*Halcyon chloris)* and *Alcedo atthis.* Some reptiles, the gecko water snake, amphibians such as family Ranidae, family Rhacophoridae (tree frogs)), Microhylidae (small frogs) and some insects (butterfly) were recorded in this habitats.

7.4.2 Wildlife species

There are 45 mammal species, 24 reptile species, 19 amphibian species, 111 bird species and 203 insect species reported to occur in the Project AI in 2012 (EIA Study by PECI). The additional ecological survey conducted in January 2017 was also based on key informant interviews and focus group discussions in My Ly and Keng Du communes indicate a slight decrease in number of mammal, reptile, amphibian and bird species compared to 2012 (Table 7.8). The family and species of mammals, reptiles and amphibians are given in Appendix 7.4.

Table 7.8 Wildlife species in My Ly HPP, 2012 and 2017 surveys

Wildlife	No. of Families	No. of Species	
		2012[86]	2017[87]
Mammal	19	45	41
Reptile	11	24	23
Amphibian	6	19	17
Bird	43	111	107
Insect	14	203	210
Fish	17	69	77
Total	**110**	**471**	**475**

[86] PECI, 2012. Environmental Impact Assessment report, My Ly HPP

[87] PECI, 2017. Biology Survey for the ESIA for My Ly HPP

Mammals

Mammals in the Project AI include 19 rodent species *(Rodentia)*, 12 bat species *(Chiroptera)*, six carnivore species, three *primate* apes, two insectivores and two ungulates *(Artiodactyla)* and one Tree Shrews *Tupaia belangeri*. These animals are mainly distributed in areas where the forest is in good condition, usually above 500 masl. Small mammals, rodents and bats are abundant in the proposed reservoir area, dam site and auxiliary areas.

The most commonly seen mammals are *Anourosorex squamipes* (Chinese mole shrew), *Suncus murinus* (Asian mole shrew), *Macroglossus minimus* (long tounged nectare bat), *Taphozous melanopogon* (black-bearded tomb bat), *Hipposideros armiger* (great roundleaf bat)*, Hipposideros Pomona (*pomona roundleaf bat*), Hipposideros larvatus (*intermediate roundleaf bat), *Rhinolophus affinis* (horseshoe bat), *Rhinolophus pusillus* (least horseshoe bat), *Murina cyclotis* (round eared tube rosed bat), *Pipistrellus coromandra* (Indian pipistrelle bat), *Bandicota indica* (greater bandicoot rat)*, Bandicota savilei* (savile's bandicoot rat), *Rattus flavipectus* (yellow breasted rat), and *Rattus norvegicus* (brown rat). These are also the most commonly caught for food by the local communities.

Reptiles

There are 24 species of scaled reptiles comprising of 8 species of lizards (Iguanian lizard, geckos lizard, wall lizards etc), 15 species of venomous and non-venomous snake, e.g., Banded krait (*Bungarus fasciatus*), Taiwanese Krait (*Bungarus multicinctus)* and cobras (Naja species), Brahminy blind snake (*Ramphotyphlops braminus*), sunbeam snake *Xenopeltis unicolor)*, Chinese rat snake (*Ptyas korros)* and one species of keeled box turtle. These are distributed in higher elevations, above 500 masl and in area of evergreen forests along rivers and streams.

Amphibian

There are 19 amphibian species including 17 species of narrow-mouthed frogs, true frogs and fork-tongued frogs (*(Huia andersonii*, *Hoplobatrachus chinensis*, *Microhyla heymonsi*, *Xenophrys major*), one species of tree frog *Phylautus* spp. and two species of toads *Duttaphrynus melanostictus* and *Ingerophrynus galeatus*. These amphibians are distributed in forest areas along streams.

Birds

A total of 111 bird species from 43 families and 14 orders are reported to occur in the Project AI; among them are 84 perching bird species from 26 families, 4 species of storks, 3 species each from fowl-like birds, falcon, Crane-like bird, shore birds, bee-eater birds, and 2 species each of doves and cuckoos. There are about 60 species identified through visual or listening to their singing. Generally, bird in this area is poor in biodiversity.

Insects

There are 210 insect species, 208 of them are moths and butterflies and 2 beetles.

7.4.3 Characteristics of fauna in the reservoir area

The reservoir area comprises mainly of secondary forest, bamboo forest, scrub land, grass land, and riverine area and waterbody and these ecosystems provide habitats for wildlife breeding, feeding, shelter and temporary migration. However, habitats in the reservoir area are disturbed due to deforestation and cleared for agriculture and grazing, and overexploitation of forest products. Since wildlife are dependent on specific habitats, wildlife populations in the Project AI were not diverse as compared to where forests are in good condition (having a high cover and intact). There are no large sized mammals/species or rare species reported in the reservoir area. There were only animals of a small size reported to occur, such as civets (*Viverridae)*, weasels (*Mustelidae)*, tree squirrels (*Sciuridae)*, rats (*Muridae)* and bamboo rats (*Rhizomyidae)*. Large mammals may however occasionally come from more forested areas in Laos to reservoir area for feeding.

Bird species include wild chicken (*Gallus gallus)*, woodpecker (*Piciformes)*, rollers (*Coraciidae)*, kingfisher (*Alcedinidae)*, drongo and *Muscicapidae.* Reptiles and amphibians reported to be present include the agama (*Agamidae)*, ground dragon *(Physignathus cocincinus)*, gecko *(Gekko gecko)*, varan *(Varanidae)*, snake (*Coelognathus radiates)*, cobra (*Elapidae)*, and some species of frogs.

The wildlife species found within the My Ly HPP area and the nearby Ban Ve HPP area and national parks are given in Table 7.9.

Biodiversity Status

The My Ly HPP influence area provides good habitat-breeding, feeding, resting for small-sized mammals such as rodents, bats, shrew/shrew mouse while large mammals may occasionally visit the area for feeding. Wildlife habitats are under human pressure and disturbed and there is overexploitation of wildlife species for food and other purposes. In general, wildlife biodiversity is considered to be low in the project's AI; species diversity is low 45 mammal species, 24 reptiles and 19 amphibian species. However, genetic diversity is high in rodents of the Muridae family – common rats and Rhizomyidae family (bamboo rats comprising of 17 species out of the total 45 mammals species). The genus Rattas – common rat has 12 species (Appendix 7.4). There are 12 species of bats from 6 families and *Hipposideros* genus – leaf-nosed bats are represented by 3 species.

Table 7.9 Number of species found at the My Ly HPP area, Ban Ve HPP and adjacent national forest and parks

Location	Distance from My Ly HPP (km)	No of species					
		Flora	Mammal	Bird	Reptile and amphibian	Insect	Fish
My Ly Dam	0	447	45	111	43	203	77
Ban Ve Dam	60	686	63	176	51	N/A	105
Pu Huong Natural reserve	50	665	291	265	N/A	N/A	N/A
Pu Hoat Natural reserve	40	-	-	142	N/A	N/A	N/A
Pu Mat National Park	60	2,494	132	361	86	1084	119

Source: Biosphere Reserve of Western Nghe An (http://sinhquyennghean.vn/?n=11/da-dang-sinh-hoc); Environmental Impact Assessment for Ban Ve hydropower project on Ca river, Nghe An province, 2006.

7.4.4 Rare and threatened wildlife in the Project AI

Table 7.10 lists the species of conservation concern which are listed either in the Vietnam Red Book or the IUCN. No amphibians or insect species are included in the list among the species reported to occur within the Project AI. Some of the reptile species listed as threatened are, e.g., *Varanus salvator, Ptyas spp* and other snakes are hunted for food by local community. While most of the mammals and reptiles listed threatened are used as traditional medicine. Thus human demand for these species is the major threat.

Table 7.10 List of species of conservation interest

No	Scientific name	Common Name	Vietnamese Name	Vulnerability status[88]		
				Vietnam (a)	IUCN (b)	Decree 32/2006 (c)
1	**Mammals**					
	Nycticebus bengalensis	The Bengal Slow Loris	Cu li lớn	VU	VU	IB
	Macaca mulatta	Rhesus monkey	Khỉ vàng	LR		IIB
	Macaca fascicularis	Leopard cat	Khỉ đuôi dài	LR		IIB
2	**Reptiles**					
	Gekko gecko	Tokay gecko	Tắc kè	VU		
	Physignatus coccincinus	Chinese water dragon	Rồng đất	VU		
	Varanus nebulosus	Clouded monitor	Kỳ đà vân	EN		IIB
	Varanus salvator	Water monitor	Kỳ đà hoa	EN		IIB
	Ptyas korros	Indochinese ratsnake	Rắn ráo thường	EN		IIB
	Ptyas mucosus	Oriental ratsnake	Rắn ráo trâu	EN		IB
	Bungarus fasciatus	Banded krait	Rắn cạp nong	EN		IIB
	Naja naja	Indian or Asian cobra	Rắn hổ mang	EN		IIB
3	**Birds**					
	Falco severus	Oriental hobby (a falcon)	Cắt bụng hung			IIB
	Psittacula alexandri	Red breasted parakeet	Vẹt ngực đỏ			IIB
	Copsychus malabaricus	White-rumped shama	Chích chòe lửa			IIB

7.4.5 Ecosystem services

The fauna species in the Project AI serve as tangible products for local communities: food and providing organs for medicinal purposes. Local residents exploit regularly (daily in many cases) wildlife for various purposes. Poaching and hunting is a common practice in the Project AI. Below are some of the uses of wildlife to the villages.

<u>Food</u>

There are 38 species of wildlife used as food by the villagers including 10 mammal species (e.g. civets, squirrels, wild pigs, rodents); 12 bird species such as doves (*Columbidae)*, red-whiskered bulbul (*Pycnonotus jocosus)* and sparrow (*Passeriformes*); 10 species of reptiles, (e.g. ground dragon (*Physignathus cocincinus)*, Water monitor (*Varanus salvator*); some species of snakes) and six species of amphibians ((i.e., field frog (*Hoplobatrachus*

[88] (a) IUCN. 2016. The IUCN Red List of Threatened Species; VU = Vulnerable;
(b) VNRB. 2007. Vietnam Red Data Book; VU=Vulnerable; LR = Lower Risk;
(c) Decree 32/2006/ND-CP. Management of Endangered, Precious and Rare Species of Wild Plants and Animals; IB= Prohibiting collection and use for commercial purposes; IIB= Restricting exploitation and use for commercial purposes

chinensis), big frog (*Sylvirana guentheri*, *Limnonectes kuhlii)*, stream frog (*Sylvirana nigrovittata)* and tree frog (*Rhacophoridae)*).

Medicinal value

There are 25 species used for traditional medicine including ten mammal species: loris (*Loricidae)*, monkey (*Cercopithecidae)*, and a species of cat (*Felidae*); four bird species such as boucal (*Centropus sinensis)*, dove (*Columbidae*); ten reptile species such as gecko (*Gekko gecko)*, species of varan (*Varanidae)*, species of snake (*Serpentes)*, species of tortoise (*Testudines*) and one amphibian species, the home toad (*Duttaphrynus melanostictus*).

Commercial purposes

There are 45 species of animals exploited for commercial purposes including 20 animal species: species of loris *(Loricidae)*, species of monkeys *(Cercopithecidae)*, species of civets (*Viverridae)* and, species of squirrels (*Sciuridae*); 13 species of birds (blue dove, spotted dove, parrot (*Psittacidae)*, dollarbird, mynah (*Timaliidae)*, and Chinese laughing-thrush (*Sturnidae*); 12 species of reptiles: gecko (*Gekko gecko)*, ground dragon *(Physignathus cocincinus)*, species of varan (*Varanidae)*, species of snakes (*Serpentes)* and species of tortoises (*Testudines*). Those species are exploited, traded between regions all over the country or even exported abroad. Some species of food value are sold to restaurants as special dishes while some species are exploited for their fur either for clothing or household decorations.

7.5 Aquatic ecology and fisheries

7.5.1 Aquatic ecology

Phytoplankton

There are 37 species of phytoplankton belonging to four algal phyla. They are silica algae (*Bacillariophyta)* blue algae (*Cyanophyta)*; green algae (*Chlorophyta)* and eye algae (*Euglenophyta)*. Silica algae are the most dominant with 19 species accounting for 51.4 % of the population count followed by green algae (32.4%), the blue algae (10.8%) and the eye algae at 5.4%. The density of silica algae is higher than that of the three other algae phylum. High dominance of *Diatoma sp* (*Bacillariophyta* algae) indicates unpolluted water where organic contamination is less.

Zooplankton

The study identified 24 species of zooplankton including six species of Copepods, 12 species of *Cladocera,* three species *of Rotatoria* and three species of larva*.* There is also high population of small crustaceans. These are common species, widely distributed and typical for flowing water environment where nutrient content is low. Common species in such type of water bodies include *Diplois daviesiae* (Rotatoria)*, Macrothrix spp., Ilyocryptus halyi* (Cladocera)*, Biapertura, Paracyclops, Paracyclops fimbriatus, and Ectocyclops phaleratus* (Copepoda). In addition, a group of species which are widely distributed and that are able to adapt both to fast and low flow water conditions, and where organic matter is rich were recorded: this include *Moina dubia, Moinodaphnia macleayi, Bosmina longirostris* (Cladocera) and *Thermocyclops hyalinus* (Copepoda).

The density of zooplankton in the sampling stations at Ca River is low, varying between 164-468 individual/m^3 in 2012 and between 204–443 individual/m^3 in the 2017 surveys. The density of population reflects the characteristics of flowing water environment in mountain rivers, where flow velocity is high and generally lower in nutrients.

Zoobenthos

The study identified 19 species of benthos, which includes two species of *Bivalvia,* 10 species of *Gastropoda,* four species of Crustaceans and three species of insect larva. These species are widely distributed and reflective of the characteristics of mountainous river ecology. The most dominant species reported for this study are snails (Gastropods). They are often found sticking on rocks or on aquatic vegetation. While the local residents have little use of the zoobenthos community (only use being from the collection of crabs and mussels), the benthic organisms play an important role in the overall nutrient cycling in the river system.

7.5.2 Fish and fisheries

Fish species and diversity

Altogether 77 fish species from 17 families and six orders were recorded in the Ca River and the streams joining it. The number of fish species recorded has increased from 69 in 2012 to 77. in 2017; during this period six new species from *Cypriniformes* order – the ray-finned fish including carps, minnows and loaches were recorded. Car River has more species (54 species) than in streams (30 species) joining this river. Out of the 30 species in streams, 13 species were not found in Ca river and 14 species were common to both water **bodies (Appendix 7.5).** Table 7.11 shows some of the species found within the Ca river and its tributaries.

Fish living in streams are normally comprise small species, preferring rapid water and high oxygen content. Typical stream fish species include *Schistura* and *Rhinogobius,* particularly the zebra tilapia and *Oreochromis niloticus*. They are adapted to streams. During the survey in March 2017 schools of young tilapia were observed in static waters. The mature ones that are big and, strong are elusive. Nets and electrofishing (although prohibited) are used for fishing.

The most common fish species recorded in the Ca river are given in Table 7.11. Out of these list, only five were recorded in its tributaries/streams. This is attributed to the differences in habitat between the Ca River and its tributaries.

Table 7.11 Common fish species caught in Ca River

No	Fish species		Ca River	Streams
1	*Acheilognathus lamensis*	Cyprinid fish	++*	+
2	*Onychostoma lepturus*	Thintail shoveljaw carp	++	
3	*Puntius ocellatus*	Snakeskin barb	++	+
4	*Puntius semifasciolatus*	Chinese barb	++	+
5	*Culter erythropterus*	Redfin culter	++	
6	*Hemiculter leucisculus*	Sharpbelly carp	++	
7	*Silurus asotus*	Amur catfish	++	
8	*Glossogobius giuris*	Tank goby	++	
9	*Oreochromis mosambicus*	Tilapine cichlid fish	+++	+
10	*Oreochromis niloticus*	Nile tilapia	++	+

*(+) less common; (++) common; (+++) most common

Eight species have a high economic value and most of them except *Onychostoma lepturus* are less common in the river (Table 7.12). None of these high valued fish species are found in streams. The latter is migratory and may be affected by the existing downstream dam (Ban Ve HPP).

Table 7.12 Fish species of high economic value in Ca River

No	Fish species	Common name	Ca River
1	*Anguilla marmorata*	Eel	+
2	*Spinibarbus denticulatus*	Barbel	+
3	*Cyprinus rubrofuscus*	Amur Carp	+
4	*Onychostoma lepturus*	Thintail shoveljaw carp	++
5	*Hemibagrus guttatus*	Catfish	+
6	*Cranoglanis henrici*	Armoredhead catfish	+

No	Fish species	Common name	Ca River
7	*Bagarius rutilus*	Catfish	+
8	*Channa striata*	Snakehead fish	+

Note: (+) less common; (++) common; (+++) most common

Capturing fish in Ca river

Capturing fish in stream

Hemibagrus guttatus

Bagarius rutilus

Bagarius rutilus

Bangana lemassoni

Plate 7.2 Photos of fish species recorded at Ca River and its tributaries

Migratory fish species

The *Hemibagrus guttatus, Anguilla mamorata* and *Bagarius rutilus* are medium to long distance migratory fish species. The *Anguilla mamorata* is a long distance migratory fish species, migrating downstream to sea for feeding. These species considered to be of high economic value, are vulnerable and are less frequently seen in river. The Ban Ve HPP dam and Nam Non dam constructed downstream of the proposed Project have already obstructed their movement to sea. Thus their habitat has been fragmented and a small population is now adapting to this new environment.

Vulnerable species

Among the 77 indentified fish species, 2 species are listed vulnerable (VU) in the Vietnam Red Book (Table 7.13). There are five species, *Anguilla mamorata*, *Acrossocheilus annamensis*, *Hemibagrus guttatus*, *Bagarius rutilus and Bangana lemassoni* listed as Vulnerable according to IUCN. Among them, *Anguilla mamorata* has already been impacted by dams constructed downstream; its migratory route has already been obstructed. All these species are over exploited.

Table 7.13 List of vulnerable fish species

SN	Scientific name	Common name	Vietnamese name	Vietnam Red Book	Vulnerability status[89]
1	*Bagarius rutilus*	Cat fish	Cá Chiên	VU	VU
2	*Acrossocheilus annamensis*	Carp	Cá Trốc		VU
3	*Bangana lemassoni*	Carp	Cá Rầm xanh		VU
4	*Hemibagrus guttatus*	Cat fish	Cá Lăng		VU
5	*Anguilla marmorata*	Eel	Cá Lệch, cá Chình hoa	VU	VU

Fisheries

Fishing is not a main occupation of the community within the Project AI. However, most of the households do fishing for their household consumption. Men, women and children go for fishing. Men use boats and cast nets, while women and children use baskets for fishing. Families take a day off to go to streams for fishing with basic fishnets and baskets. Sometime they stop the flow on streams, dewater and do fishing. Some villagers also use poisonous leaves in a stream section. Also, although it has been prohibited, the use of electrofishing is still being practiced. Although different fishing methods are used, fish catch is reported to be low, at about 1-3kg average per day, while on a good day catch could increase to 5-10 kg/day. The species commonly caught are: *Onychostoma lepturus, Bagarius rutilus, Hemibagrus guttatus, Cyprinus rubrofuscua, Oreochromis mosambicus, Danio laoensi* and *Garra orientalis.* Some people also catch crab, shrimp and mussels for household consumption.

Aquaculture practice

Fish farming is not a prevalent practice in the Project area of influence, although six households in Sopkang village, Kouan district, Laos have small fish ponds and they rear fish collected from the river. Fish produced are limited to household consumption only and rarely have enough catch for trading.

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[89] IUCN. 2016. The IUCN Red List of Threatened Species; VU = Vulnerable; VNRB. 2007.

CHAPTER 8: SOCIAL ENVIRONMENT & LIVELIHOODS

8.1 Approach and methodology

Prior to the start of the baseline social assessment by the International Consultant (IC, International ESIA team) in December 2016, field surveys and consultations had been undertaken by National Consultant (NC) groups in both Vietnam and Laos during 2012–2016. Summary of these is presented in Table 5.1 in Chapter 5 of this Volume and in Annex 4 in Volume IV. Reports prepared by the national consultants were not adequate for MIGA requirements, therefore, In January 2017 the IC with PECC1 and its sub-consultant team implemented baseline information collection in all the communes and villages to be affected by the planned HPP in Vietnam and in all the villages to be affected in Laos.

8.1.1 Baseline information collection

Following all the previous meetings and consultations that already had been undertaken in the affected villages, baseline information collection in January 2017 was undertaken through Focus Group Discussions (FGD) and Key Informant Interviews (KII) in the villages, and meetings with commune officials in the commune center. Commune-level data were collected and local considerations of the planned HPP were evaluated. The IC prepared a Guide Questionnaire for each type of FGD and KII that was used by the NC undertaking the field work (see Annex 3.2 in Volume III). Prior to the fieldwork, a one-day field methodology training workshop was also organized with the Vietnamese field teams.

The main methodology used for the comprehensive information collection was undertaking FGDs. The field teams undertook five types of thematic FGDs (agriculture, forestry, fishery, ethnic culture, gender) and four types of KII (village leader, village health worker, teacher, extension worker) in the villages both in Vietnam and across the river in the Lao territory. In Vietnam, the consultants also had meetings in every commune office for gathering basic population, socio-economic and land use data. They also interviewed commune health center and school staff, where available.

Five FGDs with different groups of people were arranged. Participants in each group were to be knowledgeable and experienced in the issues dealt with in the discussion. Each group was aimed to be gender and age balanced with both male and female participants, except for the group on gender issues (women only) and the group with ethnic elders/elder people (mostly men have the status of an elder/ethnic leader). The five thematic FGD groups were:

(1) Farmers – about land use and cultivation;

(2) Households doing forestry – about utilization of various forest resources;

(3) Fishing households – about fishing and other uses of the river and its resources;

(4) Ethnic elders/leaders – about the history, migration and the ethnic culture of the village;

(5) Gender – with only women, focusing on women’s and children’s lives and livelihoods, health and education.

In every FGD the participants were also asked about what information and how (through which information channel) they have received about the planned HPP, what they knew about the project, and what kind of information and through which information channel they would prefer in the future. The intention of this information was for the IC to find out what information the affected people had received, what they knew and comprehended about the Project, and what their concerns and expectations were.

In a brief meeting with villagers preceding the FGDs and KIIs in each village, the Project and its location was explained, the NC was introduced and the purpose of their visit was explained to the villagers. The NC also handed out a short leaflet (in Vietnamese) to the villagers with basic information about the Project, the ongoing ESIA preparation and the purpose of the team's visit to the village (see Annex 3.3 in Annex III). The NC avoided conveying any further information about the expected Project impacts and potential mitigation measures, but instead heard with the villagers participating in the FGDs about the information they previously received and their considerations concerning the planned HPP.

8.1.2 Summary of the field work

The NC collected information in all the three villages (Keng Du, Cha Nga and Xop Duong) in Vietnam and in the five villages (Phiangxang, Sopsan, Sopkang, Kengkor and Phiangthat) in Laos that are expected to be inundated by the planned My Ly HPP reservoir. They likewise visited the three Vietnamese villages (Huoi Phuon 1, Hat Ta Ven and Huoi Xui) that are expected to lose land areas due to the reservoir inundation. The NC further collected baseline information in Xang Tren village, located at the planned dam site and in the Project construction areas, and visited the four downstream villages of Yen Hoa, Xieng Tam, Xop Tu and Hoa Ly, because during the fieldwork it was not yet clear how these villages were expected to be affected by the My Ly HPP.

A total of 508 people, 296 men and 212 women in the Vietnamese villages were consulted in FGDs and KIIs. In Laos, only FGDs could be implemented with a total of 198 persons (125 men and 73 women) participating. In sum, 706 persons, 421 men and 285 women in the villages to be affected by My Ly HPP in the two countries were consulted concerning their socio-economic and cultural situation and their concerns about the planned HPP. In each commune center, meetings were organized with commune staff, added to them key informant interviews were undertaken with commune health center and school staff wherever available. Summary of the people consulted in the villages and in the commune centers is enclosed in Annex 3.4 in Volume III.

8.1.3 Baseline reporting and analysis

For reporting the information and data collected in the Project area villages and communes, the IC prepared a reporting format for the NC. This format was used to summarize the information gathered through the FDGs, KIIs, informal discussions with villagers and field teams' observations in each village. The IC also provided a commune-level livelihoods reporting template covering general livelihoods conditions in each project-affected commune and the specific livelihoods situations in the villages to be affected by the My Ly HPP. The different reporting templates are enclosed in Annex 3.5 in Volume III.

After the completed fieldwork, the NC under the responsibility of PECC1 prepared reports following the reporting templates instructions. The reports that were prepared in Vietnamese and then translated into English are enclosed in Annex 3.6 in Volume III. The village level baseline analysis undertaken by the IC is mainly based on this reporting, combined with the previous consultant reports and all other available information on the Project areas. Some of the village-level data and information was double-checked by the second group of NC team hired to implement the first phase of FPIC consultation process in the directly affected villages in June 2017 (as reported in Chapter 10 of this Volume and in Annex 5 in Volume IV). At that time the IC also visited the Project AI again and could likewise verify some situation information for the impact assessment.

8.2 Common socio-economic and cultural features of the villages to be affected

8.2.1 Population, ethnicity and movement

The administrative areas with villages and communes and the number of people to be affected in each area by the HPP are reported in the project description in Chapter 3.3. People in the project-affected areas in Vietnam are Thai and Kho mu ethnic minority people and in Laos Kho mu and Thai[90] with their own identity, language and cultural features. Most villages are inhabited with one ethnic group and people have family ties with each other; wives and husbands regularly move in from other villages and sometimes they even originate from other ethnic groups. Some villages are ethnically mixed with a few households from another ethnicity than the majority one in the village.

The ethnic groups in the Project AIs in Vietnam and Laos are related to each other, some people have moved across the national border and settled down on the other side. Naturally, villagers have regular social and economic interaction with each other over the border river.

Most villages have existed in the area for decades, however, in Vietnam some villages have been relocated from high mountain areas to lower elevation following the GoV resettlement program. Due to scarce land availability in Vietnam, some villages have been split into two in order to have sufficient cultivation land at a closer distance. Men and women move in and out for marriage, even across the national border, and many families have during the years migrated from the Lao villages to Vientiane, and from the Vietnamese villages to other provinces in the country and also to Vientiane, which lies closer than the major cities in their own country. Regular seasonal and long-term labour migration of young people to Vientiane takes place from the Lao villages, and Vietnamese seasonal manual workers find work in construction sites in Xiankhoang province in Laos. Young teenage boys and girls are reported by school teachers in Keng Du Commune to drop out of school and cross the border to Laos to work seasonally in Vientiane and Xiankhoang in order to support their families economically.

Virtually all the people in villages to be affected by the HPP are extremely poor, between 60 and 100% of the households are officially classified as poor, and if added with the near-poor households, the household poverty status in most villages comes close to 100%.

8.2.2 Infrastructure and services

The affected villages are located remotely and can be reached either by boat in the Ca River or along soil roads that are hardly vehicle accessible year round. Local people mainly travel either by wooden boats, on foot or by motorcycles, which far from all households can afford. In general, between 30 and 50% of families own a motorbike, and people are used to walking long distances of many kilometres to their agricultural fields or to the commune or village group centre. In all the riverside villages to be affected by the HPP, nearly every household owns a boat, and Ca River is the main transportation route for both people and goods. The Lao villages are located at a road distance of up to 80km from the District centre, so when they e.g. need health services, they rather travel by boat to My Ly Commune centre than to the Kouan District town.

Private houses in the villages are constructed with local materials, wood and bamboo from the forest, most of them are built on stilts, and also some are located on the ground with a cement basement. The public buildings (village cultural house, kindergarten and school) in Vietnam are Vietnamese (Kinh) style houses built on bricks and cement on a ground concrete basement. In Laos the public structures are often wooden. There are big differences between the standard of the private houses, even in the same village, from semi-permanent bamboo houses to massive timber houses with painted decorations in Thai culture style. Space and land used for fruit trees and home gardens around the houses

[90] Another spelling "Tai", and also reported as Lao Loum, which is the larger ethnic group. In Laos, people are ethnically divided into three main groups: (1) The Lao Loum, who are also called the Lao Thai or the Lowland Lao, who make up approx. 75% of the population in the country; (2) Lao Theung, the midlands people, consisting of 58 sub-groups, among them the Kho mu; and (3) Lao Soung, the highland people consisting of the Hmong and Yao as the main sub-groups and making about 10% of the national population (sources: http://minorityrights.org/minorities; https://www.luangprabang-laos.com/The-people-tribes-and-ethnical).

varies between different villages. Intra-village roads are mostly soil paths, but in a few villages concrete roads.

The villages to be affected by My Ly HPP in both countries are outside the national electricity network, and most all households have a micro-hydropower (pico) generator in the Ca River or in a tributary stream next to the village, providing enough electricity for a few hours of lighting and TV. In the Lao villages, households use both micro hydro generators and solar panels for electricity generation.

In the Vietnamese villages household water is lead from tributaries and mountain streams to water tanks in villages that have been constructed through government or donor programs. These water tanks are built with bricks, covered with cement, have water taps and may have a washing room beside. Household water for cooking, drinking and washing is taken from these water tanks. Additionally, villagers use the Ca River and its tributaries for washing and bathing, as well as for watering animals.

In the Lao villages, water is likewise lead from a stream through a tube to a water post with tap centrally located in the village. Some households have private water tanks next to their houses where water is further lead to.

8.2.3 Health and sanitation

Hygienic conditions in the remote villages are in general very poor. Household water has to be carried from village water tanks or from streams to houses. Most villages totally lack toilets, and the existing ones are very rudimentary. Pigs, poultry and dogs roam freely around in the villages. Villages lack any rubbish disposal system, and litter may lie anywhere in and outside the village including the riverside.

The general standard of knowledge about health, hygiene and nutrition is very poor and based on tradition. Mothers lack knowledge about what kind of food and nutrition their children need in order to grow and stay healthy. Children are vaccinated in those villages where mobile vaccination services are available, but if children have to be taken to the commune health centre to be vaccinated, many mothers choose not to take their children there due to the long distance and difficult travel conditions.

Both ethnic minority men and many elder women are smoking, and men often get drunk with home-brewed rice wine. Drug trafficking is taking place in the border area, and some local people, mostly younger men, are using drugs; for example, in Xang Tren village in My Ly Commune, about 50 villagers were reported to be drug addicts. Drug addiction leads to social consequences such as domestic violence, divorces and accelerating poverty in drug users' families.

The most common reported health problems are headache, diarrhoea, cold, pneumonia and itchy eyes. Women report recurrent gynaecological problems with itching due to poor hygienic circumstances without clean water and privacy for body washing. Health care services are available only in the commune health centre, which villagers seldom visit due to the distance, the cost of travel and the fact that they cannot afford buying ordinary medicines if prescribed by the commune health centre staff. In remote villages, health problems are therefore treated with medicinal plants, herbs and fungi collected in the forest. In Vietnam, there is a health worker in each village, but his/her task is only government information dissemination.

Most women, in some villages up to 90%, give birth at home, assisted by other women, but there are neither traditional birth attendants nor medical healers in the affected villages. There are few maternal or infant death cases during the recent years, but quite many miscarriages due to the hard physical labour women undertake even when pregnant. Commune health centre offers annual gynaecological health control for women, but few women from the remote villages actually take that opportunity, due to the distance to the clinic. However, increasing number of younger women visit the health centre at least once during pregnancy, and some of them even deliver their babies at the clinic. Most children are vaccinated in the villages through monthly mobile vaccination services provided by the commune health center.

8.2.4 Food and nutrition

Upland rice is the main cultivation crop and the staple food of all the affected people. Forest and river provide the resource base for other daily food. Women collect wild growing vegetables, roots, bamboo shoots and mushrooms in the forest several times every day for household food. Men are hunting rats, birds and bamboo rats for food on a daily basis. Another main protein source base is the river. Men are fishing with nets from boats and shore, women are fishing with baskets, and even children are collecting snails and shrimps in the shallow waters. Poultry with chicken and ducks is kept not only for selling but also for family food, but pigs are eaten more seldom at special occasions, during annual celebrations and family festivities such as weddings. The food base appears not to be sufficient; according to information from Keng Du Commune health centre, 20% of the children under five years are underweight in the entire commune area, and according to information from My Ly Commune health centre staff, up to 70% of the children in the remote villages are underweight.

Family kitchen is in the poorest households located inside the house and food is prepared on open fire, filling the room with smoke and leading to itchy eyes, coughing and other respiratory problems, which are reported to be common by the commune health care staff and by villagers. In houses with more developed structure, kitchen may be attached or outside the house with fireplace of stone. Firewood is collected in the forests surrounding villages, both men and women collect firewood and carry it home in traditional baskets on their backs.

8.2.5 Education

According to the Vietnamese government standard, there is a kindergarten and a primary school in every village. Secondary boarding school is located in the commune centre. GoV provides boarding support for ethnic minority children with home villages more than 7km from the school. Children stay in the school the entire week, go home on Saturday afternoon after school and return to school on Sunday evening. Children from the most remote villages may stay in the dormitory even over the weekends. Government support covers only tutoring and boarding, and parents have to send rice and other food with their children to the school. High school is located in the district town of Muong Xen, where parents have to pay their children’s accommodation, which most of them cannot afford, so very few children from the poor remote villages continue their education at high school level.

In Laos, there is a primary school but no kindergarten in each village. There is a secondary boarding school in Sopkang village where children from other villages stay over the school week and return to their home villages over the weekends. All boarding costs are paid by the Government. Highschool is located in Kouan District town, but very few children, if any, from the poor remote project-area villages study there, because at that level, parents have to pay the education costs, something the poor families cannot afford.

In the villages the ethnic minority people use their own ethnic language in everyday communication. Women regularly have lower education level than men, because girls drop out of school early during the secondary school in order to help their families with household work. Most elder ethnic minority women are not able to communicate fluently in Vietnamese, and up to 50% of the elder women are illiterate. Nowadays, it is not uncommon in the Vietnamese villages that both boys and girls as young as 12-15 years drop out of school and go to Laos for working in order to support their families. Kho mu ethic minority girls also often drop out of school in the age of 13-14 years in order to work in the village with their families. In Laos, school dropouts at secondary school level appear to be less common.

8.2.6 Livelihoods

8.2.6.1 Agriculture

All the inhabitants in the Project AIs are farmers living on low-productive rain-fed upland rotational swidden agriculture, combined with forest resources utilization, fishery and livestock farming. Many households do not have sufficient food year round, in some villages 50% of the households lack rice during the period from March to August prior to the annual harvest. Apart from upland rice, all farmers cultivate maize and cassava for animal fodder. Vegetables and fruit trees are grown on riverbanks, but in many areas the land along the Ca River is too steep and rocky to allow cultivation activities.

In general, every household has received a land use certificate for its residential land but no land use certificates are issued for cultivation land, because the land used for agriculture is upland forest that is taken into rotational cultivation through clearing and burning down the forest. The fields cleared in the upland forest are located on steep slopes with high erosion and poor soil quality**.** Usually a field is used only for one or two years and then left fallow for 4-8 years. Even if the annually used field size of each family is generally only 1-1.5ha, the cultivation regime requires them to keep several parallel areas in rotation, consequently requiring larger areas that are cleared in the forests.

The main upland crops are rice, maize and cassava, the two latter ones grown for animal fodder and to be sold in order to generate cash income.

Land use and agriculture production data of Ky Son District and My Ly and Keng Du communes is presented in Section 8.4.1 below. Section 8.5 provides information of agriculture at village level in the Project AI in Vietnam and Laos.

8.2.6.2 Livestock farming

Livestock farming is the most important livelihood after agriculture for people in the remote villages. All households have chicken and geese for family food, pigs are grown mostly to be sold but also to be eaten at special occasions as festivity food in the village. Animal diseases and deaths are not uncommon, especially among pigs and chicken that are roaming freely in the villages, and epidemics and cold winter weather kill even cattle. Animal deaths are reported to be more common in the villages in Vietnam, where veterinary services seem to be less available than in Laos, where villagers' knowledge in animal husbandry appears to be somewhat better than in the Vietnamese villages. Most families have a few cows and some households even have buffaloes, which both are kept entirely for selling to generate cash. Together with goats kept by some farmers, cattle is grazing in riverbank grasslands and forests near the upland fields. Animals can roam freely because there are no wildlife predators in the nature. Veterinary services are not well developed in Vietnam but are somewhat better available in Laos.

Section 8.4.2 below provides data on livestock farming in My Ly and Keng Du communes, and Section 8.5 details on livestock at village level in the Project AI in Vietnam and Laos.

8.2.6.3 Forest resources utilization

Forest resources are the crucial base for the daily food and provide approximately 50% or more of the livelihoods of the people in the riverside villages. Non-timber forest products are important for household food, medicine supply and economy. Women collect bamboo shoots and wild-growing vegetables and mushrooms every day for family food. Some non-timber forests products (NTFPs) like mushrooms, bamboo shoots and medicinal herbal plants are sold to traders. Men collect firewood and do logging of timber that is both used for construction of houses and other structures in the village, and also sold to traders. Hunting of birds, rats, bamboo rats, squirrels and snakes is done regularly for household food, mainly with crossbows and traps, and wild boars are hunted during the harvest season near the upland fields. Available forest resources are detailed in Chapter 7 on Biological environment.

Forests in the Project AI are designated as Production Forest and Protection Forest and their use and management system differ from each other.

Management of **Protection Forest** is specified in Protection Forest Regulation issued together with Decision No. 17/2015/QĐ-TTg dated 09/06/2015 of the Prime Minister. The provincial level Forest Protection Department and Forest Protection Management Board are in charge of protection forests and special-use forests. District forest management board allocate protection forest areas to each village to protect and manage. Forests are allocated to groups of households or village communities to manage and protect under the supervision of the forest protection force station. Villagers are not allowed to collect wood and rare animals in accordance with the laws but they are allowed to utilize NTFPs. Each village gets paid according to the area of the forest. Payment from the district is saved in the village forestry fund, and usually each household receives a fee from the fund depending on the area of protection forest it is managing. The households and the communities participating in forest protection receive protection remunerations in accordance with the State's regulations, which is 180-200,000VND per hectare per year. Part of it is used to protect forests, and the rest is shared to the households. This income appears significant for poor villagers, and the affected people expressed worry over lost income due to forest inundation in the reservoir.

Production Forest protection and management is regulated in Production Forest Regulation issued together with Decision No. 49/2016/QĐ-TTg dated 01/11/2016 of the Prime Minister. The commune's production forest areas are allocated to households or groups of households for planting trees and protecting the forest. Households get forest use certificates, they have to develop forest protection plans and organize protection of the allocated forest areas. Local Forest Protection Offices' and Commune People's Committees' task is to coordinate and support forest development, and to prevent and fight forest fires. Households are allowed to utilize NTFPs and to develop NTFP, agriculture and fishery production programs with less than 30% of the area allocated to them. However, there is a great lack of arable land, therefore areas in the highland production forests have been converted into cultivation land for staple crops, mainly rice, maize and cassava.

Forests in Laos have significantly better timber resources than forests in Vietnam where logging and swidden agriculture have deployed vast areas of any good quality timber. The Vietnamese are work in forestry in Laos, and buying up and trading timber from forests in Laos. Illegal logging appears to be common, even if not openly reported. Income from timber and NTFPs is important for the local people.

8.2.6.4 Utilization of the river

The Ca River is important as a source of livelihoods and as a transportation way for upland products, timber, firewood and other goods. Almost all households in the villages along the Ca River to be affected by the HPP have boats and are fishing for family food on a daily basis and additionally selling fish when the catch is large enough; fish is dried and salted and also made into fish sauce to be sold later. Men are fishing with nets both from boats and from the shore, women and children are using baskets, and also collecting shrimps, snails and moss in the shallow waters. Fish is an important protein source for the inhabitants along the Ca River.

Riverbanks are in some places used for home gardening, and they provide pasture for animals as well. However, large parts of the river and riverbanks are very rocky and many areas are steep, where riverbank cultivation is not possible.

8.2.6.5 Business and employment

Due to the remote location and poor transportation infrastructure **trade and business is very limited**. There are no commune markets, only a district market in the district town. In My Ly only ten households in the entire commune are registered to run small shops in the commune centre (Xieng Tam village). In most villages, there is one or two petty shops selling daily consumer goods like rice, salt, fish sauce, drinks, sweets and gasoline. Mobile traders visit villages for buying and selling goods. They sell household goods for high prices and buy agricultural and forest products at low prices. However, local farmers usually do not have much to sell to traders due to low productivity and poverty.

Vietnamese traders are the ones selling household goods and food items even in the Lao villages. Because of the long distance of the riverside villages along poor roads to Kouan District centre, selling and buying is done with the Vietnamese traders coming to the villages from Vietnam or Lao villagers going by boat to Vietnam.

There are very few available non-agricultural labour opportunities. Seasonal labour migration of mostly young men and women takes place in Vietnam to larger cities such as Ho Chi Minh City, Bing Duong and Vinh City. Local men also cross the Ca River for working in forest logging. Logging takes place in the Lao territory with available good quality wood, and the timber is mostly sold to Vietnam. Drug trafficking appears to be rather common in the border area. Vietnamese teenage boys and girls, as young as 13-14 years of age, drop out of school in order to work seasonally in entertainment industry in Laos. There is also a significant labour migration of younger people from the Lao villages to Vientiane.

8.2.7 Cultural heritage

People in the villages along the Ca River belong to the ethnic groups of Thai and Kho mu, which share the same kind of worldview and cultural features through living for generations in the same geographical environment. Forest and river provide their needed resources and form the context for their way of living. Naturally, forest and river also comprise the central spiritual elements in their culture. The local worldview contains gods/spirits related to heaven, including thunder and rain gods/spirits, to land including forest, upland field and village gods/spirits, to water resources including river and stream gods/spirits, and animal gods/spirits ruling over the wildlife. Added to all the spirits in the nature, every family respects its household gods/spirits and ancestors' spirits. Gods/spirits have to be kept benevolent with offerings and prayers in all important occasions such as sowing/planting and after the harvest, building a house, hunting, fishing, etc.

Every village has a special protection forest area where the spirits of the dead are thought to abide. **The spirit forest** is regularly at some distance (about 1km or more) from the village. People are not allowed to utilise forest resources in the spirit forest, however, cattle can be grazing there. Death ceremonies are related to the river, with an animal sacrifice - usually a chicken - thrown into the river as an offering to the river god for bringing the spirit of the dead home to the realm of the dead. **Village graveyard** is often located near the river.

The villages to be affected by the HPP each have **a village worship place** that is importantly located by the biggest tree just outside the village, in some villages with a small "temple" or spirit house on place, in some villages only with a small wooden platform for offerings. Annual ceremonies are held there when different spirits are addressed to with offerings of agricultural products, fruit and animals. Regular ceremonies take place twice a year, the month of the year depending on the ethnic group residing in the village. Typically, the annual ceremonies are connected to the cultivation cycle in the upland fields.

8.2.8 Gender roles, opportunities and obstacles

In the project-area villages, women undertake hard physical work in agriculture side by side with men, and they collect daily NTFPs and firewood in the forest while hunting is the task of men only. Women are in general not fishing with nets, but they use baskets for catching fish and they collect snails, shrimps and moss in the shallow water. Women are traditionally responsible for cooking and taking care of children.

Women in the ethnic minority villages have in general lower education level than men, and especially elder women are illiterate and cannot fluently use and understand the national language. Especially Kho mu girls drop out of school early in order to help their families with household work and livelihoods activities. It is common for these girls to get married when 14-15 years only. Women are less mobile than men, and they rarely travel outside their village and livelihoods activity areas. Men are decision makers in village, and women are not used to speaking up or expressing their opinions in public meetings. Due to the low education level and limited knowledge of ethnic minority women, it is difficult for them to learn new skills for improving their livelihoods and living conditions.

Thai ethnic culture is matrilineal, daughters are preferred, and a newly married couple is first expected to live with the girl's parents and later choose a permanent residence. Both men and women work in the fields and in the forest, but women seldom do fishing and they rarely travel outside the village. Thai women's regular secondary occupation is weaving, and each Thai household has a loom. Thai women in Vietnam plant cotton and raise silk worms for producing thread, and their earnings from selling woven skirts to mobile traders or taking the clothes to be sold in Laos are important addition to Thai household income. Thai women in Laos likewise produce fabrics, for example in Sopkang village all households are each reported to have 5-10 cages with silkworms.

8.2.9 Major reasons for prevailing poverty

There are very few available livelihoods opportunities apart from upland cultivation combined with livestock farming, fishing and forest resources utilization. The available production land is located in high areas with deep slopes, and in the Vietnamese territory, where the available land for farming is not sufficient, pressure on land is high. Erosion and poor soil quality also contribute to very low field yields. Cultivation methods are manual, seeds are local, farmers lack fertilizers and soil improvement methods, which lead to low productivity with hardly enough food for household annual consumption. Every year many households in the project-area villages lack rice during the months before the annual harvest.

Cultivation is rain fed and there are no irrigation systems. Agricultural and livestock services are very deficient in Vietnam. In Laos, veterinary services appear to be better available and consequently animal mortality is lower than in Vietnam. Support and advice from the commune/district is lacking, seeds are not provided at an optimal time, and farmers lack sufficient skills to take care of the animals that they receive through government development programs.

Villages are remote, far away from the district centre both in Laos and in Vietnam, and poor road infrastructure affects people's mobility and market access. Market infrastructure is undeveloped with the only available markets in the district towns. Most villagers rarely visit the district centre, and women do not even go to the commune centre or village group centre more than 1-2 times per year. Mobile traders buy agriculture and forest products from farmers in the villages for low prices and sell them household goods for high prices.

All the affected people originate from ethnic minorities and use their own ethnic language in everyday communication. Many elder people are illiterate and the general educational level is low, especially in the Vietnamese villages. Many people are not fluent in the national language and lack ability to take opportunities for health, hygiene, livelihoods or other living standards improvements. Still many children in Vietnam drop out of secondary school in order to contribute to the economy of their poor families, and grow up with deficient educational level which will further hamper their capacity to take new opportunities and escape poverty.

8.3 Baseline situation in the villages to be affected

8.3.1 Villages to be relocated

Totally four villages in Vietnam and five villages in Laos with approx. 525 households and 2,400 persons need to be relocated. Table 8.1 provides a summary of the villages to be relocated. An overview of the basic population, living standards, livelihoods and cultural situation of each village is provided below.

Table 8.1 Villages in the expected reservoir inundation area and construction area of My Ly HPP to be relocated[91]

MY LY HPP VILLAGES TO BE RELOCATED				
Village	**HH**	**Pop.**	**HH poverty %**	**Ethnicity**
Keng Du commune - Vietnam				
Keng Du	46	183	78	Thai
My Ly commune - Vietnam				
Cha Nga	97	435	60	Thai
Xop Duong	61	224	90	Thai
Xang Tren	174	688	84	Thai
Subtotal My Ly commune	332	1,347		
Total Vietnam	378	1,530		
Kouan district - Laos				
Phiangxang	9	36	100	Kho mu
Sopsan	16	89	88	Thai (Lao Loum)
Sopkang	48	320	63	Thai (Lao Loum)
Kengkor	29	150	100	Kho mu, Thai
Phiangthat	44	276	93	Kho mu
Total Laos	146	871		
Total My Ly HPP	524	2,401		

[91] The population, poverty and ethnicity data is based on information collected during the baseline data collection in January 2017 from commune officials, village leaders and villagers participating in FGDs. Population data was reconfirmed during FPIC consultations in villages to be relocated in June 2017. The impact assessment is based on all the available information and observations made in the project areas.

8.3.1.1 Keng Du Commune

Keng Du Village

Population: 46 HHs with 183 people

Ethnicity: Thai

Poverty: 78% of households under the official poverty line, approx. 20% have annual food insufficiency

Location and movement: 7 km from Keng Du Commune centre. Border military station located in village. Village was established in 1940, high in and out-migration, currently high labour out-migration.

Road infrastructure: Earthen access road to village from commune centre, during rains not vehicle accessible but possible only to walk. 50% of HHs own a motorbike.

River transportation: Most important transportation way, 40/46 households have boats.

Electricity: Households have private pico hydro generators in river and tributary stream

Water supply: 4 water tanks

Educational standard: Many illiterate elder women. Women are less fluent in Vietnamese than men. 12 children in commune secondary school, no student in high school.

Health and sanitation: No health services in village, people go seldom to commune health centre, border guard station in village provides health assistance. Children are vaccinated. Women give birth at home.

Livelihoods: **Agriculture.** Upland fields located on a 7 km stretch along the river and along tributaries at a distance of 1-10km from the village. 5 production groups, each HH has totally approx. 2-3ha cultivation land and use annually 0.8ha for rice and 0.6ha for vegetables, average rice productivity 2-3t/ha, not enough for selling. cassava grown for animal fodder, maize for selling and animal fodder. Peanuts is cash crop, about 0.5ha/HH.

Livestock farming. Each HH has in average 3-4 cows, 5-7 pigs, 20-30 poultry. Cows are raised for selling, pigs for family festivities, poultry household food. Cattle and poultry mortality in diseases high. Roaming freely in village and forest.

River use: Fishing is considered to be the most important livelihood after cultivation. All HHs are fishing, men with nets from boats as far as 30km away. Small catch for HH food, bigger catch can be sold. **Riverbank cultivation** of vegetables and fruit trees for family food by some households.

Forest utilization. NTFPs for daily food, hunting for daily food

Employment and trade. All women weave skirts and sell to traders. High l**abour out-migration.**

Cultural heritage: **Graveyard** with some 100 graves located 1km from village, 700m up from the river. Spirit forest outside village. Worship site by the village entrance.

Causes of poverty according to villagers: Poor soil, steep agricultural land, water supply dependent on natural conditions, lacking seed supply from the government.

8.3.1.2 My Ly Commune

Cha Nga Village

Population: 97 HHs with 435 people

Ethnicity: Thai

Poverty: 60% of households under the official poverty line, approx. 30% have annual food insufficiency, but due to poor harvest in 2015 and in 2016 increased to 40%.

Location and movement: About 30km from My Ly Commune centre along the Ca River. Established long time ago. Each HH residential land 150m^2 and no garden land around houses. Some labour out-migration of both men and women to HCMC, men also digging gold in Quang Nam province.

Road infrastructure: Earthen non-vehicle accessible road to village, during rainy season village becomes isolated.

River transportation: All transportation takes place along the river, 80% of HHs have boats.

Electricity: Households have private pico hydro generators in the river.

Water supply: Water tanks for HH water, bathing and washing in the river.

Educational standard: Daily communication language is Thai, Only approx. 25% of women can read and write in Vietnamese. Many school-drop outs when children 12 years – after finishing primary school, especially girls.

Health and sanitation: No government health services in village, but 3 traditional healers selling herbal medicines and tobacco, and 2 trained health workers with a small pharmacy selling medicines. People go seldom to commune health centre due to distance and high travel cost by boat. Women give birth at home.

Livelihoods: **Agriculture.** Upland cultivation area located up from the river, only little land along the river, 5 production groups, each HH has approx. 3ha land, average rice yield 3-3.5t/ha, cassava grown for animal fodder, maize for selling and animal fodder. A few HHs grow peanuts for selling.

Livestock farming. Each HH has in average 2-3 cows, 1-2 pigs, many poultry. In 2016 all cows and chicken and most pigs died.

River use: All HHs are fishing. **Riverbank cultivation:** only fruit trees, too deep and stony for cultivation.

Forest utilization. NTFPs for daily food, hunting for daily food.

Employment and trade. All women weave skirts and sell to traders. Some 20 villagers working in Laos, Quang Nam, HCMC. Some villagers working in wood manufacturing in Laos.

Cultural heritage: Spirit forest area outside the village, graveyard, village worship site.

Causes of poverty according to villagers: Poor road access, lack of good quality production land, steep agricultural land, lack of business skills, drug addiction – 40 villagers are drug addicts, mostly young men.

Xop Duong Village

Population: 61 HHs with 224 people

Ethnicity: Thai

Poverty: 90% of households under the official poverty line. About 15 HHs suffer food insufficiency 2-3 months/year, but in 2016 poor harvest and 6 months not enough food.

Location and movement: 15 km from My Ly Commune centre along the Ca River. Village has been in the same location since 1960.

Road infrastructure: Earthen logging road to village that is motorbike accessible but not during the rainy season.

River transportation: All transportation takes place on the river, over 80% of HHs have boats. Some 20 villagers provide irregular trade and transport services by boat.

Electricity: Households have private pico hydro generators in the river.

Water supply: Water source 2km from village, water piped to water tanks in village.

Educational standard: Daily communication language is Thai, most women over 30 years illiterate and not fluent in Vietnamese. Very few children go to secondary school in commune centre.

Health and sanitation: No government health services in village, children not vaccinated, women give birth in the village assisted by a TBA. Many miscarriages due to hard physical labour. Many drug addicts who are young, unemployed men.

Livelihoods: **Agriculture. 7** production groups with 7-9 HHs in each, every HH has approx. 2-3ha land, vegetables cultivated in upland fields because no suitable land available along the river or in village.

Livestock farming. 20 HHs have 200 cows and 84 buffaloes, 15 HHs have 70 goats, each HH has approx. 3-4 pigs and 15-20 chicken.

River use: All HHs are fishing, but previously abundant big fish has disappeared. Sometimes large catch so fish can be sold. **Riverbank cultivation** of only grass for cows and mulberry bushes for silk worms.

Forest utilization. NTFPs for daily food, hunting of rodents and birds for daily food. In general, villagers eat fish or meat at least once a day.

Employment and trade. All women weave skirts and sell to traders. Men are involved in logging and sell timber to logging companies, some young men work in wood manufacturing.

Cultural heritage: Spirit forest area 1.5ha, graveyard downstream the planned dam site, village worship site outside village under two big trees.

Causes of poverty according to villagers: Soil erosion, poor weather conditions, poor transportation conditions. The past 3 years the village has no more received government support of seeds and young livestock.

Xang Tren Village

Population: 174 HHs with 688 people

Ethnicity: Thai

Poverty:	84% of households under the official poverty line. Annual food insufficiency one month. Most HHs eat fish or meat every day.
Location and movement:	4 km from My Ly Commune centre along the Ca River. Village area steep and narrow up from the river. District town one day's travel away by boat and road. Same location at least over 60 years, high in and out-migration, currently 50 men labour-migrated to do gold-digging in Quang Nam or to work in the South. People frequently visit relatives in Laos, buy goods in Laos and sell in Vietnam.
Road infrastructure:	Earthen logging road to village that is motorbike accessible but not during the rainy season.
River transportation:	All transportation along the river, All HHs own a boat, 80% motorboats.
Electricity:	Households have pico hydro generators in the river, school and kindergarten with solar panels.
Water supply:	4 public water tanks.
Educational standard:	Daily communication language is Thai, most people literate, only elder women cannot read and write. School attendance of children 70% at secondary and 20% at high school level.
Health and sanitation:	No government health services in village, herbal medicines used. Most women give birth in village but no TBA. About 50 drug addicts, mainly younger men.
Livelihoods:	**Agriculture.** Upland cultivation area 200ha, located from one hour's walk from the village to half a day's walk. Each HH has 1-2ha production forest for cultivation. 2 HHs have totally 6ha of paddy land.
	Livestock farming. Village divided into 3 livestock farming groups with four pasturelands. 100 HHs have 3-4 cows each, 100 HHs have 1-4 buffaloes each, 20 HHs have totally 100 goats, all HHs have chicken and at least one pig for HH food. Villagers know about cattle vaccination, because previously all cows had died.
	River use: 100 HHs use boats for fishing, all HHs are fishing in the Ca River, in Kho stream where a lot of fish. One time catch about 5kg, for HH food but also for selling. Gold digging in the river. Sand and rocks for construction collected from riverside. 5-6 HHs doing riverside cultivation of banana, sugar cane, sweet potato, taro, onion, kale, potato.
	Forest utilization. NTFPs for daily food, hunting of rodents and birds for daily food. Forest products are sold to traders, border guards and teachers.
	Employment and trade. Growing cotton and raising silk worms; all women weave skirts and sell to traders. Men doing gold digging in the river. Five small shops in the village.
Cultural heritage:	Spirit forest and graveyard about 1km from village. Village worship site near the village.

8.3.1.3 Kouan District

Phiangxang Village

Population: 9 HHs with 36 people, all of the same family.

Ethnicity: Kho mu

Poverty: 100% of households under the official poverty line. Food is sufficient with fish from the river and meat and vegetables from the forest.

Location and movement: 80km from Kouan District centre. Very isolated. Village was established in 1978 when a teacher migrated from Vietnam and married a local woman, today all villagers are his descendants. Since 2005 many people out-migrated and moved to Vientiane and Xiankhouang.

Road infrastructure: Earthen logging road to village that is motorbike accessible but not during the rainy season.

River transportation: Four HHs have motorboats and they provide river transportation services, transporting mainly goods and timber logs (for the Vietnamese), earning approx. 5-6MVND/HH/month.

Electricity: Solar panels.

Water supply: 2 water taps in village for HH water, washing and bathing in the river.

Educational standard: 3 men with highschool education. All children go to secondary school and to high school, no drop-outs. All people except three elder ones can read and write in Lao.

Health and sanitation: Whenever villagers need health care, they go to My Ly health centre in Vietnam because district clinic far away. Children vaccinated through monthly mobile vaccination services from the district health care. Women give birth in village. No regular health control program available. One person knowledgeable in herbal medicine.

Livelihoods: **Agriculture.** Fields to the West of the village along the river at a distance of 300m to 1km from the village, 50-80m from the water level, about 2km along the river, mostly maize and cassava. Upland rice area approx. 10ha, after 2-3 years fields are left fallow for 3-4 years. Soil quality rather good and plenty of land because many HHs out-migrated which lessened the pressure on land. Each HH has 100-200m^2 garden land with mango, orange, grapefruit, guava, jackfruit, coconut trees, taro, tamarind.

Livestock farming. Local breed of cows, buffaloes, pigs, chicken, ducks; 3-5 pigs/HH for festivities and for selling, 2-3 cattle/HH for selling, 20-30 chicken and ducks/HH for food.

	River use: 6 HHs do fishing for family food and for selling.
	Forest utilization. Men are logging and selling timber, mainly to Vietnamese buyers, earn approx. 2-3MVND/HH/month. Men hunting muntjac (deer), birds, porcupine, wild boar for eating and selling. Women collect NTFPs.
	Employment and trade. Women are weaving skirts for domestic use and for selling.
Cultural heritage:	Spirit forest and graveyard approx. 2km outside the village. Village worship site by a big tree.

Sopsan Village

Population:	16 HHs with 89 people.
Ethnicity:	Thai (Lao Loum)
Poverty:	88% of households under the official poverty line. Food usually sufficient due to forest resources and cash from selling timber and wildlife that is used for buying food. 2016 due to poor harvest food insufficiency, had to buy rice from Vietnamese traders.
Location and movement:	In this location since 1954. Many HHs have migrated to Vientiane. 6km to village group centre (Muong Duong village), 50km to Kouan District town, 50km to Xiankhoang.
Road infrastructure:	Earthen road to village that is not accessible during the rains.
River transportation:	Five motorboats that used for transportation and fishing.
Electricity:	Solar panels, government program.
Water supply:	2 water taps in village for HH water through a French NGO program, but washing and bathing done in the river.
Educational standard:	Communication language Thai, but people also know Vietnamese, Kho mu, Hmong languages. Women in general have 5-6 grade school education, girls drop out of school due to distance to secondary school in village group centre.
Health and sanitation:	Nearest health clinic in district town, people seldom go there. No medical services available. Women deliver babies in village, some cases of maternal and infant deaths. One traditional healer selling herbal medicines in village. A couple of drug users who got addicted when working in another area.
Livelihoods:	**Agriculture.** Upland cultivation area totally approx. 100ha, each HH has 1.5-2.5 in active annual cultivation and further land in rotation. Production land distance from village 1km to 7km away. Plenty of

available land. Rice enough for HH food, and sometimes sold to Vietnamese traders.

Livestock farming. Average 5-7 pigs/HH, some HHs have up to 15 piglets, 15-20 chicken/HH. Totally 20 cows, 6 buffaloes. 2015 buffaloes died due to foot and mouth disease. Cows, buffaloes and pigs raise for selling. When animals get sick, no veterinary services available and no medicines available, so animals die.

River use: 5 motorboats used for goods transportation and fishing. All people are fishing, plenty of fish with many species. Daily catch can be up to 10kg. No riverbank cultivation or other use of riverbank resources.

Forest utilization. Men are logging and working as labourers in logging. Timber taken for construction and for selling. Men hunting daily for family food and selling to Vietnamese traders whenever catch enough. Women collect NTFPs daily for family food.

Employment and trade. Women are weaving skirts for domestic use and for selling.

Cultural heritage: Spirit forest and graveyard with some 500-600 graves in 5 sections, one of them close to the river, one section by the tributary stream. Village worship place in the village.

Causes of poverty according to villagers: Crop failure, poor road infrastructure and lack of trade.

Sopkang Village

Population: 48 HHs with 320 people.

Ethnicity: Thai (Lao Loum)

Poverty: 63% of households under the official poverty line. Food usually sufficient, only 1-2 HHs lack rice 1-2 months annually. Cultivation land availability good, and there is poultry and pigs to eat.

Location and movement: In this location since 1954. Many HHs have migrated to Vientiane. 7km to village group centre (Muong Duong village), 50km to Kouan District town. Village located right on the river bank that is quite steep, houses located spaciously.

Road infrastructure: Earthen, steep access road to village that is not vehicle accessible during the rains. Road between Kouan and Nonghed districts under construction near village, and will improve accessibility. Teenagers often go to village group centre by motorbike.

River transportation: Two motorboats that used for transportation of people and goods.

Electricity: Solar panels and micro-hydro generators.

Water supply: 6 water tanks with 2-3 water taps in each for HH water, washing and bathing done in the river.

Educational standard: Primary and secondary school in village. Elder women's educational level only up to grade 5, majority of elder people illiterate.

Health and sanitation: Nearest health clinic in district town, people seldom go there. No medical services available. Women deliver babies in village. Villagers use herbs from forest to cure illnesses, and when needed, they go to My Ly Commune health centre in Vietnam by boat.

Livelihoods: **Agriculture.** Upland cultivation area approx. 100ha located next to village and 3km stretch along the river, the most distant fields only 30 min walk away. Plenty of available land, each HH cultivate annually approx. 2-3ha on steep terrain.

Livestock farming. Each HH has 3-4 cows, some up to 30 cows, have access to district veterinary services and know how to cure sick animals, so animal mortality is low. Approx. 500 pigs in village, each HH has 20-30 chicken and ducks, pigs and poultry used for family food, cows for selling. Animals free roaming and drink from the river.

River use: 5 motorboats used for goods transportation and fishing. HHs fishing for daily food in the river and in the tributary stream close to the village, daily catch 1-3kg, fish is sold when large catch. Plenty of fish resources. Near the **riverbank** cultivate mustard, onion, sugar cane, wild growing fruit trees grow on the river bank.

Fishponds. 6 HHs have fish ponds and raise fish taken from the river.

Forest utilization. Men are logging, income from timber selling used for buying food. Men hunting wild animals for family food and selling. Women collect NTFPs daily for family food.

Employment and trade. Nine young male and female villagers work in Vientiane and other places in construction and shoe industry.

Cultural heritage: Spirit forest and graveyard close to the river. Village worship place with a small wooden house in village.

Causes of poverty according to villagers: Weather conditions, steep landscape, soil degradation, manual cultivation methods and no fertilizers.

Kengkor Village

Population: 29 HHs with 150 people.

Ethnicity: Kho mu and Thai

Poverty: 100% of households under the poverty line. Only some 3-4 HHs have enough food year round, annually 20HHs receive rice from the GoL. HHs sell timber and animals to get cash and buy food.

Location and movement: Established 1955. Many HHs migrated to Vientiane in 1998-99 and then only 8 HHs left, later many Kho mu people moved in, 2013-15 3 HHs moved to Vientiane.

Road infrastructure: Earthen path that is under construction. Kouan District town 50 km away, and it takes 30 min by motorbike to go to Nongcan village group centre.

River transportation: Nobody owns a boat, however, waterway is used for going to My Ly in Vietnam and villagers pay Vietnamese boat owners and traders for transportation. Vietnamese traders supply all HH goods by waterway.

Electricity: Solar panels and micro-hydro generators.

Water supply: Water led through tubes into water taps in village for HH water, washing and bathing in the river.

Educational standard: Daily communication languages Kho mu and Thai. Majority of villagers elder people, and only approx. 10% of women can read and write in Lao. Primary school in village, secondary school in village group centre, and children drop out of school in order to work for their families.

Health and sanitation: Nearest health clinic in district town, people seldom go there. No medical services available, but Village vice head knowledgeable in herbal medicine. Women deliver babies in village. Children are vaccinated. When needed, people go to My Ly Commune health centre in Vietnam which is 30 minutes away by boat.

Livelihoods: **Agriculture.** Upland cultivation area in annual use approx. 50-55ha, plenty of land available but few HHs to cultivate it, land located at a distance from 500m to 5km from village. Land under village management board that allocates land to HHs.

Livestock farming. 2-3 cows/HH – totally some 100 cows in village, approx. 50-60 buffaloes, Each HH has 2-3 pigs that are for family food and festivities, chicken and ducks kept for family food, 23 goats in village. Animals drink from river and streams. When sick, veterinary services available, so not many animal deaths.

River use: No boats. Five HHs fishing about once a week with average catch of 3-5kg, and women catch fish with baskets and collect snails and moss in the river.

Forest utilization. Each HH has approx. 7ha of planted forest. Men go hunting and take timber for construction and for selling, women collect NTFPs.

Employment and trade. Some teenagers 12-15 years old are working seasonally in Xiangkhoang. Young people migrate out from the village.

Cultural heritage: Spirit forest and graveyard close to the river. Village worship place with a small wooden house in village.

Causes of poverty according to villagers: Weather conditions, steep land that is difficult to cultivate, weeds grow faster than rice.

Phiangthat Village

Population: 44 HHs with 276 people.

Ethnicity: Kho mu

Poverty: 93% of households under the poverty line.

Location and movement: In 1992 three small villages were joined and relocated into this location where Phiangthat was founded. Along the Nam Duong, tributary river to the Ca River. Many HHs have out-migrated to Vientiane and other places. Many young people labour migrate seasonally.

Road infrastructure: Earthen, very steep access road to village that is not vehicle accessible during the rains.

River transportation: No boats in village.

Electricity: Micro-hydro generators in the river.

Water supply: 4 water tanks for HH water, washing and bathing in the river.

Educational standard: Communication language Kho mu, but all people can communicate in Lao. Approx. 10% of villagers illiterate, 20% of women, elder people. Primary school in village, secondary school 7km away, so many children drop out of school.

Health and sanitation: Two unpaid health care officers trained in the district live in the village and can provide health services. Common reported diseases diarrhoea, malaria. Women deliver babies in village, previously several maternal and infant deaths but not during the recent years. Due to a GoL toilet construction program, most HHs have private toilets.

Livelihoods: **Agriculture.** Upland fields along the river close to village. Average annual cultivation area 1.5-2.5ha /HH.

Livestock farming. Each HH has 2-3 cows, some up to 15-20 cows, in 2015 totally 300 cows but they all died of diseases. In January 2017, there were 80 cows but no pigs and no chicken in the village because all had died. District veterinary services available only when animal epidemics occur.

River use: All villagers fish in the Duong stream for daily HH food, regular catch 0.5-1kg. Men fish with rod and net, women with baskets. Women collect seasonal moss and algae for food. A few HHs cultivate vegetables, mainly onion and lettuce in a small area of 15-20m^2 along the river, some HHs have fruit trees along the riverbank, e.g. banana, guava, papaya trees.

Forest utilization. Village located in protected forest area which is not allocated for village use. Plenty of forest around. Men are logging and selling timber to Vietnamese traders, which is an important income source. Men go hunting every day for HH food and for selling, plenty of wildlife. Women collect NTFPs for HH food.

Employment and trade. Many young people labour-migrate to Vientiane and Xiangkhoang for a few months, for a year or permanently. There is a bridge over the tributary and villagers get income from the fee vehicles have to pay for using the bridge.

Cultural heritage: Graveyard close to Duong tributary with more than 3,000 graves. Village worship site with a spirit house located upstream from the village.

8.3.2 Villages with land to be inundated by the reservoir

8.3.2.1 Villages in Vietnam

Four villages in Keng Du Commune that are located at a distance from the Ca River have land areas along the river that are expected to be inundated by the reservoir. Overview of these villages can be seen in Table 8.2 followed by a short basic description of each village.

Table 8.2. Villages in Keng Du Commune in Vietnam with land areas to be inundated

MY LY HPP VILLAGES WITH LAND LOSSES					
Village	**HH**	**Pop.**	**HH poverty %**	**Ethnicity**	**Impact**
Huoi Phuon 1	93	388	60	Kho mu	Land affected that is used for animal grazing
Huoi Phuon 2	138			Kho mu	Land potentially affected, status to be confirmed.
Hat Ta Ven	130	636	75	Kho mu	Land affected, includes cultivation land with maize, sugarcane, eggplant, fruit trees.
Huoi Xui	138	564	87	Kho mu	Land affected. Some HHs worried over living too close to the reservoir edge (about 100m above the water level)

Huoi Phuon 1 Village with 93 Kho mu households is located in the Keng Du Commune centre at a distance of 8km from the river along a poor soil road leading to Keng Du village by the riverside. Three households are reported to sometimes fish in the Ca River, but without boat. The land to be inundated is reported to be used for animal grazing.

Huoi Phuon 2 Village was not initially listed among the villages to be affected by the HPP, but a village representative unexpectedly attended the meeting with the FPIC communication team in the commune centre in June 13, 2017. The village has 138 households and the status of its land to be potentially affected by the HPP still needs to be confirmed.

Hat Ta Ven Village with 130 Kho mu households is located 5km from the commune centre and 8km from the Ca River. Riverside land is allocated to four production groups that mainly have vegetable gardens near the river. Usually one household in the production group cultivates the riverside land for 1-2 years and then leaves it over to another household.

Villagers grow banana and papaya trees, and cultivate pumpkin, eggplant, chili and sugarcane on the riverside land. It is not known if any other type of land that is used for livelihoods or that is culturally important such as spirit forest or graveyard is located in the area to be inundated. Two households share a small motorboat and provide passenger transportation services in the Ca River. All households are reported to sometimes go fishing in the Ca River and in the Nam Xoc tributary river when they lack food.

Huoi Xui Village with 138 Kho mu households is divided into two locations, one along the Ca River and the other along the Nam Xoc River that is tributary to the Ca River. According to the villagers, there is no cultivation land along the river, however the affected land areas have to be confirmed during the detail design of the project. Villagers do not have boats, but fishing in the Ca River using nets and baskets is important for their daily food, and also sold to traders fired, smoked or salted.

The village access road leading over the Nam Xoc tributary is in the inundation area. About 15 households living closest to the planned reservoir have expressed worry that their houses might be too close to the reservoir and at risk for landslide in the steep landscape. The exact location of these houses in relation to the reservoir height has to be investigated in the detail design phase and, if necessary, appropriate mitigation measures planned.

8.3.2.2 Villages in Laos

The reservoir will affect land areas that belong to Keochia Village and Phianghong Village in Nonghed District in Xiankhonag Province. Additionally the very tail end of the reservoir according to the current design will affect a small area of Sopten Village. The riverbank here is very steep and no houses are located along the river stretch of the My Ly reservoir. The planned Lower Nam Non HPP dam site in Laos is located 0.6km from the Vietnam-Laos border, and the backwater of My Ly HPP overlaps with the planned dam site. Consequently, the tail end of the My Ly reservoir HPP will be considerably shortened (see Section 11.7 on Cumulative impacts).

Impact of the My Ly reservoir and the utilization status of the affected land of the two villages has to be investigated in the detail design phase, and any required compensation negotiated with the affected villagers.

8.3.3 Downstream villages to be potentially affected by the HPP

It is estimated that downstream the planned dam about 28.4km of the river will be potentially affected by low flow during the dry season. There are many villages along this stretch of the river, however, all the villages downstream Yen Hoa Village that is located 2.8km downstream the planned My Ly dam site, are affected by the Ban Ve HPP more than 80 km downstream. The identified downstream villages can be seen in Table 8.1 below. For the cumulative impacts of the My Ly and Ban Ve HPPs (see Cumulative section)

At the full supply level of 200m of the Ban Ve HPP, its reservoir tail end will reach up to Xieng Tam village, which is the My Ly Commune centre, located 5.1km downstream the planned My Ly dam site. Xop Tu village with My Ly Commune health centre and secondary school is located further downstream at a distance of 8.7km from the My Ly dam site. Some households here closest to the river were relocated by the Ban Ve HPP.

Ca River downstream Xop Tu village approx. 9km from the My Ly dam site

Hoa Ly village with intensive riverbank maize cultivation 14.7km from the My Ly dam site

Hoa Ly village 14.7km downstream the planned My Ly dam site is affected by the Ban Ve reservoir water level changes: households living closest to the river were relocated by the HPP, and the riverbank lands that local farmers are utilizing for intensive cultivation get flooded by water release from the dam.

There is a year-round vehicle accessible road along the Ca River from Xieng Tam village through Xop Tu and Hoa Ly further downstream to Pieng Mung village, where the road leaves the river, and the villages further downstream are accessible by boat only. Pieng Mung is an old village, and some households moved there when relocated by the Ban Ve HPP. This village is located by a tributary running into the Ca River, and separated from the river by a hill range.

The further downstream villages within the estimated 28.4km low flow regime of the planned My Ly dam are Ban Ve HPP resettlement villages. There is no road access to these villages, but local small boats are used for transportation of people and goods from a harbour right above the dam.

According to local people in the Ban Ve dam area and in the reservoir tail end area, there is plenty of fish in the reservoir and fishing is a regular activity for local people.

Location of the villages in the Ban Ve reservoir area and the expected impacts from the My Ly HPP on them have to be studied further.

Table 8.1 Villages in the potential downstream impact area

Village	HHs	Population	HH poverty %	Ethnicity	Location
Yen Hoa	99	442	70	Thai, 3 HHs Kho mu	2.8km downstream the dam site.
Xieng Tam	48	287	67	Thai, 5 HHs Kinh	Commune centre, 5.1km downstream the dam site, within tail end of the Ban Ve HPP reservoir.
Xop Tu	175	774	65	Thai, Kho mu, Kinh, Hmong	8.7km downstream the dam site, within impact area of the Ban Ve HPP reservoir.
Hoa Ly	158	702	74	Thai, 3 HHs Kho mu	14.7km downstream the dam site, within the Ban Ve HPP reservoir.
Status of villages further downstream in the Ban Ve reservoir area					

Pieng Mung	Village located by a tributary and separated from the Ca River by hills.
Xen My	Ban Ve resettlement village. No road access.
Ban Tom	Ban Ve resettlement village. No road access.
Cha Luan	Ban Ve resettlement village. No road access.
Sop Pe	Ban Ve resettlement village. No road access. About 28.4km downstream My Ly dam site.

8.4 Agriculture and livestock breeding in the affected communes

8.4.1 Agriculture

Ky Son is a rural district and majority of the inhabitants in its 21 communes are farmers living on upland agriculture and forestry. Cultivable land resources are limited and main part of agriculture takes place in upland areas.

Table 8.2 below provides an overview of land use in the two communes of My Ly and Keng Du to be affected by the My Ly HPP.

Table 8.2 Land use (in ha) in My Ly and Keng Du Communes

SN	Land use	Commune	
		My Ly	Keng Du
1	**Agriculture land (ha)**		
	Wetland rice	31.8	41.0
	Annual crops	45.0	99.2
	Perennial crops	26.0	58.2
	Other farming area	25.0	19.0
		127.8	**217.4**
2	**Forest land (ha)**		
	Protection Forest	15,210	3,204.2
	Production Forest	2,520	148.9
		17,730	**3,353.1**
	Total land area	**27, 109.9**	**8,014.9**
	Households	1,247	888
	Population	5,595	4,329

Source: PECC1, Livelihoods Survey Report, My Ly HPP ESIA (April 2017); Land use Plan of Villages 2015, Keng Du Commune, My Ly Commune; Commune Annual Report 2016, Keng Du Commune, My Ly Commune.

Farmland. My Ly Commune has 128ha of agriculture land (Table 8.2). However, all the forest area is categorized as agricultural land. In addition, My Ly has 2,520ha Production Forest allocated to households for planting trees and cultivating upland crops. It appears that most of the Production Forest area has been converted into upland farming area where rain-fed crops such as upland rice, maize, and cassava are grown on rotation.

There are 217ha of permanent agriculture farming in Keng Du Commune and almost all Production Forests are used for upland farming. Due to limited arable land, slash-and-burn farming is also practiced in some parts of Protection Forests. There is lack of information on the total land area used for crop farming in both My Ly and Keng Du Communes.

Farming practices. My Ly Commune has about 32ha of wetland rice fields on valley floors and 26ha of perennial crops. The wetland rice area is mainly located in the four villages of Xang Tren, Yen Hoa, Xieng Tam and Xop Tu. Wetland paddy area in Keng Du Commune is totally 41ha and located mainly along streams. Since there is a shortage of water during dry season, only one crop a year is grown and the land after harvest is usually left fallow and used as grazing land in winter-spring season. This is Composite Swidden Agriculture (CSA, Swidden agriculture) which integrates several types of land use - including permanent wet rice fields on valley floors or along streams and the river, and rotation of swidden plots, perennial crops, and regenerating forest patches on the hill slopes.

Swidden agriculture is widely practiced particularly in upland Production Forests. Ground vegetation is cleared and burnt and annual crops such as upland rice, maize, and cassava are planted as monoculture. Sometimes, peanuts are intercropped with cassava during wet season. Crops are grown continuously for two years and then left fallow for 3-6 years depending on land availability and its productivity. Since cassava is a long duration crop, a period of three years of fallow is practiced. However, shortage of land allows only one fallow year.

Only a few households cultivate small patches of land along the river or have home gardens.

Crop cultivation. Upland cultivation land is usually located in production forests or protection forests. The area was in January 2017 (collected field information) estimated to be about 1,065ha in My Ly and about 1,531ha in Keng Du Commune. Since upland farming takes place in most of the forest areas, the total area under various crops could be higher. Data on the exact area of swidden farming is not available. Commune land use reports (2015) account for slightly smaller cultivated areas: 1,007ha in My Ly and 1,460ha in Keng Du. According to Keng Du Commune (Land use report 2015), there are 699 households with 2,796ha of fallow land. The main crops grown are upland rice, maize, cassava and peanut.

Table 8.3 Area and productivity of farm crops in My Ly and Keng Du Communes

Crops	My Ly Commune			Keng Du Commune		
	Area (ha)*	Area (ha)**	(mt/ha)	Areas (ha)*	Areas (ha)**	(mt/ha)
Swidden land						
Upland rice	499	550	1.5-2.0	1,096	1,046	1.7-2.0
Maize - hybrid	361	360	3.0-4.0	350	398	3.0-4.5
Cassava	125	65	16-24	70	Na	20-25
Peanuts	80	32	0.1-0.2	15	16	0.16-0.18
Total	**1,065**	**1,007**		**1,531**	**1,460**	
Wet rice	31.8	31.8	3.5-4.0	30	30,0	2.0-3.5

Sources: * Data collected through FGDs in Jan 2017; ** Areas according to the commune statistics (2015).

8.4.1.1 Main crops on swidden land

Upland rice is the main crop, grown rain-fed during the wet season. Local seeds that can tolerate poor soil fertility and minimal crop management are used, and yields are only about 1.5–2.0mt/ha (potential yield can be up to 5-6tons/ha). The applied cultivation techniques are traditional, and crop growth is dependent on rainfall patterns. Sometimes the yield is even lower than 1mt/ha due to unfavorable weather conditions, traditional cultivation methods, crop diseases and pests, shortened fallow periods, and low quality seeds (which are not selected from good crops).

Change in precipitation and temperature regime affects rice production. Improved agronomic practices and improved seed materials could increase rice yields. Rice is staple food and the locally preferred crop.

Table 8.4 Average household upland farming area size

Crops	My Ly Commune		Keng Du Commune	
	Average	Maximum*	Average	Maximum*
Upland rice	1.0–2.0 ha	3.0–3.5 ha	1.0–2.5 ha	2.5–3.0 ha
Maize	0.7–1.5 ha	2.0–2.5 ha	0.5–0.8 ha	1.0–2.5 ha
Cassava	300–500 roots/hh	Up to 3,000 roots/hh	100–150 roots/hh	Up to 3,500 roots/hh
Peanuts	1,200–1,500 m^2	-	Small patch	

Source: PECC1, Livelihoods Report, My Ly HPP ESIA (April 2017). * A few households with access to land and labor cultivate larger areas.

Maize is grown during the wet season; planting is done in June and harvested in November. Most farmers use hybrid maize seeds. Although they use some fertilizers, there has been no improvement in traditional agronomic practices. Yields of 2.5 to 4.0mt/ha are considered low for hybrid maize, with a potential yield production of 6-7mt/ha. Low yield is primarily due to unfavorable weather conditions such as long lasting droughts and declining soil fertility level. About 60-80% of the harvests are sold and the rest are fed to livestock.

Cassava is a perennial root crop and has to be grown two years before harvesting. On the average, each household plants 300–500 roots/year, each root on $2m^2$ (5,000 roots/ha) in the beginning of the wet season; a few households plant up to 3,000 roots in large areas. Yield can be as high as 20–25mt/ha depending on the duration of the crop. Harvested roots are usually fed to livestock and used for wine making.

Peanuts are grown in small patches as rain-fed crop, particularly by Thai villagers. It is usually intercropped with maize or cassava or even grown alone in small patches of approximately 1,200–1,500m^2. Local seeds are used and the yields are poor, 100-200kg/ha. Harvest is about 10–30kg per household, and most of the production is sold to traders.

Wetland rice is grown along streams and the Ca River where irrigation water is available. The total area is totally about 32ha and located in the four villages of Xang Tren, Yen Hoa, Xieng Tam and Xop Tu in My Ly Commune (Table 8.48.5). Only one crop during the wet season is grown because there is not enough moisture in the soil, and no irrigation water available for a second crop. Land after harvest is left fallow for grazing livestock. The average yield is about 3.5–4.0mt/ha. In Keng Du Commune, where the total wetland rice area is about 30ha, however, the average yield is reported to be lower at 2.0–3.5mt/ha.

Vegetable and fruit cultivation. Vegetables are usually planted along the river or in the homestead gardens covering a small area of 50–100m^2. The common vegetables planted are *Brassicaceae* (crucifers, mustards and cabbage family), *Lactuca sativa* (lettuce), and *Allium* (onion, garlic, leeks and chives). The crops are cultivated for family food. Most of the vegetables are planted in Thai villages. The Kho Mu generally do not plant vegetables but instead collect wild growing vegetables in the forest.

Fruit trees are planted around houses or along the river and sometimes on swidden farms. The common categories are Longan (*Dimocarpus longan)*, pomelo (*Citrus maxima*), mango, papaya (*Carica papaya)* and pine apple (*Ananas comosus)*. The yields are often low and the fruit is therefore for family use only.

8.4.2 Livestock farming

Livestock is an integral part of the farming system in the Project AI communes. Cattle, buffaloes, pigs, goats and poultry including ducks and geese are the main livestock being reared. On average, each household in My Ly Commune has 3 cattle, 1 buffalo, 3 pigs and 15 poultry birds. A few households also keep goats (Table 8.5**)**. In Keng Du Commune an average household rears less number of cattle, buffalo and pigs but more goats than in My Ly Commune. Free-range grazing is the common practice, however a few households near the commune centre stall-feed animals with fodder and livestock feed. Most of the livestock raised are of local breed that is adapted to low level of feeding and management. Cattle, buffaloes and goats are reared for sale, while pigs and poultry are reared both for sale and for home consumption. Livestock directly contributes to household income. The major constraints in livestock improvement are disease prevalence, and the lack of effective animal health services, winter forage and market.

Table 8.5 Livestock reared in My Ly and Keng Du Communes

Livestock	My Ly Commune		Keng Du Commune		Rearing significance
	No.	No./HH	No.	No/HH	
Cattle	3,913	3.1	1,027	1.2	1
Buffaloes	1,243	1.0	315	0.4	1
Goats	522	0.4	1,112	1.3	3
Pigs	3,741	3.0	1,310	1.5	2
Poultry (chicken, ducks, geese)	18,705	15	2,615	3	3

Source: PECC1, Livelihoods Report, My Ly HPP ESIA (April 2017).

Ruminant livestock. 3,913 cattle, 1,243 buffaloes and 522 goats are reared in My Ly Commune. Each household has 2–3 cattle and buffaloes, and some households rear up to 30–50 animals. Some households raise goats, usually 10–15 goats each. In Keng Du Commune, the total amount of ruminant livestock is 1,027 cattle, 315 buffaloes and 1,112 goats. Each household rears 1–2 cattle and buffaloes, and some rear up to 15–20 animals.

During the planting season all ruminants are grazing in forests, while in the dry season they are grazing on both forest and fallow land. Availability of forage appears to be a major problem for ruminant livestock. Grazing areas in forest and fallow lands have decreased due to increasing demand for arable land, and in recent years the fallow period has become shorter. Forage shortage is serious during the winter. Another major constraint for livestock improvement is the lack of effective animal health services. Low level of nutrition and poor health services leads to many livestock deaths.

Pigs. Each household rears 1–3 pigs that are left free-ranging. Some households in My Ly Commune raise 5–6 hybrid pigs each which are stall-fed with commercial feeds. Farmers feed maize and cassava to pigs. Pig rearing has a crucial role in household income. Annually each household sells 2–4 pigs. Disease occurrence is high in March to June, and farmers lose many piglets. There is no available animal health service in the Project AI villages.

Poultry. Each household rears 5–6 chicken and/or ducks and geese. Some farmers rear a large flock of 20–50 birds. There are more poultry in My Ly Commune than in Keng Du Commune. The poultry breed is locally adapted to a free-ranging system. Disease occurrence is high and there is no effective animal health service in villages. Poultry is raised for home consumption and for sale.

8.5 Agriculture and livestock farming in Project AI villages

8.5.1 Villages in Vietnam

There are totally 739 households in the Project AI villages in Vietnam. The upland area under annual cultivation totals 940ha and wetland paddy area 23ha. Additionally, there is about 1,180ha of upland fallow land. The villages have totally 704ha of upland rice, 311ha of maize, 99ha of cassava and 20ha of other crops including peanuts (Table 8.6).

The estimated livestock reared in these seven villages totals 1,935 cattle, 535 buffaloes, 996 goats, 2,088 pigs, and 8,664 poultry. Buffaloes are reared in all the villages except in Huoi Phuon 1, and goats are raised in Xop Doung, Xang Tren, Huoi Phuon 1 and Hat Ta Ven. Pigs and poultry are reared in all the villages (Table 8.7).

Table 8.6 Estimated area under crop cultivation in Project AI villages in Vietnam

Village /Commune	Households	Population	Swidden land (ha)					
			Rice	Maize	Cassava	Others	Total	Wet rice
My Ly Commune, Ky Son District								
Cha Nga	97	435	109	45	10	2	166	-
Xop Duong	61	224	93	9	6	2	110	-
Xang Tren	174	688	223	35	26	3	287	6
Total	**332**	**1,347**	**424**	**89**	**42**	**8**	**563**	**6**
Keng Du Commune, Ky Son District								
Keng Du	46	183	31	46	12	3	92	2
Huoi Phuon 1*	93	388	71	35	13	3	122	
Hat Ta Ven*	130	636	81	104	26	4	215	15
Huoi Xui*	138	564	97	37	6	2	142	-
Total	**407**	**1,771**	**280**	**222**	**57**	**12**	**571**	**17**
Vietnam total	**739**	**3,148**	**704**	**311**	**99**	**20**	**940**	**23**

Source: PECC1, Livelihoods Reports and Village Baseline Reports, My Ly HPP ESIA (April 2017).
Note: Average farmed area by household for each crop is multiplied with the total number of households to get a better estimate of land under cultivation.
*Note: Only some cultivated land of Huoi Phuon 1, Hat Ta Ven and Huoi Xui villages will be affected

Table 8.7 Livestock reared in Project AI villages in Vietnam

Village	Cattle	Buffalo	Goat	Pig	Poultry
Cha Nga	200	100	0	388	579
Xop Duong	200	84	70	200	1,050
Xang Tren	472	250	100	174	3,045
Keng Du	240	10	0	230	700
Huoi Phuon 1	144	0	576	768	2,400
Hat Ta ven	350	48	250	390	100

Village	Cattle	Buffalo	Goat	Pig	Poultry
Huoi Xui	325	43	0	118	790
Total	1,935	535	996	2,088	8,664

Source: PECC1, Livelihoods Reports and Village Baseline Reports, My Ly HPP ESIA (April 2017).
Note: Average number of livestock/household is multiplied with the total number of households to get a better estimate of the total livestock number. Most of the animal numbers are given in Livelihoods numbers.

8.5.1.1 Xang Tren Village

Crop farming. Villagers plant rice, maize and cassava on swidden land. On an average, each household cultivates 1–2ha of rice, 0.1–0.3ha of maize and 0.1–0.2ha of cassava. They cultivate uplands crops for 1-2 years and leave the land fallow for 2-6 years before using it again.

Agricultural activities usually begin in May of the lunar calendar[92] with soil softening and grass cutting (or slashing and burning vegetation if a new land plot is taken into use). The crop lasts 5–6 months, and harvest takes place in October or November. Farmers mostly grow upland rice, on 78% of the cropped area, followed by hybrid maize, 12.5%, and cassava 9% of the cropped area. Each household plants 1,000–1,500 cassava roots, and the yield of the two-year roots is 7–8 kg/plant. Annually about 287ha of swidden land is used for upland farming.

Some 20–30 households in Xang Tren Village grow various crops along the river, mainly for domestic consumption: Banana, sugar cane, sweet potato, taro, onion, kale, melon, squash, and potato. Each household has a few mango trees or lúcuma trees for producing fruits for household consumption.

This village has about five ha of wetland paddy land, and six households grow paddy on it. It is supposed to be a double-cropped area, but due to lack of irrigation water, farmers normally harvest one crop per year.

Livestock farming. Xang Tren is divided into three livestock farming groups with four pastureland areas for cattle and buffaloes. About 130–140 households rear cattle with 3–4 cattle per household; about 100 households have 1–4 buffaloes each, and 20 households raise totally some 100 goats. All the 174 households rear pigs with at least one pig/HH and from 15 to 50 poultry/household. Altogether there are some 472 cattle, 250 buffaloes, 100 goats, 174 pigs and 3,045 poultry in the village (Table 8.9). All the livestock are of undescribed local breeds, adapted to poor feed and care, which lead to low productivity: a one-year-old pig may weight only 45 kg. Farmers are aware of cattle vaccination and of some other disease prevention measures. However, livestock rearing is challenging due to animal diseases and poor veterinary services.

8.5.1.2 Cha Nga Village

There are four production groups in Cha Nga village and each household has an average cultivation area of 3ha, of which approx. 1–1.5ha is rice, 0.1–0.2ha maize and 0.1ha cassava. Rice production is 2–3mt/ha but prolonged droughts may reduce the yield to less than 1mt/ha. Some households grow peanuts. Annually about 166ha swidden land is used for cultivation of rice, maize and cassava.

Not all households rear livestock: 70 households rear about 200 cattle, 40 households rear about 100 buffaloes, and a few households rear pigs and poultry. All households used to rear chicken and pigs, but in mid-2016 many chicken and pigs died in diseases. In Jan 2017

[92] The cultivation cycle follows the Moon calendar and May in the Moon calendar falls between May and July in the international (Gregorian) calendar.

only 10 households were raising about 50 poultry and a few households were rearing pigs near the river. No livestock vaccination services are available in this village, and veterinarians visit the village only when requested.

8.5.1.3 Xop Duong Village

Arable land is allocated to 7 production teams each consisting of 7-9 households each. The average area for upland rice is 1–2ha/household (93ha), and hybrid maize 0.1–0.2ha/household (9ha). Each household plants cassava roots in small patches. Upland crops are grown annually on 110ha of swidden land.

Almost all households rear at least one or two kinds of livestock; each household rears 2–3 or maximum 4–5 cattle, 15-20 poultry and 3-4 pig. 20 households rear totally 84 buffaloes and 15 households rear 70 goats. Altogether Xop Duong village has about 200 cattle, 84 buffaloes, 70 goats, 200 pigs and 1,050 poultry birds. Forage scarcity during winter months and prevalence of animal diseases are the main problems in livestock farming.

8.5.1.4 Keng Du Village

There are five agriculture production groups that grow rice, maize and cassava on about 92ha of swidden land. On an average each household grows 0.5–1.0ha of rice, 1.0ha of hybrid maize, 0.1–0.3ha of cassava, and some areas are under peanuts and other crops. Farmers face adverse conditions such as unfavorable weather conditions, prolonged draughts, and erosion and soil degradation.

One household in the village cultivates 2ha of wetland paddy with irrigation water from the nearby stream. Only one crop can be grown annually, because no irrigation water is available for a second crop.

There are totally 240 cattle, 10 buffaloes, 230 pigs and about 700 poultry; 5–7 households rear hybrid pigs, each 4–5 pigs. Grazing area is limited and there is a shortage of fodder for livestock. Moreover, animal disease epidemics have killed a large number of poultry and cattle.

8.5.1.5 Huoi Phuon 1 Village

This village has an area of 122ha for annual crops but there is no wetland paddy land. On an average each household cultivates 0.5–1.2ha of upland rice, 0.3–0.8ha of maize, and 0.1–0.2ha of cassava. About 50 households cultivate peanuts in small patches using 1kg seed and harvest about 30–40kg peanuts. They also grow vegetables on upland fields for home use. Some households have riverside land that is used for cattle grazing.

On an average each household raises 1–2 cattle, 5–7 goats, 6–10 pigs and 20–30 poultry. Animal health service has not been effective, so farmers have lost many small animals.

8.5.1.6 Hat Ta Ven Village

The village has at least 215ha swidden land for cultivating upland paddy (81ha), hybrid maize for grain (104ha), and 26ha of cassava (Table 8.8). On an average each household cultivates 0.5–0.8ha of upland paddy, 0.2–1.0ha of hybrid maize, and about 80% of the households plant approx. 0.6ha of cassava each. Farmers also plant local maize for fodder and grow potatoes and peanuts in small areas for home consumption.

About 40 households plant wetland rice, one crop a year near streams and the river, covering about 15ha of paddy land. Due to adverse weather conditions during the last two years, particularly prolonged droughts, grain harvests have decreased. Depleting soil fertility is another constraint.

350 cattle, 48 buffaloes, 250 goats, 390 pigs and just over 100 poultry birds are reared in the village. Not all the households rear all kinds of livestock; 121 households (93%) rear cattle, but only 6 households rear buffaloes. Poultry number decreased due to diseases in 2016. Farmers are aware of animal health and vaccination. They request help and treatment from veterinarians, but the available animal health service is poor. Cattle and buffalo dung are applied in vegetable farming.

8.5.1.7 Huoi Xui Village

There is about 142ha of swidden land in the village. On an average each household cultivates 0.6–1.0ha of upland paddy (totally 97ha), 0.2–0.4ha of hybrid maize (totally 37ha) and some cassava. Some farmers grow small patches of peanuts and other crops.

Altogether 325 cattle, 43 buffaloes, 118 pigs, and 790 poultry birds including ducks are reared in this village. Almost all households rear cattle and buffaloes; 12 households raise 5–8 buffaloes and cattle each. All households raise pigs and poultry; 1–2 pigs and about 5–6 poultry/household. No improved breed of livestock is reared in the village.

8.5.2 Villages in Laos

Land use. There is 3,076ha of forest in the Project AI villages (Table 8.8). In all villages people have encroached on production forest for upland cultivation. Upland cultivation covers 207ha, averaging 1.6ha per household.

Table 8.8 Land use (in ha) in Project AI villages in Laos

Agriculture and forest land	Area (ha)					
	Kengkor	Phiangsang	Phiangthat	Sopkang	Sopsan	Total
Upland cultivation	50.0	10	54	48	45	207
Forest	563.9	182.0	1439.7	557.3	332.9	3,075.8
Production forest	174.5	110.2	40.6	272.0	182.5	779.8
Conservation forest	313.9	71.8	386.7	92.2	150.4	1,015.0
Protection forest	75.5	-	1,012.4	193.1	-	1,281.0
Households	29	9	44	48	16	146
Population	150	36	276	320	89	871

Source: PECC1, Livelihoods Reports and Village Baseline Reports, My Ly HPP ESIA (April 2017). Land use plan of villages in 2015.

Upland rice is the major crop grown on about 172ha (83% of the total cropped area) followed by maize on 35ha (13%). All households plant cassava but the total area covered is just about 9ha. Peanut is grown only in Kengkor village. On an average each household cultivates 1.18ha of upland rice, 0.24ha of maize, and 0.06ha of cassava. Farming area is very limited in these villages.

Table 8.9 Crops grown on swidden land (in ha) in Project AI villages in Laos

Village	Rice	Maize	Cassava	Peanut/ others	Total
Phiangsang	10	3	1	x	10
Sopsan	24	20	1	x	45
Sopkang	41	5	2	x	48
Kengkor	47	1	1	1	50
Phiangthat	44	6	4	x	54
Total	172	35	9	1	207

Source: PECC1, Livelihoods Reports and Village Baseline Reports, My Ly HPP ESIA (April 2017).
Note: Average farmed area by a household for each crop is multiplied with the total number of households to get a better estimate of land under cultivation.

Table 8.10 summarizes the productivity of farm products in the different Project AI villages in Lao PDR. In terms of production, cassava has the highest yield among the crops.

Table 8.10 Productivity of farm crops (mt/ha) in Project AI villages in Laos

Villages	Swidden land			
	Rice	Maize	Cassava	Peanut
Phiangsang	1.1-2.0	4.0-4.5	15-17	
Phiangthat	1.5	2.5-3.5	18-20	
Sopkang	1.5-2.2	3.0	16.0-18	
Kengkor	1.5-2.0	3.5-4.0	18.0	0.15
Sopsan	1.5-2.0	3.5-4.0	18 - 20	

Source: PECC1, Livelihoods Reports and Village Baseline Reports, My Ly HPP ESIA (April 2017).

8.5.2.1 Crops Grown on Swidden Land

Upland rice. Each household cultivates about 1.2ha of upland paddy and produces about 2,500kg of grain. Some households with good access to land cultivate up to 2.0ha. There is annual food insecurity during 2–3 months. Upland rice yields are low, 1.2–2.0mt/ha.

The growing season is from June to November. The soil is fertile due to long fallow period and land is available, but due to shortage of labor farmers are unable to cultivate more land. There is no change in traditional agronomic practices, and the changes in weather pattern causing droughts affect grain production.

Maize. Most farmers grow hybrid maize without applying fertilizers. The average yield is in the range of 2.5–4.5mt/ha, which is considered low for hybrid maize. Each household cultivates 0.3–0.5ha and produces 1,300kg of maize grain. Corn is usually sold to Vietnamese traders but some is used as livestock feed as well. Planting season is from June to November. Local people indicated that changing weather pattern - longer duration of droughts – together with the traditional cultivation practices are the major causes of low production.

Cassava is cultivated without applying any fertilizer. Each household plants 300–500 roots/year to a maximum of 1,000–2,000 roots. The harvested roots are fed to livestock.

Peanuts are planted only in Kengkor village in small patches of land as a monocrop or intercropped with maize or cassava. Each household produces about 10-30 kg of peanuts for its own consumption only.

Vegetables and fruits. Vegetables are usually planted along the river or in the home gardens that cover a small area of 10–20m^2. The common planted vegetables are *Brassicaceae* – crucifers, mustards and cabbage family, *Lactuca sativa* - lettuce, nd *Allium* – onion, garlic, leek, chives etc. All vegetables are for home consumption. Mango, papaya and other fruit trees are planted around houses or along streams.

8.5.2.2 Livestock farming

Livestock is an integral part of the farming systems in the Project AI villages. Totally 730 cattle, 66 buffaloes, 23 goats, 845 pigs and 875 poultry are reared in the five villages (

Table 8.11 8.13). Not all kinds of livestock are raised in every village: Buffaloes are raised only in Kengkor and Sopsan, goats are reared only in Kengkor, but pigs are raised in all villages except in Phiangthat. Livestock breeds are all local, adapted to free-range grazing and low level of management. Cattle, buffaloes and goats are reared for sale while pigs and poultry are reared both for sale and home consumption. Usually Vietnamese traders go to the villages and buy live animals. There is no local market for agriculture and livestock products. Livestock directly contributes to household income. The major constraints in livestock improvement are disease prevalence, poor fodder and management, and the lack of effective animal health services and market.

Table 8.11 Number of livestock reared in Project AI villages in Laos

Livestock	Phiangsang	Phiangthat	Sopkang	Kengkor	Sopsan	Total
Cattle	30	80	500	100	20	730
Buffaloes	x	x	x	60	6	66
Goats	x	x	x	23	x	23
Pigs	20-30	x	500	70	250	845
Poultry (chicken, ducks, geese)	20--30	x	200-300	x	600	875

Source: Estimated based on FGDs in villages in January 2017.

Ruminant Livestock. Each household raises 2–3 cattle, but some rear up to 15–20 animals. Cattle is grazing freely on the fallow land and/or in the forests. There is shortage of forage during winter. Disease prevalence is high while available animal health services are poor or nearly non-existent, and consequently many animals die. All these animals are reared mainly for sale and occasionally used for family celebration.

Pigs. Each household has 2–3 pigs reared on free-range system. Pigs are raised for celebrations and slaughtered for the whole village or for some households. Some households raise more pigs and sell some to Vietnamese traders. Raising pigs faces many difficulties such as fatal diseases especially in March and June.

Poultry. Most households raise 5–10 chicken, ducks, and geese. Some households rear up to 40–50 birds. In Kengkor and Phiangthat villages, farmers do not keep any poultry. Poultry is reared mostly for home consumption and sometimes sold to Vietnamese traders coming to villages.

8.6 Current intervention in the Project AI

Provincial government has supported cattle improvement and crop development program through Agriculture Extension Office situated in Ky Son District, Vietnam. The commune level animal health worker/veterinarian provides villages with animal health services such as vaccination and disease treatment. However, the assigned service provider cannot cover all the villages in a commune and usually lacks modern skills and techniques as well as medicines for treating different kinds of livestock and different diseases. Government intervention is generally low in the mountain terrain where the scope of commercial agriculture production is low.

Program 30a, a poverty reduction program, has supported some farmers for increasing their household income through provision of seedlings and small livestock, e.g. poultry and pigs, and basic skills training on livestock improvement. Due to poor animal health services, farmers often lose livestock. There is no crop improvement or soil fertility enhancement program.

8.7 Major constraints in agriculture

8.7.1 Farming system

The Project AI has a mountainous terrain and the people living there are ethnic minority people who rely on subsistence farming for their livelihoods. The area for wetland paddy and for perennial crops is limited. Farmers grow rain-fed crops on swidden land on slopes located mostly in production forests. They harvest one crop per year and leave the land to fallow between 3 to 6 years. On sloping land without terraces, animals or machines cannot be used for ploughing land and therefore farming operations are done manually. Farmers use local seed materials except maize and farming technology has not improved over the years. Many farmers do not grow vegetables because they prefer to collect wild-growing vegetables for home consumption in the forests. Crops are grown as monocultures, but peanuts, ginger and other crops grown in small areas are also intercropped with cassava and maize. Agriculture extension service is deficient.

8.7.2 Soil fertility

There is no intervention observed in improving swidden cultivation in the Project AI. This agriculture practice is not sustainable: The period of keeping land fallow after cultivation to rejuvenate soil fertility is very short (not sufficient for the soil to recover) due to demand for farming the land again. Fertilizers are not used, except occasionally in maize cultivation, and there is no system of compost making although a few farmers in Hat Ta Ven use cow dung in vegetable plots. Legumes are not grown as main crop or as an inter-crop which could gradually build up soil fertility. In upland agriculture, annual cropping without reasonable improvement measures rapidly degrades soil. Farmers indicated poor crop yields due to low soil fertility.

8.7.3 Climate change

Crop yields are highly varying, and farmers reported reduced yields due to unfavorable weather conditions and long periods of droughts. Yield of the hybrid maize is only 40-50% of its potential. Failures of harvest were reported during the FGDs conducted in the villages in January 2017. Climate change effects will be more profound for crops growing on swidden land because these crops grow under natural conditions and wholly depend on rainfall and temperature regimes, which are gradually changing.

8.7.4 Livestock feeds and fodder

All the livestock reared are of undescribed local breeds, adapted to free-ranging system and low level of nutrition and management. Farmers reported ruminant fodder shortage during winter months; in some villages an acute shortage was noticed. A few farmers in Hat Ta Ven Village grow local maize as a fodder crop. Some farmers rearing hybrid pigs buy commercial livestock feeds. Nutrition level needs to be improved for livestock development and better yields.

8.7.5 Animal health service

Livestock health status is in general poor and high mortality in pigs and poultry was reported. Animal health service is not easily available; it is costly and of poor standard. Farmers are not trained and are unaware of disease incidence. In some villages, farmers are aware of prevention methods such as vaccination, but the lack of veterinary services makes it very difficult for them to improve their livestock farming.

CHAPTER 9: CROSS-CUTTING ISSUES

9.1 Gender

Gender roles in the Project AI communities are defined by both ethnicity and livelihoods production system. The affected people in both Vietnam and Laos originate from Thai and Kho mu ethnic minorities. These groups have been living together in the same geographical area and the same environment for generations, and the Kho mu have been influenced by the Thai that traditionally has been the dominating group. The Thai have a matrilineal descent, and women have a strong position in the household. The Kho mu have adopted the Thai custom of temporary matrilineal residence, and a newly married Kho mu couple stay with the bride's family and may only later choose its permanent location. Women's domain is the family and they may take decisions within the household, however, in the village society, decision-making and leadership is left for men, and very few women, if any, have any leadership position. A traditional Thai village elders' group consists of equal number of elder men and women, but men's opinion is worth double the opinion of women when decisions are taken.

Both men and women work hard in the agricultural fields, in the forests and connected to the river, but with partly different tasks. Men undertake the hardest work in agriculture, such as clearing a field in the forest, in the forest environment they are hunting and logging timber while women collect NTFPs for family food and firewood for cooking (Plate 9.1). Women are fishing neither from boats nor with nets like men do, but they catch fish with baskets and collect shrimps, snails and moss in the shallow waters near the river shore. Cooking and childcare are female tasks. Thai women are skillful in weaving; some women grow cotton and raise silkworms for producing thread, every household has a loom, and women weave colorful skirts which they sell to traders to get cash income.

Women's educational level is generally lower than that of men, more women than men are illiterate and are not fluent in communication in the national language (Vietnamese or Lao). Girls drop out of school in order to help in the household work, and it is not uncommon for girls to get married when 15-17 years old, Kho mu girls may get married even at the age of 13-14 years.

Women are less mobile than men, Kho mu girls and women are even discouraged by tradition to travel outside the village, and then only with male company. While men go to commune or district centre by motorbike or boat, women do not know how to drive a motorbike, they do not drive river boats, and seldom move outside their village and production areas; women may visit other villages for socializing with relatives and for festivities like weddings and funerals, but many women in the project-affected villages visit the commune or district centre only once or twice a year. Women have very poor access to healthcare; due to the distance and cost of travel, they do not attend the annual female health check-ups provided by the commune health centre, and they are not reached with information about child health and nutrition to keep their children healthy and well nourished.

Women have less contact with the world outside their village and the nearby environment than men, and their knowledge and skills are accordingly limited to the daily living and livelihoods environment of their own group. Women's capacity to learn new methods and skills in livelihoods activities such as cultivation methods or animal breeding is hampered by tradition, low educational level and isolated traditional lifestyle. In this environment, women are shy and dare not speak up to tell their opinion or ask questions in order to understand issues that are dealt with in a meeting in village. It is therefore important to design HPP impact mitigation programs for relocation and livelihoods restoration in a way that is culturally sensitive and appropriate and considering separately the roles and capacities of ethnic minority men and women.

All consultations and training programs should be arranged in a language that is understandable and culturally appropriate for ethnic minority men and women, and separately for men and women in order to ensure that women's opinions are heard, documented and taken into consideration, and that women will be able to understand and develop the skills needed for restoration of their and their families' lives and livelihoods affected by the HPP. It is likewise crucial to consider the vulnerability of ethnic minority girls and women with little regular contact with the outside world in a situation when thousands of workers and camp followers from a totally different culture with available money and different habits will be present in their remote home area. Mitigation program for adverse social impacts from the HPP construction has to be based on the vulnerability, cultural situation and knowledge level of the local ethnic minority people, especially of girls and women.

Kho mu woman feeding pigs

Woman working in upland maize field

Thai woman weaving

Elder Thai woman in traditional clothing

Plate 9.1 Women and livelihoods in the project area of influence.

9.2 Livelihoods

Currently, livelihoods of the local communities in Laos and Vietnam in the Project AI depend upon forest, water and land resources, the later in the form of swidden (shifting / slash and burn) agriculture (Figure 9.1)**.** Forest dependence is high, with protein resources, edible and medicinal plants: providing vegetables, materials for household energy, construction and other use, and animal protein through small mammals, birds, rodents, lizards and amphibians. Water resources provide free protein through fishes and aquatic insects. Apart from daily food, both these resources are helpful in generating some occasional cash through sale of small mammals and rodents. Livestock is another source providing animal some protein (mainly poultry) and cash through the sale of live animals, but disease outbreaks cause immense loss: there is little animal health available. Agriculture in the form of swidden system is less productive and provides carbohydrate needs in the form of rice as the staple food while maize and cassava for livestock. Rice production is, however, is not sufficient for yearly consumption needs for the poor families whose numbers are comparatively high, thus food insufficiency is common. Thus, food security is a serious aspect influencing PAP lives and wellbeing. This livelihoods scenario among the ethnic minorities/groups will continue resulting in deterioration in forest and other land in use until changes are brought to the practices used and sustainable processes are put in place. The My Ly HHP project affecting the above resources will have detrimental effects on livelihoods of ethnic minorities living in the Project DIA. In the context of livelihoods, forest resources are significantly more important than fisheries, livestock and crop farming as these provide a reliable and available source of food and other products.

Under the social programs of the ESMP, various plans are recommended to provide alternative livelihoods for the community such as Agriculture, Livestock and Fisheries Support Programs. Since the forest resource has been the primary source of the communities livelihoods, a biodiversity enhancement and buffer zone management plans are also recommended (See Chapter 13 for the elaboration of these plans).

9.3 Biodiversity

The terrestrial ecosystem, mainly forests and grasslands, and aquatic ecosystems and their quality in the form water resources in rivers, as a function of river's catchment, provide a good habitat for wildlife and aquatic life including fish. Biodiversity of forest vegetation and wildlife are inter-related, and serve to provide products for humans, enriched soil (after a few years or regeneration) for agriculture and work to reduce siltation through providing a more stable land cover than, for example, grasslands do. In the My Ly HPP area, biodiversity of forest vegetation is low. A growing secondary forest vegetation after exploitation or developing through a progressive forest succession on uncultivated fallow land has a comparatively low cover but it is growing. This is reflected in the riverine location of habitats where biodiversity of wildlife is limited to smaller size mammals, e.g., rodents and bats, and reptiles and amphibians. A past long period of exploitation of mature forests has depleted larger wildlife and timber resources. Short- to long-distance migratory fish species and resident species make-up the existing fish biodiversity, however a dam (Ban Ve HPP) operating downstream from the proposed My Ly HPP has already impacted upward movement of migratory species, particularly for spawning. Nonetheless, the presence of 77 fish species and several other aquatic species in Ca River indicate that the biodiversity has not deteriorated significantly.

Both the terrestrial and aquatic ecosystems in the Project AI provide tangible food products and some cash flow for the ethnic minority communities. The communities in the Project AI depend more on forest resources including wildlife and aquatic resources, fish and other, for their livelihoods than on crop farming which is restricted to mainly upland rice. The food resources from the forests are vital, for daily needs and during lean periods when food is insufficient. In general, a hydropower project disturbs the ecosystem, and as in the case of My Ly HPP it will affect significantly product available from forests and rivers to the local people. The mitigation suggested is meant to minimize impacts due to the land-take of the Project through proposing forest conservation, biodiversity restoration and agriculture enhancement measures linked to community involvement (see Chapter 12).

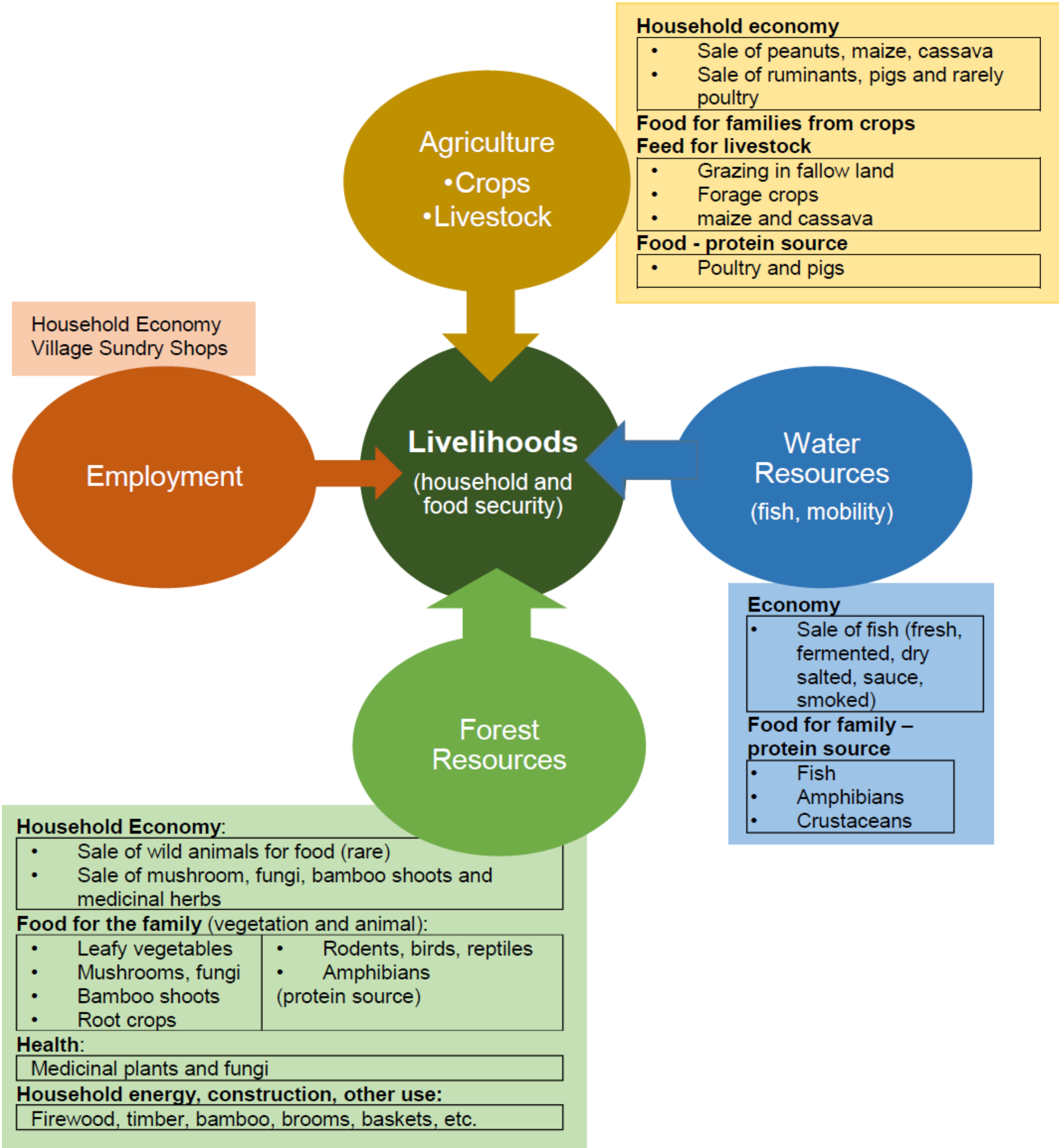

Figure 9.1 Livelihoods of Project affected households dependent primarily on forest resources followed by upland agriculture and the water resources of the river.

9.4 Ecosystem services

Ecosystem Services are the benefits that people derive from the ecosystems and includes four types: provisioning, regulating, cultural and supporting services. In the case of My LY HPP the most relevant types are those provisioning services commonly referred to as natural resources, e.g., water, food and fuel contributing to the human well-being, being central to livelihoods in the DIA and IIA. In order of decreasing relative contribution to livelihoods and importance the ecosystems services including provisioning, cultural, recreation are from

- Forest and forest-bamboo (food sources mainly rodents, snakes, birds); medicinal plants; firewood, wood for construction);

- Land (agriculture for rice production, cash crop (peanuts) and feed (maize and cassava) for livestock, some grazing of livestock; vegetation cover that provides for soil and slope stability in DIA and IIA).
- Water (fish, crustaceans; transport; cultural importance linked to rituals related to burials and spirits; bathing); and

The dependence on the forest and forest-bamboo ecosystems is high and its contribution is directly contributing to by provision of food sources, especially protein in the form of rodents and snakes. Many HH make daily collections for food sources from forest ecosystems. The areas that will be inundated will result in a loss of core nutrition and protein source. The water resources of the river are important sources of fish for many villages located in the planned inundation area (DIA, reservoir). This ecosystem service will change in composition and will need to be managed if the reservoir is to be used as a source of fish. The river which is currently free flowing and the downstream dam is more than 80km away is an important rapid way of travel across the river and along the river. Burial ritual related sacrifice (chickens) is performed with the river serving as a pathway for spirits.

There are intimate livelihoods links with forests, the Ca River and upland lands which all provide ecosystem services to the local communities. Ecosystem services and their dependence to communities is high and the loss is significant. The conservation and sound management of forests ecosystems and sustainable use of agricultural and grazing land is required in the relocation areas, so that the ecosystems services are available. The river provisioning services may be lost, accept for fishing in the form of aquaculture.

CHAPTER 10: COMMUNICATION, PARTICIPATION & DISCLOSURE

10.1 Introduction

A Public Consultation and Disclosure Plan (PCDP) is prepared for the My Ly HPP as proposed by My Ly – Nam Mo Hydropower JSC. The Project Proponent[93] is required to develop and implement a PCDP for a project identified as a "Category A" based on criteria of MIGA. The *Policy on Environmental and Social Sustainability* (MIGA 2013), *Performance Standards* (MIGA 2013)[94] and *Guidance Notes* (IFC, 2012) have guided the public consultation and disclosure procedures.

The PCDP aims to:

- Identify key local stakeholders and ensure there are adequate mechanisms for stakeholder feedback and information sharing;
- Carry out *meaningful consultation*[95], encapsulated by the practice of Disclosure of Information, Consultation and Informed Consultation and Participation (ICP) of the MIGA PS (Box 1) in a mutually acceptable process between the client and affected communities of ethnic minorities (MIGA PS7).
- Provide a framework for consultation at the local, national and international levels.
- Ensure that issues raised by key stakeholders are addressed in the ESIA report as well as in the project decision-making and detailed design phase;
- Provide mechanisms that ensure the formulation of the RAP based on the framework RPF (entitlements) prepared as part of the My Ly HPP ESIA;
- Identify the level of resources required to implement the plan and procedures to monitor implementation;
- Outline principles for grievance mechanism for local stakeholders;
- Ensure project benefits for the affected people through gender-balanced participation of different stakeholder groups.

Box 1. From the Performance Standard 1 of the MIGA, 2013 (*adapted for terminology)*

Indigenous Peoples (Ethnic Minorities)

32. For projects with adverse impacts to Indigenous Peoples, the client is required to engage them in a process of ICP and in certain circumstances the client is required to obtain their Free, Prior, and Informed Consent (FPIC). The requirements related to Indigenous Peoples (Ethnic Minorities) and the definition of the special circumstances requiring FPIC are described in Performance Standard 7.

Disclosure of Information

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[93] The terms "Proponent" or "Client" are used in this plan as per practice by some International Finance Institutions (IFI) including MIGA (PS 2013). It refers to the term "Sponsor" as is often the term used in IFC documents.

[94] MIGA (2013) and IFC (2012) Performance Standards are identical and MIGA applies Guidance Notes of IFC (2012).

[95] Meaningful Consultation. A process that (i) begins early in the project preparation stage and is carried out on an ongoing basis throughout the project cycle; (ii) provides timely disclosure of relevant and adequate information that is understandable and readily accessible to affected people; (iii) is undertaken in an atmosphere free of intimidation or coercion; (iv) is gender inclusive and responsive, and tailored to the needs of disadvantaged and vulnerable groups; and (v) enables the incorporation of all relevant views of affected people and other stakeholders into decision making, such as project design, mitigation measures, the sharing of development benefits and opportunities, and implementation issues (ADB. Safeguard Policy Statement, 2009).

29. Disclosure of relevant project information helps Affected Communities and other stakeholders understand the risks, impacts and opportunities of the project. The client will provide Affected Communities with access to relevant information on: (i) the purpose, nature, and scale of the project; (ii) the duration of proposed project activities; (iii) any risks to and potential impacts on such communities and relevant mitigation measures; (iv) the envisaged stakeholder engagement process; and (v) the grievance mechanism.

Consultation

30. When Affected Communities are subject to identified risks and adverse impacts from a project, the client will undertake a process of consultation in a manner that provides the Affected Communities with opportunities to express their views on project risks, impacts and mitigation measures, and allows the client to consider and respond to them. The extent and degree of engagement required by the consultation process should be commensurate with the project's risks and adverse impacts and with the concerns raised by the Affected Communities. Effective consultation is a two-way process that should: (i) begin early in the process of identification of environmental and social risks and impacts and continue on an ongoing basis as risks and impacts arise; (ii) be based on the prior disclosure and dissemination of relevant, transparent, objective, meaningful and easily accessible information which is in a culturally appropriate local language(s) and format and is understandable to Affected Communities; (iii) focus inclusive engagement on those directly affected as opposed to those not directly affected; (iv) be free of external manipulation, interference, coercion, or intimidation; (v) enable meaningful participation, where applicable; and (vi) be documented. The client will tailor its consultation process to the language preferences of the Affected Communities, their decision-making process, and the needs of disadvantaged or vulnerable groups. If clients have already engaged in such a process, they will provide adequate documented evidence of such engagement.

Informed Consultation and Participation

31. For projects with potentially significant adverse impacts on Affected Communities, the client will conduct an Informed Consultation and Participation (ICP) process that will build upon the steps outlined above in Consultation and will result in the Affected Communities' informed participation. ICP involves a more in-depth exchange of views and information, and an organized and iterative consultation, leading to the client's incorporating into their decision-making process the views of the Affected Communities on matters that affect them directly, such as the proposed mitigation measures, the sharing of development benefits and opportunities, and implementation issues. The consultation process should (i) capture both men's and women's views, if necessary through separate forums or engagements, and (ii) reflect men's and women's different concerns and priorities about impacts, mitigation mechanisms, and benefits, where appropriate. The client will document the process, in particular the measures taken to avoid or minimize risks to and adverse impacts on the affected people.

This PCDP presents stakeholder consultation and engagement activities that were undertaken during the preparation of the ESIA for the My Ly HPP. This PCDP also provides an outline of planned stakeholder consultation and engagement activities that are to be undertaken leading up to and during the construction of the HPP. The planned activities are to be done in association with various plans proposed in the ESIA, including the Resettlement and Ethnic Minority Livelihoods Restoration Plan (REMLRP) and the Environmental and Social Management Plan (ESMP).

An EIA to meet national requirements will be prepared for the associated transmission line project[96] by a different consultant. Thus the PCDP prepared does not include processes for the transmission line.

In line with MIGA policies, as noted above, the PCDP is intended to enhance community benefits and related environmental issues by minimizing negative effects through engaging the community. The purpose of community engagement is to build and maintain over time a constructive relationship with communities. The nature and frequency of community engagement will reflect the project's risks to and adverse impacts on the affected communities. Through functioning as a means to fully integrate with all phases of the project - planning, design and implementation - the PCDP goes beyond only describing what has already been undertaken and

[96] The consultant for the GoV transmission line EIA is identified as PECC1 of EVN, Vietnam.

is thus proactive in nature. It more saliently sets outs a roadmap for achieving the aims of the community plans, and guides the overall long term social and environmental management systems of the project.

The PCDP builds upon public consultation and disclosure procedures carried out since January 2017 during the ESIA period. It is also based on project area information that had been collected in 2015-16 and then verified through information gathering and through consultations conducted in January and June 2017. A wide range of stakeholders were consulted particularly at the local community and commune/district levels. To be consistent with MIGA policies, if communities may be affected by risks or adverse impacts from the project, the proponent is expected to provide communities with access to information on the purpose, nature and scale of the project, the duration of proposed project activities, and any risks to and potential impacts on such communities. The Proponent has obtained public views on the My Ly HPP and concerns of potential impacts, and ways to mitigate such impacts. Based on this input, the Proponent has assessed alternative ways of mitigation and considered raised concerns in its decision-making process and will continue to do so. Public consultation and disclosure procedures have been (1st half of 2017) and will continue to be carried out in an ongoing, transparent, consistent, up-to-date and equitable manner. Relevant project information has been and will be made accessible in a timely manner and in a language understandable to the groups being consulted. *Broad community support* through a FPIC process has been confirmed for this project and follow up of this process is required. The Proponent will explore a range of modes of communication during the future project period. Information included as part of this process has been considered in the preparation of the ESIA Report and associated plans and safeguard documents (e.g., the ESMP and REMLRP).

A common communication strategy and program will be developed in line with the proposed PCDP.

A full PCDP is prepared and annexed to this ESIA (Volume V).

10.2 Previous Public Consultation and Disclosure

The Proponent and hired national consultants in Vietnam and Laos had several meetings with the local authorities at commune and village level about the proposed project during 2012-2016. People in the villages to be affected by the project were also informed about the possibility of the HPP in a few instances. There is no proper documentations of the information provided to the affected people, nor if any information was disclosed to people or to local authorities. in July 2016, PECC1 arranged a meeting with local authorities and leaders in all the villages that were expected to be affected by the HPP. In some villages even affected household representatives participated in meeting with the PECC1 consultants. PECC1 delivered a 30-page ESIA summary to the local authorities, which contained technical information of the project, its environmental and social impacts and applicable resettlement policy on land acquisition and resettlement. This appears to be the only written document with project information provided to local government and village representatives.

These consultations were not arranged in a manner to allow informed consultation and participation of the project affected people and cannot be considered as part of the ICP process.

10.3 Consultations conducted prior to 2017

There have been a range of communication activities which have taken place since 2012 through January 2017. The activities were combined for two HPPs which the Proponent is expecting to develop. These are listed below (Box 2).

Box 2: Communication taken place with project stakeholders during 2012–2016

The Project Owner (Proponent) hired Vietnamese consultants have undertaken meetings and investigations in the planned project areas in 2012, 2015 and 2016. The Proponent's representatives accompanied the different consultant teams and presented the proposed projects in the meetings with commune and village representatives. In 2017, the international consultant collected baseline data. The communication meetings are listed below.

In 2012 PECI (Power Engineering Consulting and Investment JSC) undertook an assessment in the project areas for preparing an EIA.

In August 2015 PECI worked in the project area for an updated EIA[97]. Proponent provided a document (209/ML-TD of 14 Aug 2015 by ML & NM1 JSC) presenting the Project in the meetings with commune officials and a few village leaders to inform them about the Project.

In July-August 2015 Nghe An Consultant worked in the project areas for preparing a resettlement plan according to the GoV requirements, during which meetings with commune, village and mass organizations leaders are recorded to have taken place.

In July 2016 PECC1 (Power Engineering Consulting Company 1) undertook an updated assessment in the communities in the two HPP project areas covering all the villages identified to be directly affected in both.

In the Lao territory, 2016, ASA Consultant prepared Environmental and Social Impact Assessment[98] on the areas identified to be affected by the two HPPs.

PECC1 consultants visited Kouan District capital in December 2016 in order to collect baseline environmental and social data. This trip still remains to be reported in full.

10.3.1 Details on the communication meetings

In 2012 PECI (Power Engineering Consulting and Investment JSC) undertook an assessment in the project areas for preparing an EIA for each hydropower project, during which meetings with a few commune and party officials and mass organization representatives are recorded to have taken place in the communes to be affected by the planned HPPs.

In August 2015 PECI worked in the project area for updated EIAs. The Proponent provided a document (209/ML-TD of 14 Aug 2015 by ML & NM1 JSC) presenting the Project in the meetings with commune officials and a few village leaders to inform them about the Project.

The following content of the meetings was reported by PECI:

- Proponent summarized the EIA results;
- Positive and negative impacts on the environment and health of communities in the project area;
- Mitigation measures of negative impacts on the environment during construction and operation;
- Opinions of the participants;
- Conclusions from the meeting:
- Agreement on the project;
- Proponent will ensure mitigation of negative environmental impacts;
- Agreement about the environmental mitigation measures that Proponent proposed;

[97] The EIAs for both hydropower projects were approved by MONRE, Nov. 20 2015. (MONRE-Ministry of Natural Resources and Environment, GoV).
[98] The ESIAs are not approved yet.

- Proponent will confirm that the construction site will be restored to be clean and beautiful after the project.

In July-August 2015 Nghe An Consultant worked in the project areas for preparing a resettlement plan according to the GoV requirements, during which meetings with commune, village and mass organizations leaders are recorded to have taken place. The issues dealt with in these meetings were the expected Project impacts, land losses, compensation, resettlement and agreement of suitable areas for relocation of each affected village. The consultant team also undertook a survey among the households that were identified to be relocated by the Project, covering the household living standards, size and standard of their houses and other structures, land areas and crops cultivated.

The General Resettlement Plans (RP) for My Ly HPP (Nghe An Forestry planning Division 2015) that were prepared based on the assessment in the project areas include the villages in the Vietnamese territory that are expected to be relocated by the respective project, but not those affected by land loss only. The RP contains no information about communication with local stakeholders, except for reporting as the survey and interview methods “quick interviews with families, hearing comments from community and authorities at various levels about their expectations on compensation and resettlement”, and as “method of study with community co-operation: the proposed resettlement options have been made available to authorities, unions of villages and commune so as they can jointly discuss and exchange wishes, comments on resettlement options”. There is no further reporting over how the local authorities and the affected households were consulted or what information about the Project they received. The RP contains no information of the expectations, wishes and comments of the local people. To date, the prepared RPs are awaiting approval by Nghe An Province authorities.

In July 2016 PECC1 (Power Engineering Consulting Company 1) undertook an updated assessment in the communities in the HPP project area covering all the villages identified to be directly affected. PECC1 distributed a summary EIA to commune representatives and Village leaders. Copies of this document were handed out to each commune and each village leader. PECC1 and Proponent representatives had meetings in each commune and in each affected village, where this information was conveyed to participating commune and mass organization leaders and household representatives. In these meetings the Proponent and PECC1 consultants presented the same issues as in the Summary EIA document. PECC1 consultants also conducted key informant interviews with commune chairmen, village leaders, commune health centre staff, village Women’s Union chairpersons as well as focus group meetings with fishing households in a few villages, for collecting information on land use and livelihoods, and health and poverty situations. PECC1 also undertook a comprehensive household socio-economic sample survey on approx. 25% of the households to be directly affected by the HPP (as identified in the GoV RP).

In the Lao territory, 2016, ASA Consultant prepared an Environmental and Social Impact Assessment on the areas identified to be affected by the My Ly HPP. The ESIA report that the consultant undertook household surveys and focus group discussions with people in the villages to be affected by the HPPs. It is reported that any issues that were raised during household interviews were brought to a panel of village representatives for further discussion. It is further reported that most people learned about the project from the consultant team and from the local authorities, and they were worried over the inundation of their villages, and in that case preferred to move up to higher location. The consultant provided data and detailed cost estimates over the losses of houses, land, crops and other assets as well as a cost estimates for relocation and livelihoods restoration, but no information on what kind of information was conveyed and how to the local stakeholders, what kind of communication that took place during the preparation of the ESIAs.

PECC1 consultants visited Kouan District capital in December 2016 in order to collect baseline environmental and social data from province authorities. The content of these consultations was not documented.

10.3.2 Conclusions from the consultations

The information that has been provided to local leaders and communities has been mostly technical, added to presenting in general terms the expected positive and potential negative impacts from the project on people and the environment, and the GoV general policy requirements concerning mitigation of negative environmental impacts, land acquisition and resettlement. Commune and village leaders have been told about the positive impacts the HPP will bring to the communities such as roads, electricity, and economic development, and they have been informed about the reservoir impacts on villages that need to be relocated. Local leaders and villagers are recorded to have agreed to the project implementation and the mitigation to be provided by the Proponent. However, the discussions with village level stakeholders in January 2017 revealed that majority of them knew about the project only through hearsay; they had heard that there will be a HPP and that some households or maybe all the village will be relocated, but they had no knowledge about when the project will start, if and where they will be relocated, and what other impacts the project will cause them. Lack of information had led to worry and insecurity among the people in the affected villages.

Neither the prepared ESIAs for the My Ly HPP in the Lao territory nor the GoV RP for the affected villages in the Vietnamese territory contain any documentation of the stakeholder communication that is referred to as methodology used for preparing these documents. There is no documentation of what information the affected communities have received and how they have been consulted.

These meetings in villages appear not to have been arranged in a way that would have made it possible for the affected people to properly understand the project impacts and mitigation measures and provide them with opportunities to ask questions, express their views and concerns and receive response to their worry.

10.4 Baseline information collection since January 2017 as part of this ESIA

In January 2017, the International ESIA consultant with PECC1 and its sub-consultant team implemented complementary baseline information collection in all the villages to be affected by the HPP. They undertook five types of thematic focus group discussions (agriculture, forestry, fishery, ethnic leaders, gender) and key informant interviews (village leader, village health worker, teacher, extension worker) in the villages both in Vietnam and across the river in the Lao territory. In Vietnam, the Consultant also had meetings in every commune office for gathering basic population, socio-economic and land use data. They also interviewed commune health center and school staff where available. In a brief meeting with villagers preceding the focus group discussions and key informant interviews in each village, the project and its location was explained, the consultant team was introduced and the purpose of its visit was explained to the villagers. The consultant also handed out a short leaflet (in Vietnamese) to the villagers with basic information about the project, the ongoing ESIA preparation and the purpose of the team's visit to the village. The consultant avoided conveying any information about the expected project impacts and potential mitigation measures, but instead asked the villagers what information and how (through which information channel) they so far received about the planned HPP, what they knew about the project, and what kind of information and through which information channel they would prefer in the future.

10.4.1 FPIC process, June 5 – 16, 2017

Consultation process based on MIGA PS7 requirements on Free, Prior and Informed Consent were initiated in June 2017 with an independent Vietnamese communication team hired by the Proponent according to advice from and designed by the IC to undertake informed consultations in all the villages to be affected by the HPP. These consultations were aimed to be the first step in the FPIC process to be continued throughout the Project planning and design, implementation, monitoring and evaluation.

Villagers were provided clear and understandable information about the HPP planning, expected schedule, impacts and proposed mitigation measures. All households in each village to be affected by the reservoir inundation and dam construction received an information leaflet which explained the Project and its specific expected impacts on their village, the proposed relocation site for the village and the proposed mitigation measures. Every household also received a project impact area map showing the dam site, the reservoir and all the villages and communes to be affected. This information was presented and explained by the consultant in a public meeting in each village, and all the information was also provided in large format flip charts hanged up along the walls in the meeting room.

For those villages that will lose riverside land but not be relocated, the consultant had similar consultations with the Village leaders.

All commune offices and all the Village leaders in the villages to be affected by relocation or by land loss also received and Information leaflet presenting the Project, its reach, inundated villages and other impacts and proposed mitigation measures. Importantly, both information leaflets contained information of the Project developer and the expected planning and implementation schedule.

Having received the information, the PAP had an opportunity to discuss the Project, its impacts and proposed mitigation measures. Their views and opinions, questions, worries, concerns and proposals were discussed and recorded by the consultant team. All the issues that had come up in the consultation meeting were written down in a village consent document that was signed by the Village leader representing the villagers.

<u>Results from the consultations and main concerns from the affected people</u>

There was *broad community support* for the Project: In all villages the PAP agreed to the Project and to be relocated – on the condition that all the proposed mitigation and compensation measures will be realized in a proper way. Villagers expressed many issues of concern and requirements on the available resources in the relocation site and on the procedures for a feasible resettlement that they can agree to. The PAP were also in full understanding that they will receive information, be consulted and participate in all phases of the planning and implementation of the relocation. Their preferred future communication methods are printed information, village and group meetings and information through the Village leader.

The most important issues of concern expressed were on the proposed relocation site, its location, geography and available resources for daily living and livelihoods. Villagers want to participate in choosing the relocation site and in its design, and monitor its construction. They request to receive sufficient compensation covering all the losses, damage and relocation costs that is paid in full and in only one or two payments before relocation directly from the Proponent to each affected household without any intermediaries. Compensation payment procedures and timing of the relocation are a great worry for all villagers. The other key issues concern the construction and type of village as well as private infrastructure including houses, roads, electricity and water supply systems. Villagers emphasize that land use certificates have to be issued to all households on the new location. They also request a monitoring and grievance system and involvement of villagers in monitoring of the resettlement and compensation process.

Cultivation land and forest resources are a critical concern for livelihoods of the PAP. They request that land is compensated with similar land, and land is also needed for livestock. Access to forest resources should not be disrupted during relocation, and the important income from forest protection and management has to be ensured and not be reduced due to the Project. Loss of river fishery is a great worry due to the importance of fish resources for both household food and income.

Culturally proper procedures for dealing with the cultural heritage to be inundated are also of vital concern for the PAP who want to choose the location for a new graveyard and for a village spirit house in the new location.

10.5 Public Consultation and Disclosure Program

10.5.1 Key principles for the Public Consultation and Disclosure Program

This section outlines the key principles applied in the development of the PCDP, and those guiding the consultation and disclosure activities of the proponent. These principles are in conformity with GoV, GoL and MIGA guidelines suitably modified to align with the cultural specificities of the impact area.

The principles are:

- Stakeholders must be consulted and be involved in a two-way communication with the project Proponent. Men and women must be included in the communication
- The consultation should be preceded by providing all the relevant and accurate information.
- Consultations should be a continuous process to allow the participants to know whether their concerns are being addressed by the project proponent, particularly in the final project design and the construction periods.
- Supply of information and consultation with different stakeholders should be through a language and medium they are comfortable with.
- The formulation of the final RAP is based on the meaningful consultation and the framework RRP, ideally done after all consultations and disclosure on the entitlement framework is complete and agreed upon.
- In certain cases, for example, the land acquisition process, where the information provided by the government is not easily understood by the people, the proponent should take responsibility for simplifying and ensuring that the whole process is understood by the project affected persons. In the case of My Ly HPP the proponent will facilitate communication with the affected people so that a common understanding of the resettlement and compensation process is achieved.
- There ought to be a specific and transparent mechanism for recording of grievances and a feedback mechanism to inform the action taken by the project proponent.
- Clear enunciation of responsibility and accountability procedures, qualified and trained personnel and resource availability for effective implementation of PCDP.

Modes of communication and information provision

The choice of specific medium for specific stakeholders is determined by their facility with a particular medium and the need for that information. The project will utilize a range of modes of communication to provide information to various stakeholders. Project Information and a summary of the Environmental and Social Impact Assessment Report will be made available in written once approved. The brochures planned and project information will be made available in the local languages. Regular communication will be maintained with key stakeholders via a communication plan which will be elaborated based on this PCDP and the different project phases and activities.

Record of consultations

All records of public consultation sessions will be maintained and made available for public access at the district office, village school and/ or proponent's office in the project area.

Response

A response will be provided to all queries and grievances at the next meeting else reasons will be explained for delays with the provision of a possible time frame for redressal.

Periodicity of public consultation

- For the directly affected people, those who are losing land and income, a regular and continuous process of consultation will be held throughout the land acquisition and relocation process.
- For the public in general, the frequency of the consultations and their focus will vary with the changing project phases.
- The consultations before the construction stage should be held at regular fortnightly or monthly, where appropriate, intervals to apprise the people regarding the land acquisition process, the compensation amount, other entitlements, alternate employment/agricultural-training opportunities, training programs, mitigation plans & land purchase assistance.
- In the beginning of the project, discussions will be held with villagers for restoration and rehabilitation of cultural sites, if any of concern, as will rehabilitation/ restoration/ relocation and conservation of erosion risk areas, protection forests, and planned safeguard, mitigation and safety plans.
- Temporary workers impacts will have to be addressed.
- At a later stage, when the residential colony (permanent housing) is occupied by project staff and free movement of outside public starts due to new road, consultations will be held with the (settlements) residents to mitigate impacts on social and cultural environment. For instance, safety and security of women and children, in settlements, who are left alone when men may in the field due to temporary migration of men may be a concern.
- After the plant is commissioned, issues of waste disposal from plant operations and to a limited extent from residential colony will be discussed with villagers.
- The project proponents should maintain a regular process of dialogue and information sharing at least every quarter with other stakeholders such as the government officials and district administration.

10.5.2 Tasks and timeline for an effective PCDP

A task list is provided in the PCDP for the period when the environmental and social management plans, relocation and livelihood restoration will be implemented. The pre-construction and construction periods are critical periods for consultations as the key management and safeguard plans are put in action.

10.5.3 Resources and Responsibilities

The project proponent will establish dedicated units for environment and social issues within the ESMP and RAP institutional structure to address all social and environmental impacts of the project, as well as ensure proper implementation of the public consultation and disclosure programs, REMLRP (eventual RAP) and ESIA programs and plans included in the ESMP.

10.5.4 Responsibility and organization for Communication and Disclosure

Apart from the institutional support to be provided by the Proponent’s staff, an implementing agency (one or two effective consulting environmental and social organization/ institution/ company and/or an NGO) should be appointed for the implementation of the safeguard documents (ESMP, REMLRP, FPIC process, etc.) and for consultation and participation with the local communities. It is vital that an international consultant team should be used to closely guide the implementation of the above plans in line with MIGA practice. Note that based on experience from several projects in Vietnam and Laos, the team used for communication/ public consultations should be separate from the ESMP unit, as the ICP requires specialized expertise and ability to take a neutral stand.

At the corporate level, the Proponent will set up a section for Resettlement, Mitigation and Enhancement which will be headed by a General Manager (GM) or the Chief Executive Officer (CEO). The GM will be responsible for a Division called Social and Environment Management Division (SEMD).

This corporate unit will have the following key functions:

- Setting up appropriate institutional arrangements at the project site to oversee implementation of social and environment mitigation action plans.
- Appointing an independent Monitoring and Evaluation agency
- Establishing village development funds from the project in each of the villages where the REMLRP and all other relevant plans will be planned and implemented.
- Monitoring the RAP (as part of the REMLRP) and ESMP activities.
- Address grievances not addressed by the Project office.
- Ensure that the RAP is implemented in accordance to the guiding policies of the Proponent and MIGA, and coordinated with the Proponent's CSR program, when prepared.
- Arrange training programs for officers to be involved in the RAP, and follow-up.
- Explore and develop corporate linkages with financial institutions and banks to facilitate financing of income generating schemes for the PAFs.

The project office should have a number of key staff, e.g., a Community Liaison Officer (CLO, a Resettlement/Social Specialist (RS), a Community Development Officer (CDO)

10.5.5 Grievance Redress Mechanism

In compliance with MIGA guidelines, the Proponent is to respond to communities' concerns related to the project. If the Proponent anticipates ongoing risks to or adverse impacts on affected communities, the Proponent is required to establish a grievance redress mechanism to receive and facilitate resolution of the affected communities' concerns and grievances about the Proponent's environmental and social performance. The grievance redress mechanism should be scaled to the risks and adverse impacts of the project. It should address concerns promptly, using an understandable and transparent process that is culturally appropriate and readily accessible to all segments of the affected communities, and at no cost and without retribution. The mechanism should not impede access to judicial or administrative remedies. The Proponent will inform the affected communities about the mechanism in the course of its community engagement process. The PCDP proposes core steps for the Proponent's grievance redress handling procedure.

CHAPTER 11: IMPACT ASSESSMENT AND MITIGATION

11.1 Overview

This chapter presents primary impacts from the Project that will likely affect the physical, biological and social environments. It also provides recommendations for mitigation measures to minimize if not totally avoid these impacts. Impacts were assessed based on their extent, duration, significance and vulnerability of receptors (See Chapter 5 Approach). A summary of the impacts are then presented in Table 11.4.

11.2 Pre-construction / Construction phase - Physical impacts

11.2.1 Change in topography, landscape and visual impacts

Issue. Construction of headworks and auxiliary facilities will change local topography and landscape of the Project area

Baseline.
The Project area is located in a remote rural mountainous setting. The proposed construction area is distributed at an elevation range of 200-400masl and slopes can reach up to 40^0 to 50^0.

Impact and rational. The construction of the headworks (dam, penstock, spillway etc), the power station, and the auxiliary facilities will require earth moving activities such as stripping of top soil, shallow to deep excavation and levelling of the slopes/land and eventually change the topography and ultimately the rural landscape setting of the area. The earthmoving activities will also induce soil erosion, sedimentation, slope instability and landslides.

The dam will also give way to a 1247ha reservoir (at FSL) with a length of 42km and a conspicuous 118.6m dam wall.

Location. The main components (e.g., dam, powerhouse, spillway, intake) and auxiliary areas are located in My Ly Commune, Ky Son District, Nghe An Province, Vietnam. The reservoir tail will reach up to Laos.

Assessment. The change in topography and landscapes are **site specific** but its duration is **permanent**. Inducement of impacts such as soil erosion are **temporary** and limited during construction only. Sensitivity of the resource is **moderate** having no sensitive physical resource in the Project DIA and overall the impact has a **major significance**.

Proposed mitigation. Advanced engineering measures are now available to arrest slope stability and erosion issues. Available best engineering practices/technology will be considered in the design stage to ensure slope protection and sedimentation ponds will be available. This will be supported with revegetation measures. The 50m safeguard buffer zone along the perimeter of the reservoir will enhance soil protection and watershed management efforts.

Reservoir Catchment Management Plan will be developed to ensure adequate and proper implementation of the indicated measures.

11.2.2 Generation of waste and hazardous materials

Issue. Construction works will generate large volume of solid waste and some hazardous wastes materials.

Baseline. The Project is in rural setting where commercial activities are limited and industrial operations are non-existent and therefore waste are mostly from domestic activities. Waste therefore are kept either within backyard or burned. No community waste disposal area is established more so a landfill.

Impact and rational. The various construction activities will generate the following waste:

- Large volume of soil spoil from the excavation;
- Construction wastes such as left-over building materials (e.g., cement and steel, insulation, electrical wirings, tree stumps/branches, rubble and plastics, nails, shingle and roofing material, lubricants and paints etc.). Construction wastes may contain lead, asbestos or other hazardous substances.
- Domestic waste from 3,400 workers and employees during the peak of construction. These workers will produce solid and liquid wastes and will require treatment and safe disposal.
- Hazardous wastes such as used oil and lubricants from the use of petrochemical products from delivery trucks and heavy construction machineries (e.g., bulldozers, booms, brakes, cranes forklifts, and back hoes). In addition, old tyres from trucks and company vehicles.
- Waste from the use of explosives to level off the soil at the construction area or at quarry site.

Improper disposal and handling of the above wastes can contaminate soil and water and cause a health hazards to the workers and the community.

Location. Waste will be generated across the Project construction areas and if properly managed, the area of impact will be within the confines of the Project DIA. For hazardous substances that requires special disposal treatment, these will be disposed off-site or stored properly.

Assessment. Extent of impact is **site specific** and has a **short term** duration (construction phase only). With the sheer volume of wastes to be potentially generated, magnitude is potentially **large** with **medium** sensitivity. The impact is of **major** significance

Proposed mitigation. Waste generation will be managed by developing the Solid Waste Management Plan which will address solid wastes including construction spoils. A Material Use and Site Waste Management Plan will also be developed to address hazardous wastes. A bespoke Construction Environmental Management Plan (Construction EMP) which include water and sediment management shall be developed for the Project. This Construction EMP shall be part of the agreement between the Proponent and the Contractor.

A spoil disposal area of about 52ha been identified for the Project (see Chapter 3. Project Description). The Plans will provide guidance and procedures on proper disposal and treatment using a waste management hierarchy, reduce, re-use and re-cycle.

11.2.3 Quarry operations

Issue. Quarry operations can cause dust and noise pollution. The quarry area is at some distance from the Project DIA and transport of aggregates will pose road safety problems along its route.

Baseline. The Sop Tu quarry will be the source of rock aggregates. It is estimated that the Project will need 1.45Mm^3 of aggregates and 0.45Mm^3 of crushed sand. The quarry site is about 11ha and located approximately 13.58km downstream of the dam site. Villages are present along the stretch of this road.

Impact and rational. The operation of the quarry will have the following impacts:

- Potential loss of assets due to widening and upgrading of roads to cater heavy trucks;
- Noise pollution from blasting activities; and
- Dust pollution at quarry area, nearby villages and along the route of delivery trucks.

Location. The Sop Tu quarry is located approximately 14km downstream of the dam site, in Xop Tu village in My Ly Commune, Ky Son District Nghe An Province.

Assessment. The extent of impacts is **local** and duration is **short term** during construction phase only. The degree of impact is **moderate** and sensitivity is **high** due to the presence of sensitive receptors along the route of delivery. The impact is of **major** significance.

Proposed mitigation. The quarry footprint and the extent of the road to be rehabilitated need to be surveyed and delineated to identify potential loss of assets and determine if compensation is necessary. Land loss is not anticipated because a right of way (ROW) has been established, although some temporary assets may have occupied the ROW.

If blasting is used, there is a need to determine the boundaries of the quarry area and determine its proximity to the nearest sensitive receptors. It is also important to establish baseline of fauna within the quarry area to identify sensitive wildlife that maybe affected by the elevated noise during blasting. A blasting clearance needs to be secured and blasting plan will need to be developed.

11.2.4 Deterioration of water quality

Issue. Damming rivers can reduce water quality due to lower oxygenation and dilution of pollutants. Earthmoving for construction of facilities can further induce pollutants to the river.

Baseline. Drinking water at the Project site is sourced from mountain' springs. Few can afford treated water/filtered mineral water. Water for domestic uses is from the river. The river is also used for fishing and recreation such as swimming and navigation. Baseline water quality monitoring indicated a clean water free from industrial pollutive substances although a high presence of coliforms was detected.

Impact and rational. The impoundment of rivers can reduce water quality due to lower oxygenation. The relatively stagnant water at reservoirs limits dilution of pollutants compared to fast flowing rivers. Also the flooding of biomass especially forests creates underwater decay and reservoir stratification. Water quality can decline because deeper lake waters lack oxygen. The Project will inundate 1247ha and the FSL of the reservoir is 330m.

The earthmoving activities to construct the headworks and auxiliary facilities induce sedimentation and soil erosion. Both impacts will consequently have impact on the water quality of the river. Stripping of vegetation and earthmoving might also alter the spring/s or reduce volume of water used by the community.

Generation of waste (see discussion on waste generations), if not properly managed can potentially contaminate water quality both groundwater and surface water. The diversion of river water to create the dam will increase sediment load and therefore affect water quality.

Location. Change in the quality of the river water can be seen in the reservoir, immediate downstream of the proposed dam and along the river stretch adjacent to the auxiliary facilities. Depending on the degree of disturbance, load of pollutants, sewage and time of the year, where rain water might reduce the concentration of pollutants, it might reach Ban Ve HPP reservoir. The FSL of Ban Ve is approximately 2.8km from the Project's dam site.

Assessment. Change in water quality is **site specific** but can also extend beyond the Direct Impact Area (see above). Although the trigger is **short term** (construction activities), depending on the degree of effect, it can extend to **medium term** (e.g., slow release of sediments). For this impact, magnitude is **large** and sensitivity of the resource is **high**. The impact is of **major** significance.

Proposed mitigation. Water quality can be maintained or reduce potential impacts reduced by:

- Delineate boundaries of the work areas to limit unnecessary clearing;
- Schedule activities areas to be cleared/ stripped to exposure at one given time;
- Stabilisation of slopes;
- Development of the Construction EMP that shall contain management of water quality, sedimentation, construction and domestic waste including toxic wastes.
- Sanitation improvement and waste management programs in the villages would be required and will be elaborated in the Sanitation Enhancement /Waste Management Plan as part of the social program to address for example the elevated levels of coliforms in the river and spring water where the community source their drinking water.

11.2.5 Flood risks

Issue. Flood risks during river water diversion and reservoir filling/inundation

Baseline. There are four villages in Vietnam and five villages in Laos that are either located within the proposed dam site or construction areas and will be inundated during the filling of the reservoir. The PAF will however be relocated prior to any construction activities (see Social section). A total of 1,039.3ha will be submerged, along with physical assets and vegetation.

Impact and rational. Although relocation will be done prior, the river diversion may pose flood risks to some extent e.g. stray animals, assets very near the reservoir edge. The diversion may also create a local tremor (reservoir triggered seismicity) from the strong current of the diverted water. Increased suspended solid is also anticipated as the water current scour the bottom sediments.

Location. Within the estimated reservoir area of 1,247ha.

Assessment. Extent of the inundation covers Laos territory and Vietnam territory which makes it **regional**. Duration however is **short term** within the construction phase while magnitude of impact is **large**. With no declared national parks or any highly sensitive resource to be submerged except for two plant species, an herb (*Drynaria fortunei*) and hardwood species (*Pterocarpus indicus*) (see Biology and Social sections), resource vulnerability is **medium**. The impact is of **major** significance.

Proposed mitigation. Relocation of conservation plants will be carried out prior to construction. A resettlement policy framework that covers the required elements for a relocation plan including compensation is discussed in Social section. An Emergency Preparedness and Response Plan (EPRP) that contain a warning notification system shall be developed to ensure that once water diversion has started, the safety of both the workers and community is paramount.

11.2.6 Riparian release and environmental flows

Issue. Maintenance of riparian release and environmental flow during inundation of the dam (and moving into the operation phase).

Baseline. At present, there is sufficient water along the stretch of the proposed dam location to the existing Ban Ve HPP downstream, even during the dry season, for domestic use, fishing, some recreation (e.g., swimming) as well as navigation. The downstream Ban Ve HPP operation has its FSL (200m) at 2.8km from the My Ly dam site and the level of water recedes gradually during the dry season to about 28.2km from the My Ly dam site (MOL of 155m) resulting in a gradually lower of the water in the river. The villages along this 28.3km stretch are already affected by the operation of Ban Ve HPP.

Impact and rational. During reservoir impoundment, upstream of the dam has to be collected to meet water storage requirement before the operation of the hydropower. However, there is still a need to release and maintain minimum flow downstream to mitigate environmental impacts and maintain the discharge requirement for Ban Ve HPP. It is likely that the stretch of 28.2 will need enough water discharge from My Ly HPP is sustain aquatic life and any use (fishing and transport) that may be there during the dry season. A reduction in water flow downstream is likely to happen.

Location. The river stretch from the proposed dam site to Ban Ve HPP MOL (155 m) and 28.2km from the My Ly HPP dam site.

Assessment Potential affected area will be local from between the My Ly dam site to Ban Ve HPP and will only be felt during filling of the reservoir therefore **short term**. The degree of impact is **major** given the extent of the Project's reservoir to fill in and Ban Ve's FSL level is only 2.8km from Project's dam site. There are villagers downstream who use the river and vulnerability is **high**. The impact is of **major** significance.

Proposed mitigation. Reduction of flow is inevitable during the water impoundment. At this stage, it has not been determined how much reduction is anticipated. The detailed design phase shall include modelling of water release. The operation regime of Ban Ve HPP is a primary consideration as well as the villages that may be affected due to the reduce water in the river due My Ly HPP.

Recommended mitigation measures to minimize impacts are:

- Water levels shall be monitored regularly to establish long term discharge data for environmental analysis and as an input to electricity production, and determine the likely flow during the dry season with and without My Ly HPP. A discharge level (environmental flow) regime has to be establish with the social and environmental as well as Ban Ve HPP operational needs;
- A Building Block Methodology as a concept may be used to develop a environmental flow regime (see note below)
- Part of the public disclosure shall include the schedule of water diversion and release to raise awareness among the community;
- An Emergency Procedure and Response Plan shall be developed and will include training of the local residents to prepare them in emergency situations.

NOTE: Suggestion of Approach for Environment Flow Determination

Most compensation flow falls within the range of 10 to 20% of the long-term flow, for the conservation of macro and microflora, aquatic insects and fishes in dewatering zone. The minimum recommended compensation flow during dry season ranges from 0.5 to 15 m^3/s. This discharge is to from an ecological perspective considered more than sufficient for the maintenance of adequate wetness conditions to support the ecosystems that may exist in this boulder bed river, riparian vegetation, water resources, and fisheries.

In Vietnam there is little knowledge of minimum requirements for the survival and growth of fish in nursery pools and general river habitats during dry seasons. There is growing knowledge in Laos but little from the affected rivers. Knowledge on the influence between physical factors such as characteristic, temperature, dissolved oxygen or water quality parameters and the migration and spawning of commonly found fish species is limited. In the international arena, it appears that rivers and associated species behave differently and there is no common standard for minimum flow needs, and thus a case specific decision has to be made (Bain 2007), and where there is room for adapting flows may be the solution.

The 10% minimum flow thus appears to overall have a stabilizing affect in that, with densities tending to decrease but populations are maintained. This observation supports some of the findings from international studies.

In My LY HPP there will be reduced flow during the operation phase during the dry months with a 2.8km stretch affected, this ending at the FSL (200m) of the downstream Ban Ve HPP (see cumulative assessment in this chapter). However, this stretch will likely increase gradually in length as the Ban Ve HPP reservoir water level at FSL recedes to the potential MOL of 155 at the end of the dry period, or rather before the rains start trickling in. The longest stretch that could be affected or subject to low water flow may reach 28-30km, i.e., at the 155m MOL of Ban Ve HPP (level set by the MOIT, GoV).

The mean monthly flow regime of Ca River at the dam site of Ban Ve HPP, where seasonal data is collected is used as a base to understand the hydrological dynamics. The flow discharge expected at My Ly dam is lower than at Ban Ve, however the annual flow regime from Ban Ve HPP depicts the pattern of flow through the year which would be the same pattern at the planned My Ly HPP dam site. The aquatic ecosystem, its functions, population dynamics and fish migration are adapted to this regime (although intra and inter annual variations persist). The environmental flow is proposed to be a minimum of 2.5 m^3/s, which by common Vietnamese practice is around 10 % of the month with the lowest average flow of the year. Thus from June to October/September overflow over the dam will also contribute significantly to the regime peak. Thus the period with the most critical release flow contribution from the dam will be in December to May/June. However, for most of the years a flushing flood could be released in late May-June (10 – 15 days) to remove sediments from the reservoir and contribute to a high water levels in the low flow section-rewetting the driest stretch (dam site to at least the confluence with Yen Hua village).

The peaking activity is anticipated to impact both on fish diversity, density and migration pattern (short to mid-range) in the part of the river stretch before the reservoir of Ban Ve HPP begins. and indirectly on the area downstream the dam. Flushing of sand from the reservoir with a high flow in during the dry season (less rains) might be expected to leave sediments in slow flowing area as pools. Sediment collection may, however, be reduced by the flushing to be timed with the onset of the monsoon, whereby sediments are expected to be washed away.

International studies of environmental flow. There has been considerable international interest in trying to understand the interactions of water flow and aquatic life to determine environmental flow requirements. Covich (1993) has shown that stream flow regimes have a major influence on the biotic and abiotic processes that determine the structure and dynamics of stream ecosystems (see also studies by Kaasa, 2004;2001). High flows are important not only in terms of sediment transport, but also in terms of reconnecting floodplain wetlands to the channel (not relevant in case of My Ly HPP. High flows promote fauna dispersal, thus spreading populations of species to a variety of locations. The life cycles of many riverine species require an array of different habitat types whose temporal availability is determined by the flow regime. Given that there is the Ban Ve HPP operating downstream that has likely had an influence on the fish populations over the last 10 years, the impact of the My Ly HPP will need to be focused on species and human use in the reservoir stretch of Ban Ve HPP (from FSL (200m) to MOL (155m), expected 28.2km stretch from My Ly HPP).

All recent evidence indicates that the paradigm of mimicking the natural flow regime is the most beneficial to the ecosystem and its utility (by human) once inundation take place, and is summed up comprehensively in Poff et al. (1997). This is a holistic model that goes far beyond minimum flow and single species orientation and focuses instead on restoration and maintenance of the ecosystem and/or habitat as a whole – at least aiming to allow for minimum needs. In the case of My Ly HPP human use of the water is linked to periodic river bank agriculture, fishing, bathing and possibly burial rites.

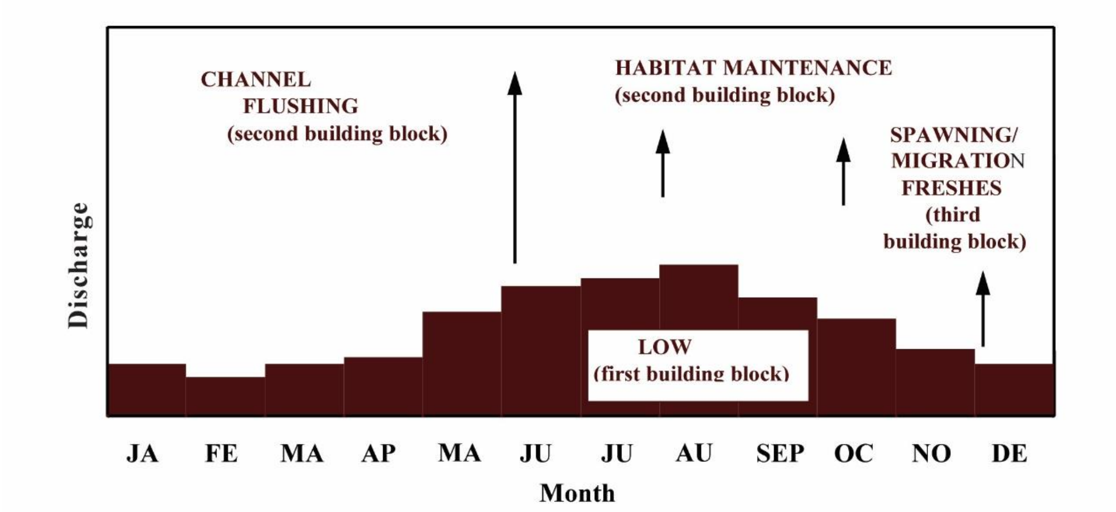


Figure 11.1. Example of flow regime built up using building blocks

Biologically, however, there are increasingly more ecological models used to set ecological flow imperatives, goals and operational rules. Implicit in a good ecological flow model is the appreciation that a simple provision of physical habitat of a specific target species is not the only ecological function of river flow. Perhaps one the best known is the Building Block Methodology (BBM) developed in South Africa (Figure 11.1), see discussion in Acreman and Dunbar 2004). The basic premise of the BBM is that riverine species are reliant on basic elements (building blocks) of the flow regime including low flows (that provide a minimum habitat for species and prevent invasive species), medium flows (that sort river sediments and stimulate fish migration (short to medium range) and spawning) and floods (that work to maintain channel structure and allow movement onto floodplain habitats, not relevant for long-distant migrants as these have migrated). A flow regime for ecosystem maintenance can thus be constructed by combining these building blocks. The need for the BBM in the case of My Ly HPP is however hard to predict as more detailed information on seasonality and ecologies of aquatic species (particularly fish) are little known.

Recommendations. Given that there is some human use of the river and that the uses are likely to be sustained due to the Ban Ve HPP (as long as the water quality is acceptable) but altered in the low-flow stretch of My Ly HPP. Fisheries and fish species and populations will be impacted but are expected to stabilize after a few years and Ban Ve HPP reservoir used by villagers today. The ESIA recommends that the My Ly HPP releases a level which would sustain species and human needs (given that monitoring is done at the pre-construction phase to gather basic ecological and river use data.

The fish and river use activities as such should be monitored and if the findings reveal that the recommended release is not feasible the Proponent should be willing to adjust the minimum environmental flow. Thus, an adaptive approach should be taken in the long run. Any adjustment to the environmental flow after 3-5 years of monitoring should reflect the building blocks (low flows, channel flushing, habitat maintenance and spawning/migration freshest) as indicated in the Acreman and Dunbar (2004).

By-pass system for fish at the dam. There is little possibility that a fish ladder will work properly in My Ly HPP with the present knowledge and the proposed operating regime. The reasons for this are:

- The water level will constantly change both on daily and yearly basis in the reservoir. The regulation zone in the reservoir will be high if it is flushed once a year.
- Previous experiences show that it is difficult to build fish ladders that work with dams with the height of about 100 m. This is, in addition, technically difficult if the water level in the reservoir is constantly changing.
- It is highly likely that even if it is possible to establish a fish ladder that handles upstream migration the downstream movements of eggs, larvae, juveniles and post-spawning adults will be extremely difficult to handle.
- There is little known about the migratory species and their ecologies, and if these species can adapt to the stretch upstream the downstream dam (Ban Ve HPP) and My Ly HPP dam site.

The migration of all the long-range migrating species has been blocked by the presence of downstream dams. A fish adaption study is also proposed to be carried out (see Chapter 12).

11.2.7 Air and noise pollution

Issue. Construction activities pose air and noise pollution

Baseline. The Project AI has no indication of air pollution while noise level is also inherent of rural setting and therefore has low levels. There are no significant sources of man-made air pollution and noise in the area except for road traffic (usually motorbikes or small trucks) which are irregular and in-frequent. Baseline noise and ambient air monitoring are all within the national standards.

Most of the community however, prepares food using solid fuel (eg wood, charcoal or crop wastes) in open fire. Such inefficient cooking fuels produce high levels of indoor pollution with health damaging pollutants including small soot particles that penetrate deep into the lungs. Respiratory ailments are very common in the community.

Impact and rational. Major construction activities will pose air pollution and can be a health hazard to workers and to the residents. Example of construction activities that create dust suspension and release emissions are:

- Road works for access roads;
- Rock blasting and breaking out of hard grounds;
- Foundation excavation;
- Filing;
- Concrete placing;
- Grouting works;
- Plying of delivery trucks and company vehicles across Project AI;
- On-site operation of both fixed and mobile construction plant and equipment; and
- Quarry related activities (e.g., blasting, excavation – detailed impacts are further discussed in quarry section);

Noise generating activities includes the above construction activities including diversion of water and filling out of the reservoir.

Location. Construction areas and along access roads

Assessment. Extent of impacts will be **local** and limited to the construction areas and along the access roads. Duration is **short term** within the construction phase and degree of impacts is **moderate** at the construction area while **large** along the access roads. There are no sensitive receptors at the construction areas because PAPs should have been relocated prior to construction. Along the access road, there is the presence of sensitive receptors such as settlements, children crossing, school, community activities and traffic, and therefore with a potential **large** magnitude impact. Vulnerability is therefore **medium to high**. The impact is of **major** significance.

Proposed mitigation. Noise reduction options that shall be considered during construction include:

- Relocation of sensitive receptors (see Social section);
- Positioning of temporary site compounds as far as reasonably practical from sensitive receptors and use of terrain, material stockpiles and natural vegetation as screen to maximise distance between work activities and receptors.
- Selecting equipment with lower power levels;
- Installation of suitable mufflers on engine exhausts and compressor components;
- Installation of acoustic enclosures and noise barriers;
- Limiting the hours of operation especially for noisy equipment;
- Scheduling of workers movement and use of vehicle as practicable to avoid peak of traffic volume/ community activities;
- Ensuring compliance with MIGA standards;
- Undertake construction activities in accordance with best practices; and
- Develop a Grievance Redress Mechanism, both for the workers and the community to record complaints and be able to adequately and properly address concerns.

Poor air quality due to release of contaminants can result in possible respiratory irritation. If the above best construction practices are practiced, this also eliminate sources of air pollution. In addition, awareness and education related to sanitation and general health program is part of the social programs for the community.

11.2.8 Traffic impact

Issue. The increase of road traffic poses road safety and health hazards

Baseline. Traffic is low and the mode of transportation is mostly motorbikes and motorboats. About 30-50% of the households own a motorbike while most of them have motorboatsand many local people go on foot. There are a few trucks that are used to transport limited farm produce such as rice and maize. Motorbikes are also used for mobile trades (e.g. products such as mattresses are being sold house to house using motorbikes).

Impact and rational. The transport of heavy equipment, delivery of construction materials, movements of workers and employees (e.g., estimated at 3400 during construction) will create a significant disturbance in a currently slow traffic. The significant increase in traffic will also pose road safety hazards to the community.

Location. Construction area and along access roads.

Assessment. The extent of impacts will be **local** and limited to the construction areas and along the access roads. Duration is **short term** within the construction period. The degree of impacts is **large** because the community has not been exposed to high volume traffic and some roads are not ready to accommodate the significant increase in vehicular traffic including heavy trucks. Vulnerability is **high** because of the presence of sensitive receptors (community) and limited resource (existing road conditions). The impact is of **major** significance.

Proposed mitigation. Roads shall be upgraded both to cater the increased volume and type of vehicular traffic (e.g., heavy trucks). Road safety measures will be implemented and will include the following:

- Road safety signs shall be installed in strategic locations
- Vehicles will be properly maintained; and
- Drivers will be trained in safe driving.

11.2.9 Sedimentation (operation)

Issue. The impact of siltation and sedimentation in the reservoir

Baseline. Initial results of the sedimentation estimates carried out for My Ly HPP, showed that after 30 years of operations, sediment yield will be approximately 28.2x10^{6}m^3, and is about 5.56% of the total reservoir volume. By the 50th year, it will increase to 9.15% with 46.4x10^{6}m^3 sediment volume.

Impact and rational. Overtime, sedimentation reduces live storage and at some degree the power generation capacity, and ultimately economic viability of the HPP.

Location. Reservoir

Assessment. Extent of the impact is **site specific** to the reservoir and impact is **long term**. The magnitude is **major** and sensitivity is **high** and therefore significance is **major**.

Proposed mitigation. Watershed management can minimize sedimentation and extend the reservoir's useful physical life. Measures shall include:

- Control of road construction and other land uses in the upper catchment area;
- Establish forest conservation (planting and maintaining) areas upstream of catchment to reduce sediment flows in to the reservoir. The 50m buffer can serve for this purpose;
- Maintain slope stability through using new and efficient slope engineering techniques; and
- Install upstream sediment check structures, protect dam outlets.

The operational regime should also consider regular flushing in the reservoir, otherwise removal of sediment mechanically will be needed which is costly.

11.3 Pre-construction/ Construction phase - Biological impacts

11.3.1 Impact on forest and wildlife biodiversity

Issue. Inundation of forests can cause loss of forest and wildlife biodiversity and wildlife habitat, and construction activities can disturb wildlife habitat.

Baseline. Secondary forests, e.g., mixed evergreen rain forest, semi-deciduous forest and mixed broadleaf bamboo forest have regenerated after exploitation, and some progressive forest succession has taken place on abandoned uncultivated land for the last 3-15 years.

The biodiversity value of forest vegetation in the direct impact area of the Project is low to medium since these growing forests are still disturbed due to grazing and occasional conversion to upland farming. Out of the total 447 vascular plant species, 149 of them are medicinal plant and edible plant species, fuelwood and timber species, and ornamental and rattan /bamboos species. There are two threatened species *Drynaria fortune* an epiphytic herb and *Pterocarpus indicus* hardwood species, however these species are widely distributed in adjoining forests.

The secondary forest, mixed broadleaf bamboo forest, and riverine area provide essential habitat for small mammals from the orders of rodents and bats, and bird species, reptiles and amphibians. There are no large mammals in the Project DIA. There are 45 mammal species (among them 19 *Rodentia* and 12 *Chiroptera*) , 24 reptile species, 19 amphibian species, 111 bird species and 203 insect species reported to occur in the Project DIA. Three mammal species (*Nycticebus bengalensis, Macaca mulatta and Macaca fascicularis)*, 8 reptile species (*Gekko gecko, Physignatus coccincinus, Varanus nebulosus, Varanus sanvator, Ptyas korros, Ptyas mucosus, Bungarus fasciatus and Naja naja)* and 3 bird species (*Falco severus, Psittacula alexandri, Copsychus malabaricus*) are listed in IUCN Red List as species of conservation concern. The wildlife in the Project DIA serves as tangible ecosystem products to the local communities (e.g., such as food and some organs of animals for medicinal purposes). There are 38 species of wildlife used as food by the villagers including 10 mammals, 10 reptiles and six amphibians.

Impact and rational. There will be loss of forest biodiversity and habitat of small mammals, bats, lizards and amphibians due to inundation of about 1,247 ha forests along the Ca River to a stretch of 42 km, and submerge plants of the two threatened species *Drynaria fortune* and *Pterocarpus indicus.* Small size wildlife, bird, reptile will move out of submergence area or spreading far from Project site for new habitat. The two vulnerable plant species, are well distributed in adjoining secondary forests.

There will be disturbance to wildlife habitat at the construction sites and some smaller species e.g. frogs, lizards and rodent species may be killed. Large size mammals, e.g., monkey, wild boar, mumtjac will move to further calm forest in higher areas. Wildlife dispersed from the site during construction disturbances will come back when noises caused by construction activities are reduced under project operation.

Location. All along the 42 km long reservoir and construction areas.

Assessment. The extent of the Project impact is **site specific** in reservoir and construction areas. Impacts will be **long term** duration due to loss of forest biodiversity and wildlife habitat in submergence area, while wildlife habitat disturbance in construction area will **short term** duration. Magnitude of the impact is **large** in reservoir area and **small** at construction sites. Sensitivity is high in reservoir area and **low** in construction sites**.** The overall significance of the impact is **moderate**.

Proposed mitigation. Reservoir Catchment Management Plan (RCMP), Safeguard Buffer Zone, Biodiversity Enhancement and Ecosystem Services Restoration Plan (BEESRP), and Endangered Species Restoration shall be developed and implemented for restoring and improving biodiversity numbers status and wildlife habitat in the Project DIA. Safeguard buffer zone will create suitable environment for small mammals, bats, lizards and amphibians.

11.3.2 Impact on aquatic life and fisheries

Issue. Barrier to movement of migratory fish species, change in aquatic habitat in reservoir and habitat disturbances at the dam site during construction are the major issues.

Baseline. There are 77 fish species in Ca River and its tributaries; streams have normally small fish species, preferring rapid water and high oxygen content. Among the 77 species five species, *Anguilla mamorata*, *Acrossocheilus annamensis*, *Hemibagrus guttatus*, *Bagarius rutilus, Bangana lemassoni*, are listed as “Vulnerable” in IUCN Red List. The *Hemibagrus guttatus, Anguilla mamorata* and *Bagarius rutilus* are medium to long distance migratory fish species and they are overexploited for their high sale value. The Ban Ve dam constructed downstream of this proposed project has already obstructed their movement and their habitat has been fragmented and a small population is now adapting to this new environment.

Impact and rational. (a) Habitat of aquatic life and fish species will alter at the dam construction site due to water course change, increase in turbidity and water pollution from lubricants, cement slurry and other chemicals. Reduced visibility will normally reduce primary production (algae and peripyton) affecting the invertebrates and fish, thus eventually fishery activities. Species of fish preferring clean water habitat and oxygen rich habitat will be reduced and could disappear. Biodiversity will be less, fish species of migration habit along river and oxygen and clean habitat adapted fish species will be gradually replaced by small size fish species which can bear and deal with polluted environment.

(b) Aquatic species structure and composition will change both in quantity and quality, reflecting typical characteristics of aquatic communities in reservoir. High sediment load, increased organic and nutrients from decomposed vegetation will favour mud eating fish species adapted with stand still water environment and fish species adapted with flowing water environment will reduce both in number of species and quantity. Fish biodiversity will change.

(c) Migratory species in upstream of the dam will be stopped to get to downstream areas for reproduction while fingerlings are stopped in downstream of the dam, unable to get to the upstream to live and grow. Habitat will be fragmented. Low flow in the downstream area during dry season will impact aquatic life and fishery.

Location. Dam site, reservoir, and downstream area

Assessment. The extent of the Project impact is **site specific** in reservoir and construction area and downstream area. Biodiversity impact in reservoir will be **long term** duration. Magnitude of the impact is **medium.** Sensitivity is **moderate** and the overall significance of the impact is **minor** as the Ban Ve dam at the downstream area has already obstructed upward movement of migratory species.

Proposed mitigation. Compensatory environment flow will be regulated which could minimize downstream impacts. Periodic removal of blue algae and weeds in the reservoir, and implementation of Fisheries Support Plan are proposed. A fish adaptation study is also proposed to monitor fish species diversity and populations in the MyLy reservoir and downstream stretches including Ban Ve HPP.

11.4 Social

11.4.1 Impact on physical assets

Issue. The reservoir will inundate the villages along the river and the tributaries that will be part of the reservoir. All private residential land, houses and assets, and all public infrastructure and structures will be inundated.

Baseline. Private houses in the villages are constructed mainly with local materials, wood and bamboo from the forest, most of them are built on stilts, but some are located on the ground with a cement basement. The public buildings (village cultural house, kindergarten and school) in Vietnam are Vietnamese (Kinh) style houses built on bricks and concrete, and on a concrete basement on the ground. Space and land used for fruit trees and home gardens around houses varies between different villages. Households have no grid electricity, and most families have a private micro-hydropower generator in the river with electricity line leading to the house. Intra-village roads are mostly soil paths, but in a few locations built of cement**.**

Impact and rational. The reservoir will inundate the entire villages including:

(1) Private family houses and all the related household assets;
(2) Residential land around the family houses with garden and fruit trees;
(3) Family electricity supply with micro hydro generators in the river and related power lines; and
(4) Public infrastructure: (i) Public water tanks with related water pipes for household water supply; (ii) intra-village roads; (iii) village cultural house; (iv) kindergarten, (v) school.

Location. Three villages in Vietnam: Keng Du in Keng Du Commune, and Cha Nga and Xop Duong in My Ly Commune, and five villages in Kouan District in Laos: Phiangxang, Sopsan, Sopkang, Kengkor and Phiangthat are located in the reservoir inundation area and will be permanently lost/submerged.

Assessment. The extent of the Project impact on the villages is **site specific** in the reservoir area and will be **permanent** in duration. Magnitude of the impact on village inundation is **large**. Sensitivity is **high**, due to extreme poverty and vulnerability of the affected ethnic minority people. The impact is of **major** significance.

Proposed mitigation. The affected villages have to be relocated and full compensation provided for all land and assets lost due to the HPP. The impact is assessed and required mitigation measures proposed in the Resettlement Policy Framework (RPF) of the REMLRP. The RPF is based on the baseline assessment, assessment of the expected impacts, and on the opinions and concerns from the affected people during the first phase consultations of the ICP process that were undertaken during the ESIA preparation.

A Resettlement Action Plan (RAP) will be required for each affected village following MIGA standards and has to be prepared in the next phase of the planning and detail design of the HPP, when all the detail losses will be confirmed in detail.

11.4.2 Impacts due to location in DIA, related construction activities and workers' camps

Issue. Xang Tren village is located in the Project structure and activity area and will be highly impacted by the HPP construction.

Baseline. Xang Tren is located right up from the Ca River on a slope up to a logging road leading to the border guard station along the river. All the villagers are Thai ethnic minority people and great majority of households are under the poverty line. The village has existed since the 1950s, and has established its identity and ethnic culture in its location. Interaction with people from other villages is limited due to the difficult accessibility. All families own boats, and the Ca River is the main transportation way for them. Many villagers, especially younger men have labour migrated to other parts of Vietnam, and drug use appears to be present in the village with about 50 reported drug addicts.

Impact and rational. The village will suffer a major impact from the construction. Village life will be highly impacted by the presence of construction workers and camp followers, transportations, noise, dust and other disturbance from the construction (See physical section). The affected people, especially women and children, are currently living quite isolated with little contact with people and influences outside their own area. They are highly vulnerable to losing their social norms, ethnic culture and way of life, as well as be at risk for prostitution, sexually transmitted diseases, drugs, drinking, human trafficking, gambling, etc. through an influx of the expected more than 3,400 mainly male workers plus camp followers from other parts of the country with different culture and lifestyle and more available money. There is a high risk for negative social as well as both physical and mental health impacts on individuals and on the entire village community from the very close presence of the HPP construction.

Workers related issues: Also nearby villages will be impacted by the influx of high numbers of people coming from outside the local setting. There will be not only new opportunities for trade and business with the construction staff, but they will also potentially increase the pressure on natural resources in forests, lands and water if not properly managed.

Location. The village is located 1km downstream the dam site, next to the planned workers' camp and Project administrative areas, and in the midst of the main construction area.

Assessment. The extent of the project impact on the village is **site specific** in the project structure and activity area and will be **permanent** in duration. Magnitude of the impact is **large**. Sensitivity is **high**, due to the extreme vulnerability of the affected ethnic minority people. The impact is of **major** significance.

Proposed mitigation. Xang Tren village have to be relocated and full compensation provided for all land and assets left behind. The impact is assessed and required mitigation measures proposed in the RPF of the REMLRP. The RPF is based on the baseline assessment, assessment of the expected impacts, and on the opinions and concerns from the affected people during the first phase consultations of the ICP process that were undertaken during the ESIA preparation.

A community awareness program on risk behavior, HIV/AIDS and other sexually transmitted diseases (STDs) and human trafficking prevention is proposed as part of the REMLRP. The program will cover all the villages in the vicinity of the construction areas and along the transportation roads to the construction area.

ESMP will include the awareness raising and agreements required to reduce the potential risk on the local environment by the construction workers through hunting, fishing, wood removal from the forest, etc.

Construction contractors will also be required to implement an awareness program for all the construction workers on risk behavior, HIV/AIDS and other sexually transmitted diseases (STDs) and human trafficking prevention. The program will be included in all the construction contracts.

A RAP will be required following MIGA standards and has to be prepared in the next phase of the planning and detail design of the HPP, when all the detailed losses will be confirmed. An Influx Management Plan will also be implemented.

11.4.3 Impact on cultural heritage

Issue. Land areas and assets that are of crucial cultural and spiritual importance for the affected ethnic minority people will be inundated.

Baseline. All the affected villages have: (1) A spirit forest area which is comprehended as the residence of the dead; (2) Graveyard located outside the village, often near the river; (3) Village worship site, sometimes with a very simple wooden spirit house or wooden platform for offerings only, usually located in the outskirts of the village. These cultural sites and assets are central in the worldview of the affected people and therefore have to be taken into consideration in a culturally sensitive and appropriate way.

Impact and Rational. The reservoir will inundate village worship sites in the affected villages, and land areas with spirit forests and graveyards.

Location. The culturally important lands and assets of each affected village are located in the inundation area near the village or at a short distance from it. Some of the graveyard and spirits forest areas may not be inundated but be located near the reservoir border, and they may remain at a distance from the village resettlement site. The exact location of the area of each village and the reservoir impact will be assessed in detail in the planning and design phase of the HPP during the relocation and compensation planning.

Assessment. The extent of the project impact is **site specific** in the reservoir area and will be **permanent** in duration. Magnitude of the inundation impact is **large**. Sensitivity is **high**, due to the central role of the spirits of the dead and the gods/spirits of different natural elements and places in the worldview of the affected ethnic minority people. The impact is of **major** significance.

Proposed Mitigation. Proposed mitigation is provided in the RPF of the REMLDP. According to the traditions of most of the affected ethnic minority groups, graves need not be relocated if inundated. However, some families have expressed worry over the submerged spirits and want to relocate the graves. New graveyard, new spirit forest and new village worship site have to be founded in the resettlement site in a culturally sensitive and appropriate way. The Project is required to provide compensation to the affected people for arranging culturally required spirit relocation ceremonies, some of which according to the ethnic tradition have to take place one year before the relocation of people.

11.4.4 Impact on physical assets of the government

Issue. Border guard stations in the reservoir and dam construction area need to be relocated.

Baseline. The Project area is located in the national border area between Vietnam and Laos, and there are border military stations along the river.

Impact and Rational. The reservoir will inundate one border guard station in Keng Du Commune and one border guard station in My Ly Commune is located in the dam construction area. These have to be relocated.

Location. A border guard station is located just downstream the My Ly dam and will be in the dam construction area. Another border guard station is located in Keng Du village and will be inundated by the reservoir.

Assessment. The extent of the project impact is **site specific** in the reservoir area and dam construction area and will be **permanent** in duration. Magnitude of the inundation impact is **small**. Sensitivity is **low**, and the significance is **minor**.

Proposed Mitigation. Proposed mitigation is provided in ESMP, and decision of the compensation made in consultations with the GoV. Mitigation measures on any similar assets to be inundated in the Lao PDR will be agreed in consultation with the GoL.

11.5 Pre-construction / Construction phase Impact on livelihoods –

11.5.1 Reduced access to wildlife harvests for food

Issue. Loss of wildlife used as food by the local community.

Baseline. The forests and the riverine area serve as provisioning food products to local communities. Wildlife species such as rats, bamboo rats, civet, tree squirrels, wild chicken and birds, wild dragon, gecko, some species of snakes and frogs are sources of protein. Some organs of wildlife species are also used for medicinal purposes.

Impact and rational. Loss of about 1,247ha forest land to inundation and restrictions imposed on wildlife collection/harvest in safeguard buffer area covering about 708ha all along the reservoir stretch would reduce wildlife hunting opportunities for local communities. This will impact upon nutrient rich food availability and will put more pressure on the remaining forests for hunting.

Location. Forests and riverine areas along the reservoir in all Project affected villages.

Assessment. The extent of the Project impact is **site specific** in the reservoir and safeguard buffer areas. Impacts will be **long term** in duration. Magnitude of the impact is **medium**. Sensitivity is **high** because of reduced availability of nutrient foods from forests and the overall significance of the impact is **major**.

Proposed mitigation. The BEESRP shall be developed. Conservation and managed harvests of wildlife in DIA forests and riverine areas will be adopted. The approach would be sustainable harvests of wildlife used for food by local community. This program could be implemented in the remaining production forest areas and in some parts of protection forests at community level. It will be planned and implemented as a "compensatory program" to enhance the livelihoods of ethnic minority population (see Biology section).

11.5.2 Impacts on livelihoods related to Ca River

Issue. Loss of fish and other river resources (e.g., shrimp, crabs, shells) used as food by the local community.

Baseline. Generally, all households do fishing for consumption. Both in rivers and streams are used. Fishes, shrimp, crabs, frogs, snakes, among others contribute to protein requirements of local communities, as well as provide cash for livelihoods. The locals indicated lowering of fish yields is primarily due to over fishing. Most families have boats used for fishing, and access is not an issue. Aquaculture practice is not common although six households in Sopkang DIA village in Laos have maintained a small pond each and rear fish species collected from the river.

Impact and rational. Alteration in aquatic habitat and water pollution in river and riverine areas in the construction sites, e.g., Xang Tren, and over harvesting for meeting the demand from the workforce during construction would reduce fish catch in Xang Tren, Xieng Tam and Xop Duong villages. Barriers to fish migration during operation phase would further reduce fish catch in reservoir area. Displaced people from the direct impact area will be resettled higher up from the river and they will have less access to the reservoir for fishing. Again, the controlled water release from the dam will affect the river ecosystem downstream from the dam and fishing would be much reduced particularly during the low flow period. This would affect people living in Xieng Tam and Xop Tu villages.

Location. Within the reservoir and downstream villages such as Xieng Tam and Xop Tu, in Vietnam.

Assessment. The extent of the Project impact is **site specific** in the reservoir area and immediate downstream from the dam. Impacts will be **long term** in duration. Magnitude of the impact is **medium**. Sensitivity is **high** because of reduced availability of fish and other river resources during construction and thus the overall significance of the impact is **major.**

Proposed mitigation. Implementation of the Fisheries Support Plan (see section ESMP) which will have program components such as cage fish program, community fish farming in relevant villages and provision of community managed boats. The environmental flow shall also be decided in the detailed design regulated and monitored to main aquatic ecosystems just below the dam.

11.5.3 Loss of livelihoods related to livestock

Issue. Loss of fallow land and forests will reduce grazing area and forage availability for ruminant livestock like cattle, buffaloes and goats.

Baseline. The villagers rear cattle, buffaloes, goats, pigs and poultry including ducks. Pig and poultry population is volatile and decreases drastically with frequent disease outbreaks. All animals are reared under free-ranging management system. Disease outbreaks in poultry, pigs and cattle are uncontrolled due to lack of animal health services, and frequent animals deaths mean a great economic loss for the poor farmers.

Impact and rational. Farmers will lose grazing area of about 900ha forest on riverbanks that will be inundated, about 700ha forests in safeguard buffer area, and about 85ha of fallow land after crop harvest. Loss of land will reduce forage availability and affect livestock production; pressure on adjoining forest areas for animal grazing will potentially increase as well.

Location. Fallow land and forest area along Ca River in all 12 direct impact villages

Assessment. The extent of the Project impact is **site specific** in the reservoir and safeguard buffer areas. Impacts will be **long term** in duration. Magnitude of the impact is

medium. Sensitivity is **low** as because of less productive ruminants and the overall significance of the impact is **minor**.

Proposed mitigation. Development of a Biodiversity Enhancement and Environmental Services Restoration Plan (see ESMP section). This will involve propagating / planting, conserving and managing plant materials that could provide food and medicines for local community and forage for ruminant livestock. This program could be implemented in the remaining production forest area and in some parts of protection forests at community level. It will be planned and implemented as “compensatory program” to enhance livelihoods of ethnic minority population.

11.5.4 Inundation of land areas used for livelihoods activities

Issue. Loss of agricultural land and crop production which are the basis of livelihoods for local communities.

Baseline. Seven villages in Keng Du and My Ly communes, in Vietnam and five villages in Kouan District, Laos, cultivate rain-fed crops on about 1,147ha of swidden land. Under the rotational farming system, they have access to about 2,294ha additional swidden land for crop cultivation. They grow wetland paddy along streams in about 26ha and they plant vegetables and fruit crops on riverbank and homesteads. They grow rain-fed paddy maize and cassava as main crops on swidden land and some minor crops like peanuts and pumpkin.

Impact and rational. Farmers will permanently lose about 85ha of swidden land in the reservoir, 10-12 ha in Safeguard Buffer Area and about one hectare at the auxiliary construction site and some farming land on river bank and homestead. There will be an annual loss of up to 61 mt rice, 23 mt maize, 51 mt cassava, about 1 mt of peanuts and minor crops as well as loss of fruits and vegetables grown on riverbank in reservoir area.

Assessment. The extent of the Project impact is **site specific** in the reservoir area and Xang Tren village and will be **long term** in duration. Magnitude of the impact is **small** as just about 10% of their cultivated swidden land is lost. Sensitivity is **high** due to high poverty status while the overall significance of the impact is **moderate.**

Proposed mitigation

a) The swidden land lost in production forest area has low productivity. Moreover this land area will be reasonably compensated and provided a resettlement site so as to ensure livelihood and living standard of PAPs will be better than before (see RPF).

b) Development of an Upland Farming Diversification Plan (see ESMP). This will include component on crop diversification and multiple cropping with perennial plants – fruits and fodder and medicinal plants.

c) Development of the Soil Fertility Enhancement Plan (see ESMP). Simple compost making practices such as using biomass collected from nearby forests, crop residues and cattle dung will be adopted and implemented as pilot project in the swidden land as well as in wetland paddy area and home gardens. Legumes such as soybean, beans or other similar plants will be intercropped with maize and cassava which could provide some edible materials and also enhance soil fertility.

11.5.5 Impact on river transportation

Issue. Impact of the dam and reservoir on river transportation between up - and downstream areas.

Baseline. Ca River is the primary way of transportation for the villages along the river. All households have their own boats.

Impact and rational. River transportation will be disturbed by the reservoir inundation and the dam will cut off transportation between up and downstream areas. Lost transportation of both goods and people will have a major effect on accessibility to services in the commune center, communication and social life between people from different villages, and their livelihoods.

Location. Reservoir area and downstream of the dam. Both the villages along the river to be inundated in the reservoir area and the villages downstream the dam will be affected.

Assessment. The extent of the project impact is **site specific** in the reservoir and downstream area and will be **permanent** in duration. Magnitude of the impact is **large** due to the effect of lost river transportation on people's lives and livelihoods. Sensitivity is **high**, due to the poverty status and importance of the river transportation for the affected people. The impact is of **major** significance.

Proposed mitigation. All the affected villages will have a vehicle accessible year-round road. To compensate for lost river transportation other type of transportation means have to be considered in the detailed design phase.

The impact is assessed and required mitigation measures proposed in the REMLRP.

11.6 Operation phase

11.6.1 Impacts on the downstream low flow area during operation

Issue. Downstream the dam on a stretch of 2.8km, water flow will be significantly reduced during the dry season.

Baseline. In the operation phase there will be two villages in the downstream low flow area, the existing Yen Hoa and Xang Tren to be relocated on the opposite river bank. Fishing and river transportation is important for the villagers, animals are grazing on the riverbank and drinking the river water, and people wash clothes and bath in the river. However, the Ban Ve HPP reservoir reach is up to Yen Hoa village, 2.8km downstream the planned My Ly dam.

Impact and rational. Villages in the downstream may potentially be affected by reduced water flow during the dry season and water fluctuations depending on the dam operation. This may have impact on fishery, riverbank cultivation, river transportation and household water availability.

Location. In a river stretch of 2.8km downstream the dam.

Assessment. The extent of the project impact is **site specific** in the downstream area and will be **long term** in duration. Magnitude of the downstream impact is **medium**, expected to occur only part of the year. Sensitivity is **medium**, and the significance is **moderate**.

Proposed mitigation. Proposed mitigation is provided in ESMP through monitoring of water use and water levels. The Project's operational regime, when finalized during the detailed design shall consider the environmental flow and Ban Ve's operational regime as well.

11.6.2 Implementation of the environmental safeguards

Issue. Implementation of the environmental safeguards (the ESMP) will enhance the physical features and biodiversity of the Project AI thus having a positive effects.

Baseline. The Project DIA has been assessed to have low to medium biodiversity as human pressure to the available natural resource is high. The forest serves as the primary source of food for the village, and the river for their source of protein. Some areas declared as Protection Forests are converted into swidden farming. The pressure for exploitation for forest products for food and use of natural resource is expected to increase as the population increases in the area. Without sustainable management of these resources, biodiversity is further put at risk. The swidden farming also leaves the soil less productive, can result to landslides, increase soil erosion and ultimately affect water quality and the fisheries resources.

Impact and rational. The development of the Environmental and Social Management Plan (ESMP, see section), if implemented properly and adequately will ensure that the impacts identified will be mitigated and addressed. The above current conditions of natural resources will be improved and enhanced. The ERMLRP also aims to improve the living condition of the PAF/PAP. The Project is also expected to generate employment for the community which will decrease their dependence on natural resources alone.

Location. The Project area and especially the DIA.

Assessment. The extent of the Project impact is **site specific** and duration is long term. Magnitude of the impact is **large** and sensitivity is high therefore the overall significance of the impact is **moderate**.

Proposed mitigation. See ESMP and ERMLRP

11.7 Cumulative Impacts

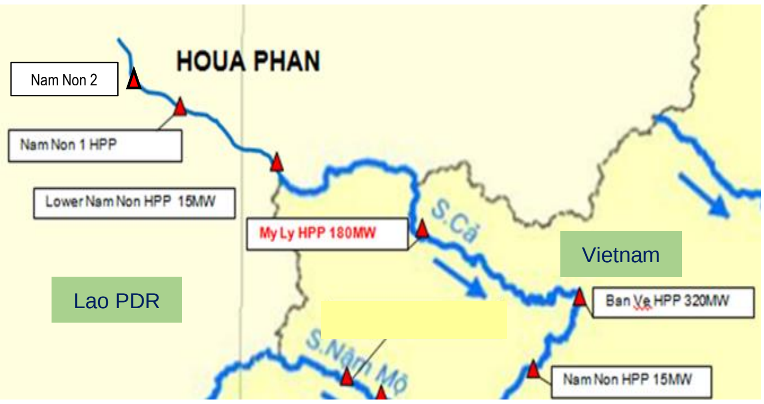
Cumulative impacts are those that result from the incremental impact of the Project when added to existing, planned and reasonably predictable future projects and developments. The cumulative impacts have been assessed based on the principles outlined in the IFC Guidance Notes (2012).

The purpose therefore of this assessment is to better understand the impacts of the existing HPP and planned HPPs within the Ca River cascade system, together with this Project. There is currently limited quantitative data on some receptors available to make a fully informed cumulative impact assessment. As more information on the planned operation and information from the proposed monitoring (river and use) in this report will be available at the detailed design, the assessment below has been limited to be semi-qualitative.

The assessment however has looked at different vital ecosystem and social attributes aspects such as biodiversity, critical habitats, sensitive receptors, livelihood and ecosystem services.

Two of the large rivers that flow downstream into Vietnam from Lao PDR are the Ca (Nam Non) and Nam Mo rivers. The Ca River (Song Ca in Vietnamese and Nam Non in Lao[99]) joins in confluence with Nam Mo River and flows into the Gulf of Tonkin. My Ly HPP is planned on the Ca River where there are both hydropower projects planned and in operation (Figure 11.1). During the preparation of this ESIA, there are planned three projects upstream located in Laos, where two have feasibility studies completed. The closest upstream hydropower project (Lower Nam Non) has a completed feasibility study, however the exact status of the approval of the EIA is not known, at this stage. There are two hydropower projects downstream in the Ca River which are in operation Ban Ve HPP (320 MW and Nam Non HPP (15 MW).

[99] There are several names used in Vietnam for the Ca River.



Ban Ve HPP (320 MW)

The Ban Ve HPP is a large dam hydropower project (dam height of 137m and the dam site is situated about 85 km from the planned My Ly HPP dam site) and has been in operation since 2010. The project was approved in July 2003 and dam construction started in February 2004. The 320MW Ban Ve HPP was commissioned in May 2010. The operator is EVN Generation Company (Genco) No 3.

The hydro power plant is located in the central Nghe An Province's Tuong Duong District of Vietnam. It is the first hydroelectric project to have been built wholly by Vietnam. Production is about 1.76 TWh/yr. Electricity is transmitted to the national grid across a 200km transmission line that runs from the plant to a transformer station in Vinh City.

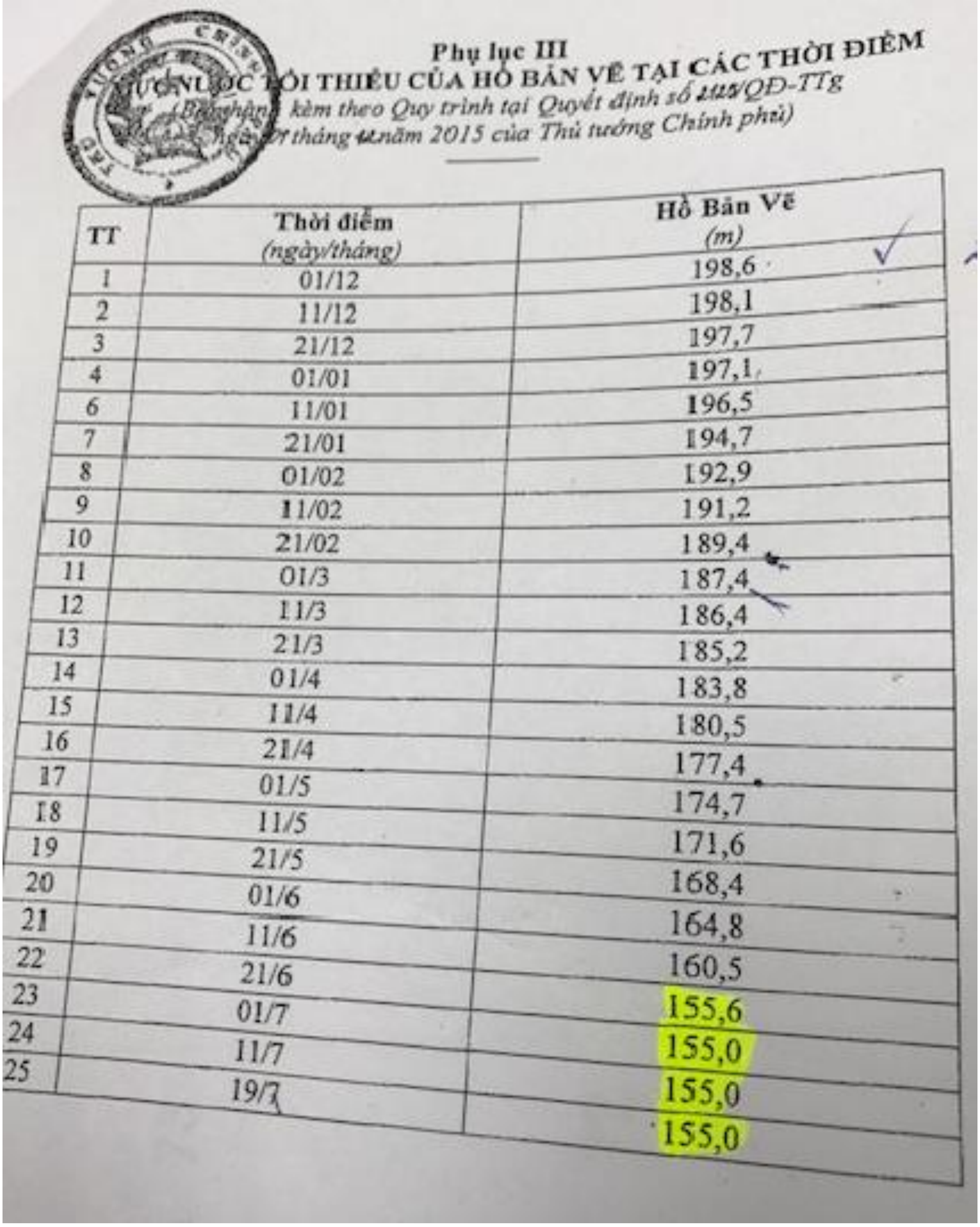
Source: http://www.power-technology.com/projects/ban-ve-hydro/;
http://www.industcards.com/hydro-vietnam-a-m.htm (accessed 23/02/1; photo from
http://www.udidata.com/

Figure 11.2 Location of existing and planned hydropower (HPP) projects on the Ca River with respect to the planned My Ly HPP and existing Ban Ve HPP.

The inter-reservoir operational rule for Ca River cascade (Decision No. 2125/QD-TTg by the Government's Prime Minister dated 01/12/2015) requires Ban Ve HPP to have the following operational specifications:

1. The operating level of the reservoir during flood season (when the highest water is experienced) shall be 192.5m;
2. The minimum operating level of the reservoir during dry season from December to July, depending on the driest month of the year (May to July) shall be 155m. This can vary slightly year after year depending on the start of the dry season and when its peak is experienced.
3. Between the months of September to November, the reservoir will be impounded up to FSL at 200m.

The operational minimum water level based on Decision No. 2125/QD-TTg of Van Be HPP is presented in Figure 11.3. My Ly HPP operational regime will therefore comply with these water level requirements.



Phụ lục III

MỰC NƯỚC TỐI THIỂU CỦA HỒ BẢN VẼ TẠI CÁC THỜI ĐIỂM

(Ban hành kèm theo Quy trình tại Quyết định số 2125/QĐ-TTg ngày [illegible] tháng [illegible] năm 2015 của Thủ tướng Chính phủ)

TT	Thời điểm (ngày/tháng)	Hồ Bản Vẽ (m)
1	01/12	198,6
2	11/12	198,1
3	21/12	197,7
4	01/01	197,1
6	11/01	196,5
7	21/01	194,7
8	01/02	192,9
9	11/02	191,2
10	21/02	189,4
11	01/3	187,4
12	11/3	186,4
13	21/3	185,2
14	01/4	183,8
15	11/4	180,5
16	21/4	177,4
17	01/5	174,7
18	11/5	171,6
19	21/5	168,4
20	01/6	164,8
21	11/6	160,5
22	21/6	155,6
23	01/7	155,0
24	11/7	155,0
25	19/7	155,0

Figure 11.3 Decision No. 2125/QD-TTg of Van Be HPP, which sets the requirement for the minimum operational water level of the existing Ban Ve HPP.

Table 11.1 Existing and planned hydropower projects on the Ca River

Hydropower projects on the Ca River	Installed capacity (MW)	Status	Country	Project documents available	Project owner
Nam Non 2	Not known	Not known	Lao PDR	-	
Lower Nam Non 1	Not known	FS	Lao PDR Phianghong Village	-	
Lower Nam Non	15	FS, 2016	Lao PDR Phianghong Village	Feasibility Study Profile (issued by PECC1, 2016)	SN Energy Ltd. Company and Chichareune Construction Ltd. Company
Upstream					
My Ly	**180**	**FS**	**Vietnam-Lao PDR**	**GoV Technical FS, EIA and RP, GoL EIA**	**My Ly – Nam 1 HPP JSC**
Downstream					
Ban Ve HPP operated since 2010; dam site is located about 85 km downstream HPP of My Ly Project. It has a reservoir length of 82.2km	320	Operation	Vietnam	Technical Design, Hydrological and EIA reports, Reservoir operation regime, Dam safety report (Issued by Ban Ve HPP JSC, 2015)	EVN Generation Company (Genco) No 3
Nam Non	15	Operation	Vietnam		Nam Mo HP JSC, 2016
FS = feasibility Study					

The potential impacts of the planned My Ly HPP and impacts of the other planned existing and planned hydropower projects immediately downstream and upstream of the My Ly HPP are presented in .

Table 11.2. The observations and impacts presented are based on data available and further study would be required.

Table 11.2 Characteristics, receptors and potential impacts of other hydropower projects

Aspect / Receptor / Issue	Technical details / Current status	Cumulative Impacts: due to presence of Ban Ve HPP (downstream of dam site, in operation) and planned projects (upstream of reservoir)
Downstream		
Dam Height of Ban Ve HPP (RCC – roller compacted concrete dam. **Reservoir Length**: 82.2 km	137 meters	Ban Ve HPP dam wall has blocked long distant migratory fish. The reservoir has active fisheries with fingerlings introduced, cage fisheries and fishing with boats and nets.
FSL of Ban Ve HPP reservoir	200masl End of reservoir reaching about 2.80 km from My Ly dam site. (distance based on My Ly dam site to Yen Hoa's approximate location along the river)	The low flow zone of the My Ly HPP will be at least about 2.8 km stretch of the river. The villages that are at the downstream of My Ly HPP in its low flow stretch are Xang Tren and Yen Hoa.
MOL of Ban Ve HPP reservoir (dry season)	155masl End of reservoir reaching 31.20km from My Ly dam site. (Variation between the FSL and MOL is 28.20 km. The distance from the FSL to the My Ly dam site is 2.80km	There are nine villages in the 28.20 km stretch (difference between FSL and MOL). These may be affected based on their use and dependence on the river. The building of the My Ly HPP may result in less flow of water during the dry season when the MOL is eventually reached (the water level of FSL from 200m will move from about 198.60m (1 Dec), 192.90m (1 Feb), 175m (around 26 April) to a low of 155.60m (21 June) to the lowest 01-19 July) before the rains start.
Operation	Storage project / Peaking	Reservoir fluctuation may affect level of water downstream the planned My Ly HPP dam site.

Aspect / Receptor / Issue	Technical details / Current status	Cumulative Impacts: due to presence of Ban Ve HPP (downstream of dam site, in operation) and planned projects (upstream of reservoir)
River stretch between My Ly HPP and Ban Ve HPP back water at FSL	2.80km downstream of Xang Tren reaching Yen Hoa village. Note the slope of the river is rather gradual so variation is little noticed in the water level. (the red area on the map (in the cell to the right) is the My Ly dam site and permanent project works area)	
River stretch between My Ly HPP dam site and Ban Ve HPP reservoir back water at MOL, at end of June/July – dry period.	31.20km downstream Note the slope of the river is rather gradual so variation is little noticed in the water level. Ban Ve HPP reservoir water level may be receding close to Xop Tu village.	
Fish species diversity and migration, and fisheries	Fisheries comprising aquaculture is practiced and fishing is done (including using boats).	The migratory fish have been blocked due to the dam wall of Ban Ve HPP. The reservoir of Ban Ve HPP (length of 85km) has likely allowed for short- and medium - range migrants to survive. The planned My Ly will not affect long distance migrants.
Vegetation diversity and status of river slopes	Impacts are there due to the reservoir of Ban Ve HPP from the FSL reservoir.	River side vegetation has been affected during the low flow period (likely between 28.20km) and receding of the Ban Ve HPP reservoir. Thus impacts are already present since operation of Ban Ve HPP. Additive impacts of the planned My Ly HPP are seen as minimum but this is being studied closely.
Settlements along reservoir of Ban Ve HPP which may be effected due to My Ly HPP during the dry season – when reservoir water level is low. The settlements are Xang Tren (located by the planned dam site and to be resettled across	Settlements are not affected at FSL and during lower levels of Ban Ve HPP reservoir. There is water for fishing and other activities, including mobility by boat and domestic use. The reservoir tail end recedes to a distance of about 28.4km from the planned My Ly dam site (this is being evaluated)	The lowering of the Ban Ve reservoir water level during the dry season makes the several villages in the reservoir area of Ban

Aspect / Receptor / Issue	Technical details / Current status	Cumulative Impacts: due to presence of Ban Ve HPP (downstream of dam site, in operation) and planned projects (upstream of reservoir)
from Yen Hoa village), Xieng Tam, Xop Tu and Hoa Ly.		
Livelihood activities along the reservoir of Ban Ve HPP, reservoir stretch that is likely to fall into the low flow stretch of My Ly HPP during the dry season	See above. Agriculture water use is obtained from tributaries and mountain water springs. River is used for domestic activities, fishing and mobility (to other villages, across the river and fishing).	Fisheries and mobility may be affected during the dry season. This will need further assessment based from actual inflows from tributaries and release from the planned My Ly HPP.
Ecosystem services that will be affected	At present, there is river water present and available all year round. The situation will change during the construction and operation of the My Ly HPP.	There will be no additional changes due to My Ly HPP (e.g., expected impacts are on fisheries, mobility and domestic uses). Note that the river stretch during the dry season will be affected.
Upstream		
Dam height (planned Lower Nam Non HPP)	Not known	
Stretch of river between planned dam wall of Lower Nam Non HPP and water level of My Ly HPP at FSL	The current plan has it that the back water of My Ly HPP may overlap with the location of the dam site of the planned Lower Nam Non HPP (Phianghong Village) which is 0.6 km from the Vietnam-Laos border.	This is not an unusual condition in projects in Vietnam. The situation is that the tail end of the planned My Ly HPP will be shortened considerably due to the location of the Lower Nam Non HPP.
Villages upstream		Impacts are likely minimized due to the other planned projects. These as informed appear to be in the pipeline for construction.

11.7.1 My Ly downstream villages in the potential extended low flow area

It is calculated that downstream the planned dam, about 28.40 km of the river will be potentially affected by low flow during the dry season. There are many villages by the river along this distance.

Xang Tren Village located 1km downstream the planned dam site and in the midst of the planned Project construction areas will be relocated. The identified resettlement site according to My Ly Commune authorities is about 1.5km downstream the river, which means that the village will still be relocated in the immediate downstream area of the dam. The proposed new location of Xang Tren Village is on the right bank of the river approximately across the river from Yen Hoa Village. Downstream Yen Hoa, all the villages along the river are within the reservoir area of Ban Ve HPP and affected by its operation.

At the full supply level of 200masl of the Ban Ve HPP, its reservoir' tail end reach up to Xieng Tam Village, which is the My Ly Commune center, located 5.1km downstream of the planned My Ly dam site. Xop Tu Village with My Ly Commune health center and secondary school, is located further downstream at a distance of 8.7km from the My Ly dam site. Some households here closest to the river were relocated by Ban Ve HPP.

Hoa Ly village 14.7km downstream of the planned My Ly dam site is affected by the Ban Ve reservoir water level changes. Households living closest to the river were relocated by Ban Ve HPP and the riverbank lands that local farmers are utilizing for intensive cultivation get flooded from its backwaters (tail end of the reservoir).

There is a year-round vehicle accessible road along the Ca River from Xieng Tam village through Xop Tu and Hoa Ly further downstream to Pieng Mung village, where the road leaves the river, and the villages further downstream are accessible by boat only. Pieng Mung is an old village, and some households moved there when relocated by the Ban Ve HPP. This village is located by a tributary running into the Ca River, and separated from the river by a minor mountain/hill range.

The further downstream villages within the estimated 28.4km low flow regime of the planned My Ly dam are Ban Ve HPP resettlement villages. There is no road access to these villages, but local small boats are used for transportation of people and goods from a harbor right above the Ban Ve dam. According to local people in the Ban Ve dam area and in the reservoir tail end area, there is plenty of fish in the reservoir and fishing is a regular activity for local people.

Table 11.3 below provides an overview of the villages within the estimated downstream impact area of the My Ly HPP.

Table 11.3 Downstream villages potentially affected by the planned My Ly HPP.

No	Village	Distance from the planned My Ly HPP dam site	Potential Impacts and monitoring needs
1	Xang Tren	1km	1km downstream the dam site, in the Project construction area – village to be relocated
2	Yen Hoa	2.8km	FSL = 200masl 2.8km downstream the dam site (At FSL, reservoir starts receding from this level)
3	Xieng Tam	5.1km	My Ly Commune centre 5.1km downstream the dam site
4	Xop Tu	8.7km	8.7km downstream the dam site, some HHs were relocated by Ban Ve HPP
5	Hoa Ly	14.7km	14.7km downstream the dam site, some HHs were relocated by Ban Ve HPP
6	Pieng Mung	16.9km	Village located by a tributary and separated from the Ca River by a minor mountain range
7	Xen My	21.7	Ban Ve resettlement village, no road access
8	Ban Tom	23.9km	Ban Ve resettlement village, no road access
9	Cha Luan	27.2km	Ban Ve resettlement village, no road access
10	Sop Pe	28.4km	MOL=155masl Ban Ve resettlement village, no road access. Located about 28.4km downstream the planned My Ly dam site

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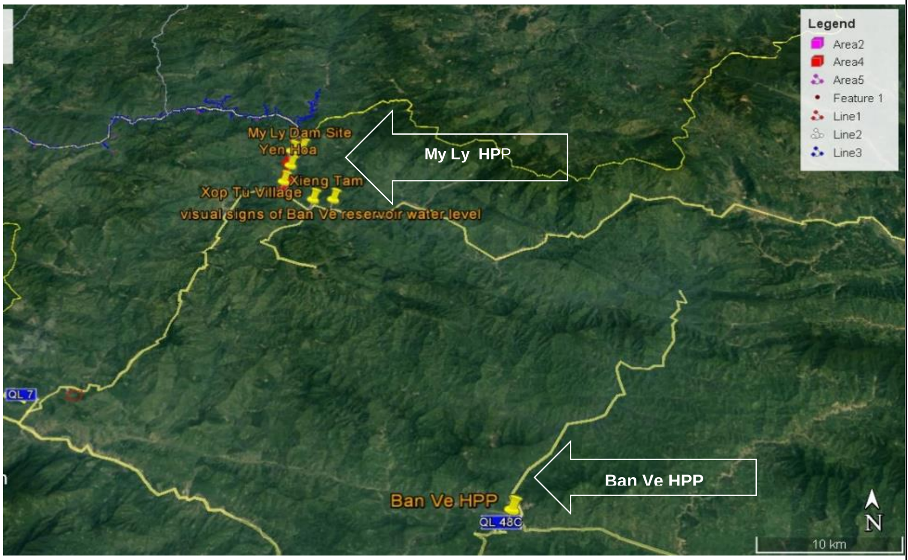

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1.

Location of Ban Ve HPP in relation to the planned My Ly HPP dam site (estimated at 85 km along the river from the dam site of My Ly HPP)
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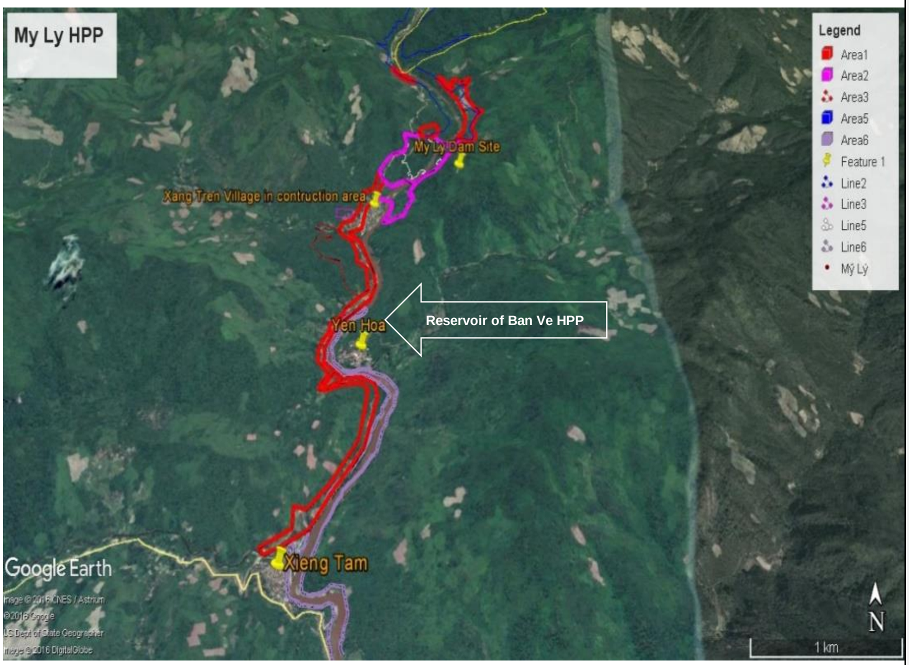

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2.

The reservoir (in light purple) of Ban Ve HPP at FSL reaching upstream Yen Hoa village located 2.80km downstream of the planned My Ly dam site.

Xang Tren village is downstream the planned site in the construction area. The villages have expressed to be relocated along the right bank, opposite of Yen Hoa village.
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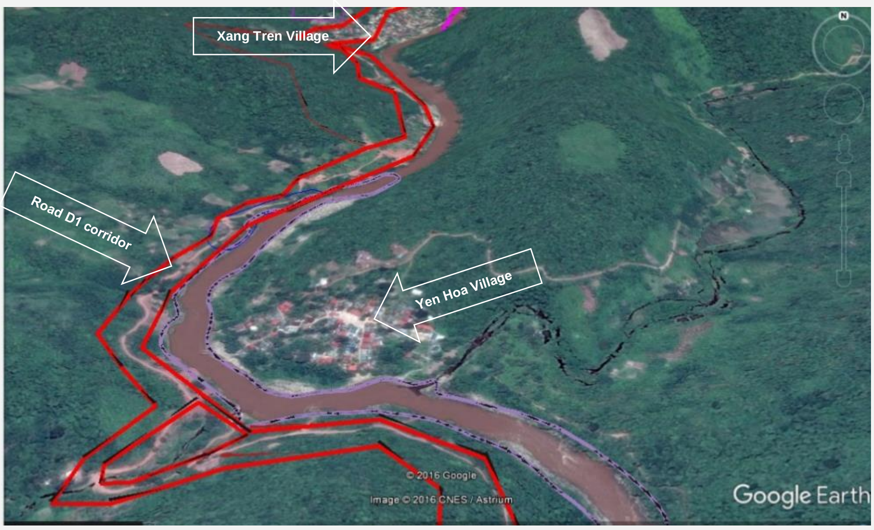
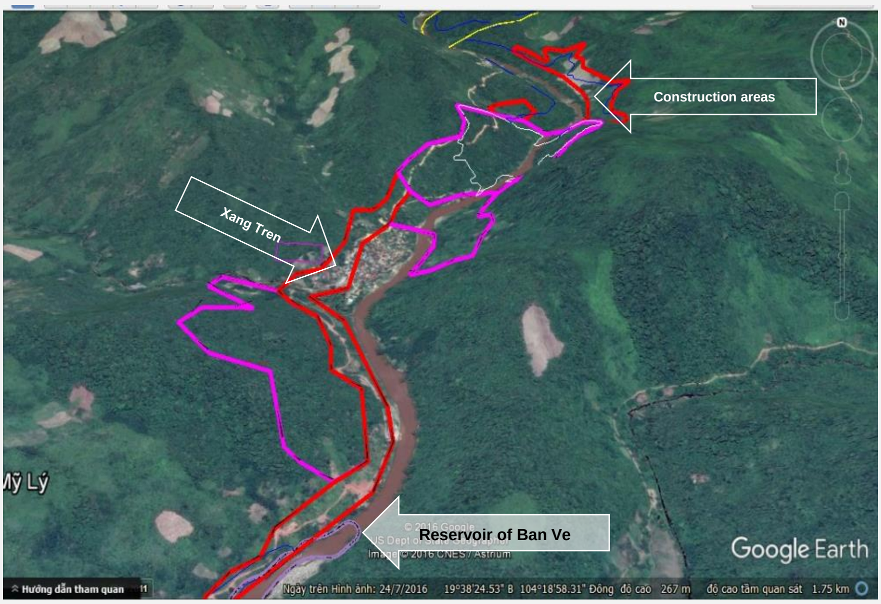
	**3.** The reservoir of Ban Ve HPP at FSL reaching upstream Yen Hoa Village located approximately 2.8km downstream of the planned My Ly dam site.
	**4.** see above

Figure 11.4 Impacts of the existing downstream Ban Ve HPP hydropower Project reservoir in respect to impacts of the planned My Ly HPP

11.7.2 Key cumulative impacts

The key cumulative impacts of the development of My Ly HPP to the Ca River system includes:

1. Villages using the river may be affected as the Ban Ve HPP reservoir recedes from its FSL to MOL, a distance of about 28.4 km from the My Ly proposed dam site. The receding level of the reservoir leaves the river with the natural flow in the river during the period of the year, however, with the My Ly HPP the flow will be further reduced. This may affect current river related activities.
2. Dry season river bank may be affected if there is a significant reduction of water based on the discharge decided for My Ly HPP.
3. Fish species however are not likely to be significantly affected as long as the reservoir shall be maintained at its MOL all the time.
4. River bank natural vegetation is already affected by the Ban Ve HPP reservoir regime, since its operation in 2010 and therefore no significant impact is foreseen

5. Navigation to the downstream villages without access road maybe affected from the potential reduction of water flow.

Monitoring of the potential impacts identified above requires monitoring and evaluation to further assess the seasonal impacts. Potential impacts however are foreseen to be medium to high, and are subject to re-assessment based on a regular monitoring regime to be started during the detail design phase and construction period.

11.8 Riparian release and environmental flow

Issue. There is a need to maintain riparian release and preserve environmental flow for the river ecology to thrive.

Baseline. For use in the hydrological analysis, both for technical and environmental purposes, river discharge were modelled using a limited empirical data. At My Ly dam site, the annual discharge is 107.2m^3/s. This discharge currently meet the operational requirements of Ban Ve HPP downstream of the Project (see Cumulative section). Downstream of the dam site are smaller tributaries and contributes approximately 11.79m^3/s to. The practice in Vietnam is that the environmental flow is decided during the detailed design phase when the mode of operation is finalized. An economically sound environmental flow is recommended which maintain minimum ecosystem services and aquatic diversity.

Impact and rationale. It is anticipated that there will be reduction of river flow when the My Ly dam site is operational.

Assessment. The extent of the impact is **site specific** but duration is **long term**. However no sufficient conclusion can be made at this stage therefore assessment is not complete.

Proposed mitigation. There is a need to monitor the river flow of Ca River at strategic locations and this primary data collection shall be an input to a more robust hydrological assessment and be able to make a fully informed assessment.

11.9 Transboundary impacts

Issue. The Ca River system originates from Laos and extend to Vietnam, covering two countries and may potentially trigger transboundary impacts.

Baseline. The My Ly HPP is located in the boundary area of Vietnam - Lao PDR on the Ca River. The main components (e.g., dam, powerhouse, spillway, intake) and auxiliary areas are located about 1.6km from the Vietnam - Lao PDR border in My Ly Commune, Ky Son District, Nghe An Province, in Vietnam. The catchment area down to the proposed dam site is approximately 7,100km^2 and more than 99% of which is in Laos territory.

There is an agreement between the two governments to develop My Ly HPP in Vietnam addressing the impacts in Laos and complying with Laos EIA requirements (see Chapter 1).

Location. Project influence area.

Impact and rational. Based on MIGA's definition of transboundary impacts, the Project triggers an assessment of potential transboundary effects because of the use of river water from Laos while the HPP is in Vietnam. In addition, the agreement approved the use of the river. The agreement spelled out conditions on responsibility and benefit sharing for each of the participating countries.

Potential positive impacts will include benefit sharing and economic opportunities which will be a subject for the two countries and Proponent. At this period, the precise scope of the benefit sharing is not known. Most of the physical and biological impacts are concentrated in Vietnam, being the host for both the main construction works and auxiliary facilities. Five villages will be affected in Laos and will be relocated (see Social section).

There is an existing HPP downstream the planned My Ly HPP, which has blocked long distant migrant fishes, and the impact on this at this stage is small. There are also planned projects upstream in the Laos territory for which feasibility studies have been completed (see Cumulative Impacts, this chapter). It is not anticipated that any further environmental impacts will affect the Laos side.

Assessment. The extent of the impact of the development of the Project is **regional** given that the benefits will go to the two countries and duration is **long term**. However, overall assessment of transboundary impacts on physical and biological environments is **low.** Since the Project in Vietnam results in impacts on villages in Laos, the social impact is **high** due to the relocation needed. The relocation process if done according to MIGA requirements will work to reduce expected impacts.

Proposed mitigation. Overall mitigation is in REMLRP and ESMP. Monitoring of reservoir buffer zone, water quality and all measures proposed in the plans.

11.10 The reservoir and global impacts

Issue: Climate change and reservoir

Impact and rational: The My Ly HPP area of influence is regarded as warm sub-tropical in climate and the vegetation composition and crops grown in the area attest to its clear tropical affinity. For this evaluation the dam is assessed as a warm sub-tropical reservoir. Studies point to emissions being much higher in the humid wet tropics than in other regions (St Louis et al. 2000; Duchemin et al. 2002; Barros et al. 2011; Demarty and Bastien 2011) and the region where My Ly HPP is planned. Emissions are large in the first years after forming a reservoir (e.g., Galy-Lacaux et al.1999; Abril et al. 2005) and when large biomass material is present submerged in the reservoir, unlike the large poorly vegetation covered Ca River valley (grassland and secondary vegetation abounds in the DIA) in the Nghe An Province.

In reservoirs water quality (e.g. turbidity and oxygen concentration amongst others) decreases accordingly to depth. Water quality can however also have pronounced horizontal quality gradients, especially in long and relatively narrow reservoirs as the Ca, where the water quality can vary considerably between the riverine, transitional and lacustrine zone and within the season. Water depth and hydraulic retention time are the most important characteristics determining water quality. The water depth, geomorphologic and climatic conditions (wind exposition) determine the stratification pattern (mixing regime). The hydraulic retention time is important for the exploitation of nutrients, trophic tolerance, self-purification processes and secondary pollution effects.

In the deeper strata of the reservoir the oxygen content will be reduced compared to the surface layers due to decomposition of organic matter accumulated at the bottom of the reservoir. The decomposition consumes oxygen, increase carbon dioxide and increase the content of nutrients. This will probably be most profound the first years because of release of organic matter from the inundated areas in the reservoir. If O_2 is not present in the lower strata of the water, due to decomposition of organic matter, it might lead to toxic values of manganese, iron and H_2S. A possible effect will also be increased emission of carbon dioxide (CO_2), methane (CH_4) and N_2O, although CO_2 is not regarded as a serious issue in dam/reservoirs based on recent research (Abril et. al. 2013). The vegetation in the planned reservoir inundation area will be removed as required by the GoV/GoL. In deep-water especially of warm humid tropical reservoirs high concentrations of methane are often formed (up to 10 mg/l and more). When water level in the reservoir is lowered during the dry season, methane starts to bubble off through the reservoir surface. But more important is the release over the turbines and the spillways. The sudden fall in pressure when the water comes out results in quick release of methane and carbon dioxide. This will not be the case in this reservoir, due to its length and the release pressure is not expected to be very high.

However, since the reservoir will be flushed as deemed required (details to be determined during the design phase and expected to nearly every year) it is not anticipated that there will be a build-up of organic matter over time and dramatically reducing the chances of gas accumulation and release (Duchemin et al. 2002; Barros et al. 2011). According to the water quality samples, Ca River at this stretch is an oligothrophic river system with a medium content of organic matter which again adds to keep gas levels on the lower side. These facts contribute to reduce the chances of a high release of greenhouse gasses. However, depending on the temperature and the turnover time in the reservoir decomposition will likely release some CH_4 accordingly to seasonal and reservoir characteristics at a given time. The release of gasses is however not seen as serious for this dam.

Due to the long reservoir turnover time in approximate December to June/July the oxygen content probably will be not very different in the deeper strata from the upper strata during this time of the year. The months with the longest reservoir turnover time are during the cold period of November to Feb/March. This is the coldest time of the year which will slow down the decomposition and production of $CH_{4,}$ to some degree overall contributing to low levels of greenhouse gas release. The situation should be monitored carefully especially the first years and if the reservoir is not flushed. It is noted that it is planned that the reservoir will be flushed on a 1-2 year basis.

There is no clear-cut model developed on how to estimate the emission from a reservoir prior to its construction. A very rough approximation can, however, be achieved by using average emission numbers from other reservoirs. A Canadian group looking into this question found that average emissions from tropical reservoirs range from 200 to 3000 grams of CO_2 per kilowatt-hour (kWh), and temperate reservoirs have low emissions. Since relevant estimates for reservoirs in the region as the My Ly HPP reservoir are not available and since the waters temperatures can be warm with cool season period we believe that the emission level will be on the lower end of the scale above (Duchemin *et al*. 2002).

Impact assessment: Any emission is a **direct** result of Project reservoir impounding. The impacts are **short-term**, if measures are taken to assure that carbon material entering the reservoir is minimized. The levels (magnitude) are as mentioned and according to the current understanding are of **small** impact globally and the significance is **low**.

Mitigation: Monitoring of reservoir and downstream water. Actions to be taken to minimize carbon material (vegetation, wood) resident in the reservoir for long periods and catchment conservation (Abril et al., 2013).

Table 11.4 Environmental and Social Impacts Matrix, My Ly HPP.

No	Project activities	Location	Impact and rationale	Impact qualifier				Significance	Mitigation
				Extent	Duration	Magnitude	Sensitivity		
CONSTRUCTION PHASE									
Physical environment									
1	Change in topography, landscape and visual impacts	DIA, The main components (headworks) and auxiliary areas are located in My Ly Commune, Ky Son District, Nghe An Province, Vietnam. The reservoir tail will reach up to Laos.	Earth moving activities due to construction of both main works and auxiliary facilities will result to, change in topography, and further induce soil erosion and sedimentation, landslides and slope instability.	SS	ST to P	L	M	Major	Sound engineering practices/technology consideration; Construction EMP RCMP
2	Generation of waste and hazardous materials	DIA, Across Project construction area	Various construction activities will generate wastes such as large volume of spoils, construction wastes, domestic wastes from 3,400 workers during the peak construction works; used oil, lubricant and used tires from truck, company vehicles and heavy machineries; Use of explosives.	SS	ST	L	M	Major	51.86 ha designated disposal area Solid Waste Management Plan, RCMP EHSP Construction EMP EPRP Influx Management Plan Material Use and Site Waste Management Plan

No	Project activities	Location	Impact and rationale	Impact qualifier				Significance	Mitigation
				Extent	Duration	Magnitude	Sensitivity		
3	Quarry operations	DIA, IIA Xop Tu Village in My Ly Commune	Potential loss of assets; Noise and dust pollution;	L	ST	M	H	Major	Construction EMP; Blasting clearance; Delineation of the quarry area and extent of road rehabilitation
4	Water quality	DIA, IIA Reservoir and downstream of the dam	Degradation of water quality	L	ST to MT	M	H	Major	Construction EMP CRMP, Material Use and Site Waste Management Plan Sanitation and waste management
5	Flood risks	DIA, IIA Reservoir area	Impoundment of the reservoir may pose flood risks	R	ST	L	M	Major	Resettlement Plan Emergency procedure and Response Plan
6	Riparian release and Environmental flows during river diversion	DIA River stretch from dam site to Ban Ve HPP	Impoundment of the reservoir will cause reduction of river flow	L	ST	L	M	Major	Monitoring of water level Legal obligation to the operation regime of Ban Ve HPP
7	Air Quality and noise	DIA, IIA Construction area and access roads	Air quality and noise pollution	L	ST	M to L	M to H	Major	ESMP
8	Traffic impact	DIA, IIA Along access roads	Road safety and dust due to increase of vehicular traffic	L	ST	L	H		ESMP Influx Management Plan

No	Project activities	Location	Impact and rationale	Impact qualifier				Significance	Mitigation
				Extent	Duration	Magnitude	Sensitivity		
Biological Environment									
9	Clear felling of trees/shrubs and other vegetation in permanent construction sites	DIA Ca River at dam site and powerhouse area at Xang Tren Village	Loss of 31ha forest vegetation	SS	ST	L	L	Negligible	Good practices in felling trees; plantation after construction work
10	Clear felling of trees/shrubs and other vegetation in auxiliary construction sites	DIA Auxiliary site at Xang Tren Village	Loss of 46ha forest land, 1ha upland farm area & 6ha water body/other land	SS	ST	S	L	Negligible	Good practices in felling trees; plantation after construction work
11	Pressure on forest resources for fuel wood and timber	DIA, IIA Forest area near Xang Tren Village and adjoining villages	Pressure on forest from about 3,400 workforce and others on fuel demand of about 600m^3/1000 persons/yr	SS	ST	M	H	Major	Supply of alternate source of cooking energy; regulated harvest; wood harvested from forests to be inundated

No	Project activities	Location	Impact and rationale	Impact qualifier				Significance	Mitigation
				Extent	Duration	Magnitude	Sensitivity		
12	Land acquisition for reservoir up to 300m FSL level in Cha Nga, Xop Duong, Xang Tren villages in My Ly Commune and Keng Du, Huoi Phuon 1, Hat Ta Ven and Huoi Xui villages in Keng Du Commune, Kyson District, Vietnam; Phiangxang, Sopsal, Sopkang. Kangklor, Phiangthat villages in Kouan District, Laos	DIA Inundation area including dam structures at Xang Tren to 42km upstream (12 villages)	Total loss of 1,247 ha forest land; loss of trees, shrubs and other vegetation including threatened species	SS	LT	L	H	Major	Safeguard buffer zone CRMP BEESRP
			Submergence of 34,885 mt organic biomass	SS	LT	L	M	Moderate	Organic biomass will be cleared and removed from the inundated area.
13	Acquisition of secondary forest, scrub for safeguard buffer area establishment of a buffer zone around the reservoir	DIA Dam site at Xang Tren Village to 42 km upstream (12 villages)	Degraded and over used fallow land, upland farmland, scrubs and secondary forests are managed and improved	SS	LT	S	L	Moderate	Safeguard buffer zone CRMP BEESRP

No	Project activities	Location	Impact and rationale	Impact qualifier				Significance	Mitigation
				Extent	Duration	Magnitude	Sensitivity		
14	Clearing, excavation, grading and filling activities	DIA Construction site at Xang Tren Village	Loss of wildlife habitat due to removal of vegetation Less mobile, smaller species such as frogs, lizards and small mammals (rats) will be killed	SS	ST	S	L	Negligible	Implementation of good practices for construction works
15	Construction disturbances e.g. blasting, drilling, vehicle,construction work at night	DIA Construction site at Xang Tren Village	Interrupt normal wildlife movement, feeding and other activities. Some wildlife species might temporarily migrate to other forest area	SS	ST	S	S	Minor	Implementation of good practices for construction works Restrict heavy construction work during night time
16	Increased workforce population	DIA Construction site at Xang Tren Village	Potential for illegal hunting, trapping, poaching for food and trading	SS	ST	S	M	Major	Awareness and training to construction supervisors community and workforce, posters and pamphlets
17	Coffer dam construction and related activities, Changing water course and drainage system	DIA, IIA Dam site at Xang Tren	Stream bed disturbances; increase in turbidity; alter habitat of fish, amphibians and other species	SS	ST	S	L	Moderate	Implementation of good practices for construction works
18	Petrochemicals, cement slurry and other toxic materials discharge into river	DIA Dam site at Xang Tren	Water pollution in dam site and downstream area; mortality in fish and aquatic species in dam site and downstream area	SS	ST	M	M	Minor	Implementation of good practices for construction works

No	Project activities	Location	Impact and rationale	Impact qualifier				Significance	Mitigation
				Extent	Duration	Magnitude	Sensitivity		
19	Influx of construction workforce up to 3,400 at peak stage	DIA, IIA Dam site at Xang Tren	Increased demand for fish, lizards and amphibians for food and trade; over harvesting	SS	ST	L	H	Major	Awareness and training to construction supervisors and community; enforcement of government regulations
20	Restricted use of buffer area	DIA Safeguard Buffer Area	Less opportunity to local community for harvesting forest products	SS	LT	S	L	Minor	BEESRP
21	Pressure on forest resources for fuelwood	DIA, IIA Fuelwood need of permanent staff at dam/powerhouse site	Illegal felling in nearby forest; 100 persons need $60m^3$ wood per year	SS	LT	S	L	Negligible	Regulated felling of dead woods
22	Operation of diversion weir	DIA, IIA Downstream area, Yen Hoa, Xieng Tam Village	Obstruction to fish passage of migratory species. Ban Ve dam in the downstream area has already obstructed movement of migratory species	R	LT	M	M	Minor	Reservoir fisheries development plan; community fish farming plan
23	Regulated water diversion to powerhouse in dry season	DIA Dam site and downstream area	Creation of low flow zone in the immediate downstream area; impacts on aquatic habitat and growth	SS	LT	L	H	Moderate	15% of average minimum monthly flow will be released as environmental flow

No	Project activities	Location	Impact and rationale	Impact qualifier				Significance	Mitigation
				Extent	Duration	Magnitude	Sensitivity		
24	Flushing of de-sander basin in low flow season	DIA, IIA Downstream area	Increase turbidity in downstream area affecting fish habitat	SS	ST	M	L	Minor	Avoid flushing during dry period
Social Environment									
25	Reservoir filling/ inundation	DIA Inundation area	<u>Impact on Physical Assets</u> Inundation of 3 villages in Vietnam and 5 villages in Laos with private residential land, houses and assets, and public structures (intra-village roads, water supply, kindergarten, school, village cultural house). Villages to be relocated.	SS	LT	L	H	Major	Relocation and compensation. as required by MIGA. See RPF in REMLRP. Participatory consultations and Agreements required, see PCDP.
26	Dam construction	DIA Project structure and activity area	<u>Impacts due to location in DIA related construction activities and camps.</u> Xang Tren Village is located in the midst of the construction areas and will be highly impacted by e.g. the workers' camp, transportations, dust, noise, etc. Village to be relocated.	SS	LT	L	H	Major	REMLRP

No	Project activities	Location	Impact and rationale	Impact qualifier				Significance	Mitigation
				Extent	Duration	Magnitude	Sensitivity		
27	Reservoir filling/inundation	DIA Inundation area and IIA	Inundation of land areas used for livelihoods activities, both riverbank lands, upland fields and forest areas providing timber and NTFPs, and areas used for animal grazing.	SS	LT	L	H	Major	REMLRP
			Graveyards inundated or at a longer distance. Graveyards inundated or to be left at a long distance from resettled villages.						
28	Reservoir inundating the river and the dam construction	DIA and IIA Inundation area and downstream	(i) Fishing and collection of other edible river resources will be lost, affecting livelihoods and food supply of local people. (ii) River transportation will be cut off by the dam and consequently lost between upstream and downstream areas.	SS	LT	L	H	Major	REMLRP
29	Reservoir filling/ inundation	DIA Inundation area and IIA	Inundation of one border guard station and another one located in the dam construction area; these have to be relocated.	SS	LT	S	S	Minor	ESMP, a decision to be made in consultations with the GoV

No	Project activities	Location	Impact and rationale	Impact qualifier				Significance	Mitigation
				Extent	Duration	Magnitude	Sensitivity		
30	Land acquisition for dam, powerhouse, temporary & permanent work and living facilities at auxiliary area	DIA Dam site at Xang Tren	Loss of 31ha forest vegetation; loss of 46ha forest, 1ha arable land and 6ha other land at auxiliary area	SS	ST	S	L	Negligible	Xang Tren Village will be relocated and families resettled with land compensation
31	Land acquisition for reservoir	DIA 12 villages	Loss of 85ha swidden – upland farming area	SS	ST	S	L	Negligible	All DIA villages will be relocated and households will be compensated & resettled with land or land.
32			b).Loss of grazing land in 903 ha secondary forest /scrub vegetation c) Loss of forest land; loss of opportunity for harvesting wildlife for home use,	SS	MT	H	M	Minor	BEESRP

No	Project activities	Location	Impact and rationale	Impact qualifier				Significance	Mitigation
				Extent	Duration	Magnitude	Sensitivity		
OPERATION PHASE									
33	Dam operation	DIA, IIA Low flow area	Villages in the downstream area potentially affected by reduced water flow during the dry season and water fluctuations depending on the dam operation, impacting fishery, riverbank cultivation, river transportation and household water availability.	SS	LT	M	M	Moderate	ESMP
34	Low flow and Cumulative impact	DIA, IIA Downstream of the dam	Downstream villages may potentially be affected by reduced water flow and water fluctuations from dam operation. Impact on fishery, riverbank cultivation, river transportation and household water availability.	SS	LT	M	M	Moderate	ESMP Legal obligation to Ban Ve HPP operation regime

No	Project activities	Location	Impact and rationale	Impact qualifier				Significance	Mitigation
				Extent	Duration	Magnitude	Sensitivity		
35	Implementation of environmental and social safeguards	The Project Area of Influence	The development of ESMP if implemented properly and adequately will ensure that the impacts identified will be mitigated and addressed. The above current conditions of natural resources and villagers will be improved and enhanced. The Project is also expected to generate employment for the community.	SS	LT	L	H	Moderate (+) impactt	Mitigation and monitoring must be done. Agreed ESMP plans must be implemented.
36	Trans-boundary Impacts	Project Area of Influence	Most of the physical and biological impacts are concentrated in Vietnam, being the host for both the main construction works and auxiliary facilities.	R	LT	L	H	Low (Physical and biological)	
			Potential positive impacts will include benefit sharing and economic opportunities which will be a subject for the two countries and Proponent.	R	LT	L	H	Major Social	

No	Project activities	Location	Impact and rationale	Impact qualifier				Significance	Mitigation
				Extent	Duration	Magnitude	Sensitivity		
37	Global change and reservoir	DIA Reservoir	The reservoir may potentially generate emissions and affect water quality and impact on climate change.	SS	ST	S	S	Low	ESMP, Monitoring of reservoir and downstream water
	DIA – Direct Impact Area IIA – Indirect Impact Area								

Notes: Description of Impact Qualifier:

Extent: SS= Site Specific in the Project area/Local, R= Regional, N = National; **Duration:** ST= Short term, MT= Medium term, LT= Long term
Magnitude: S= Small, M= Medium, L= Large; and **Sensitivity**: S=Low, M=Medium, H=High.

CHAPTER 12: SUMMARY OF MITIGATION, ENHANCEMENT AND SAFEGUARD MEASURES

12.1 General overview

This chapter provides the summary of the mitigation and enhancement measures proposed in the preceding section (Chapter 11, various potential Project impacts). In addition to these safeguard measures, note that part of the impact mitigation process has already taken place during the Project design and optimization phase. As part of the Project optimization process, a number of measures have been taken to minimize the social and ecological footprint of the proposed HPP. For instance, among the alternative locations for the different Project components (dam site, powerhouse, location, etc.), the technical team has selected optimal locations taking into account multiple criteria (e.g., social, environmental, economic, and bio-physical, etc.: See Analysis of alternatives section).

This chapter provides the details of the mitigation and enhancement measures proposed during the ESIA process. A summary of the measures are provided in Figure 12.1. The measures listed in the matrix combine and integrate measures across different themes presented below. There are three umbrella programs which encompass thematic plans (see Figure 12.1).

- Physical Environment Program;
- Biological Environment Program; and
- Social Program.

In addition to the three programs, there is the Construction Contractor Required Plans /Aspects which spells out the plans that the Contractor needs to develop to ensure that constructions impacts are adequately addressed.

The plans within each program are listed in the respective sections in this chapter. There is however four plans placed under the Physical Environment Program which span across all programs but may have different degrees of requirement or may not need all the components and these are:

- Reservoir Catchment Management Plan (RCMP);
- Environment, Health and Safety Plan (EHSP);
- Awareness and Capacity Building Plan (ACBP), and
- Emergency Preparedness and Response Plan (EPRP)

There is also mitigation measures which are specific and stand-alone actions proposed and these are listed in the sections of concern.

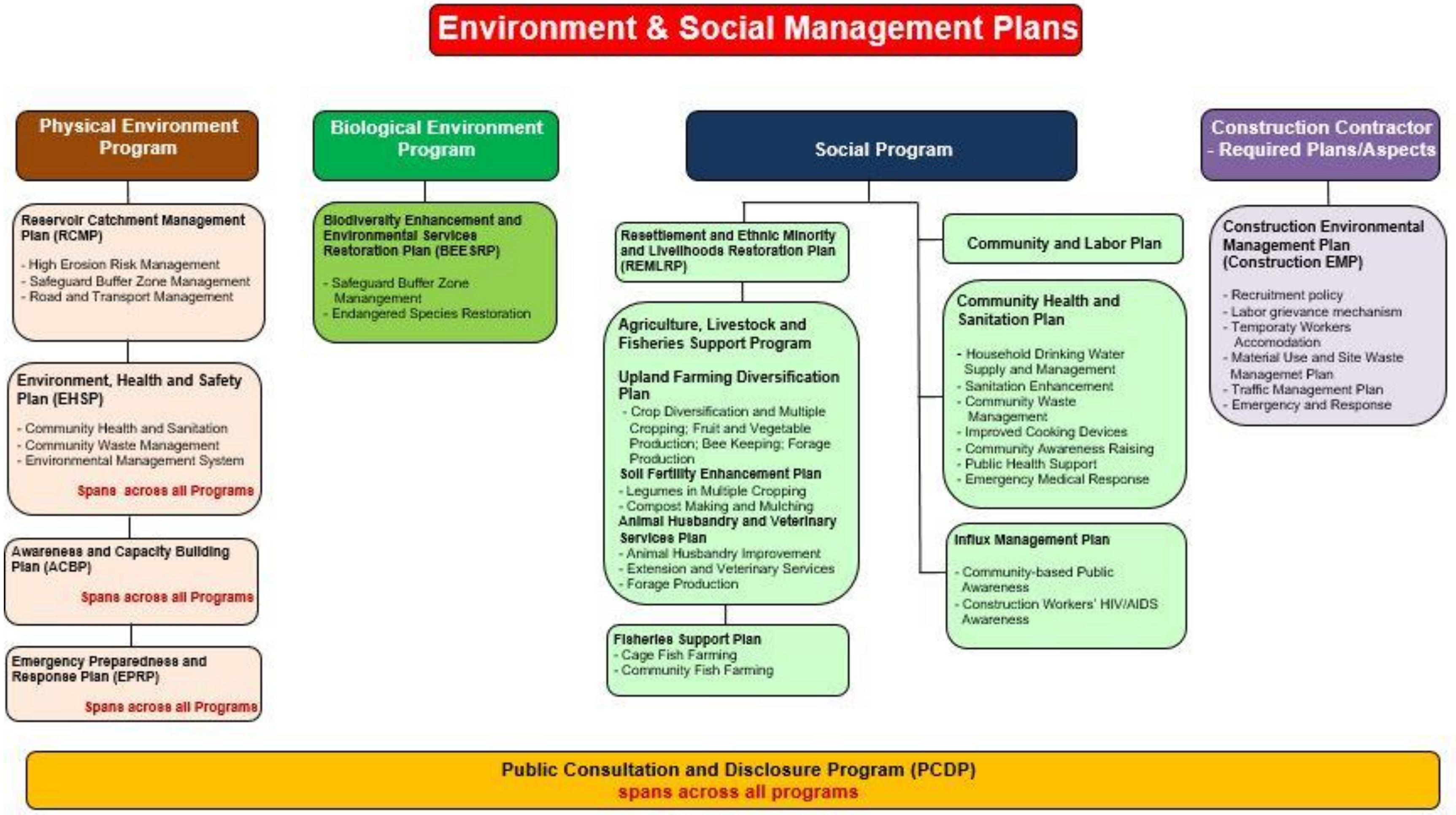


Figure 12.1. Environmental and Social Management Plan

12.2 Physical environment

12.2.1 Land use, degradation, soil erosion and geological hazards

Slope stability and risk assessment techniques for the high risk slopes in the reservoir area are recommended and include modification of slope geometry, drainage, retaining structures and internal slope reinforcement. The mitigation measures are as follows:

(i) Toe embankments and/or toe buttressing and/or slope angle reduction;
(ii) Drainage galleries/tunnels and/or sub-horizontal drains to lower groundwater level;
(iii) Removal of potential slides either by excavation or by triggering them under controlled conditions (e.g. during reservoir filling);
(iv) Erosion protection measures in the water fluctuation zone (rip rap) and upslope (drainage trenches and vegetation planting); and
(v) Soil nailing / ground anchors.

The final mitigation techniques chosen will be part of the detailed design phase (pre-construction phase). The above mitigating measures can all be included in a plan. <u>The development and formulation of the Reservoir Catchment Management Plan (RCMP) is highly recommended.</u>

<u>Reservoir Catchment and Management Plan</u>
The maintenance of the stability and integrity of slopes of the reservoir, and the immediate catchment is essential for human safety, upland land-in-use stability, and reducing potential erosions and mass movement. The life of the My Ly HPP Project is dependent on securing slopes, reducing erosion, and halting to the degree possible, landslides. All mitigation extended to secure slopes and Project construction and other used areas (e.g., auxiliary, roads, labor and construction camps) will directly and indirectly increase security and enhancement to natural resources and arable lands in the immediate vicinity of the Project.

This would foster also wellbeing of local people. All reservoir catchment management will contribute to watershed stability and maintain ecosystem functioning. A sub-plan for roads is also proposed under this plan, the framework of which is provided below. The cost of the slope stability mitigation is included in the Project costs in the feasibility study.

The slopes that need revegetation above the reservoir level are dealt with in the vegetation and forest resources section of this report. In addition, strict regulation of the reservoir level fluctuations and local communities using the land resources have to be taken into account.

The CRMP has key sub-plans and salient features are given below:

High Erosion Risk Management Sub-plan
The RCMP will be securing the Safeguard Buffer Zone (SBZ) and all areas identified as ‘erosion risk area’. In addition, it will include measures to increase landscape stability. Forest management, protection and planting should follow established practices based on the experiences of similar conditions. Compensatory planting is also included as part of this plan. The Project proposes the reservoir catchment area to be mapped and identified for its vulnerability during detailed design phase.

Safeguard Buffer Zone Management Subplan
The concept of a safeguard buffer is to make the area completely vegetated (covered with forest) maintaining vegetation at different strata so that it will function to reduce erosion, and infiltrate sediments before water is discharged into the reservoir. The proposed SBZ has secondary mixed evergreen and deciduous forest, secondary scrub, mixed broadleaf and bamboo, grassland, cultivated and uncultivated fallow land, rocky areas and streams. Currently, it is over exploited for grazing, collecting food materials and hunting for rodents, birds, lizards and amphibians for home consumption.

'Greening' the safeguard buffer zone and safeguarding high risk erosion areas.

The safeguard buffer covering an additional 50m elevation and contouring above 235masl full supply level of the reservoir has been mapped for land cover but not for soil erosions and vulnerability status. In order to ensure safety from the reservoir to local people and to protect the reservoir shoreline (catchment stability) through planting forests (afforestation and reforestation including fodder and fruit trees and other vegetation used by local community. The Project has proposed to maintain a buffer area between settlements and the upper contour of SBZ (285m). This strip is recommended to be 50m with the understanding that it will be jagged as it can be significantly narrower in rocky areas (where no protection is needed) and in stable forest areas but can include the adjoining high risk soil erosion area. The latter may increase the width of the buffer strip to secure slopes to decrease sediments in the reservoir and enhance safety.

To reduce the erosion risks and sediment flow to the river, upland cultivation on slopes inside SBZ will not be allowed, however, riverbank cultivation on more favorable slopes could be practiced with clearance and allowance from the commune authorities. Grazing will have to be stopped but the non-timber forest products and small size wildlife like rodents, birds, lizards, frogs and similar species could be harvested in a sustainable manner for home consumption since this is related to livelihoods of the ethnic minorities. Similar to Protection Forest, the SBZ could be managed by a group of local community.

The SBZ is therefore proposed as a 'green' belt of the Project/reservoir to enhance catchment stability (reduce erosion and landslides) and thus function to provide ecosystem services (e.g., forest products, soil stability, nutrient retention, carbon storage).

Road and Transport Management Subplan

One of the potential impact of the Project is road traffic and safety especially those associated with heavy vehicle movements along the transport corridors. The Project will require widening of roads, strengthening of bridges, special slope stabilization and erosion measures, special warning systems, land acquisition, and fulfillment of national requirements, and acceptance by and interaction with the national road authorities, some of which has already been considered in the FS, and details will be worked up in the detailed design. In addition and importantly, the issue of the loss of connectivity and its mitigation has to be included. It is recommended that a bespoke transport plan be commissioned for the Project at the detailed design phase looking at logistics and engineering requirements of the Project, and assessing environmental and social impacts, as appropriate.

Vehicle movement during the construction phase in connection to spoil disposal activities, machinery movement within the Project Direct Impact Area (DIA) can be harmful to local populations and domestic/wild animals. Potential impacts of such traffic have been addressed in this ESIA in the respective sections. Precise impacts and detailed mitigation measures, however, are not possible to delineate at this time due to the fact that the final planning and alignment of roads is not complete. However a framework for a road plan is suggested below.

A sub-plan for the planned roads within the RCMP should be formulated after the road alignments are finalized. A framework for the development of such a sub-plan is provided here. The plan should include guidelines for integrating environmental considerations into constructing and maintaining roads supported by the Project as good engineering practice. The guidelines will be included in all contractor's bidding documents and operating contracts. The guidelines will cover all aspects of road construction, such as (i) clearing and grubbing; (ii) roadway excavation; (iii) channel excavation; (iv) excavation and backfill of structures; (v) embankment; (vi) sub-base and base; (vii) pavements; (viii) drainage, pipes, and outlets; (ix) grassed areas; (x) slope protection; and (xi) mortared stonework. In addition the guidelines describe the maintenance and environmental management required in relation to roads, including monitoring needs.

Excavation of roads in steep sides with soft soil leaves large areas of denuded soil open for rain and water erosion. This problem applies to the inner side of the roads with the drain ditch, the road itself and the outward facing of the road. Even for temporary roads, this will create wounds in the terrain that will slide and erode during the construction period if no stabilization is done. The construction of roads, and permanent and temporary housings and camps should begin at the onset of the dry season with the excavating and bulldozing. Before the wet season starts, the road sides should be sowed with grass.

The road ditch should be lined in erosion prone areas. The water in the road ditch should be released into existing brooks/streams. The road ditch should be released as often as possible, i.e. wherever there is a natural brook/flood brook. Road ditch outlets should not be allowed to be discharged into places where there has been no waterway before. If this is necessary in some places, relevant enforcements should be made to prevent erosion.

All road construction (access roads and broadening of roads) will require similar procedures adjusted to the specific sites. The permanent roads and sites should be paved as soon as possible after the construction. The team responsible for this should work out a strategy for structured procedures for bio-engineering and revegetation allowing for adjustment based on site specifics. Parking lots, camp areas and construction sites should be subjected to the same mitigation measures as recommended for roads.

12.2.2 Hydrology, sediments and reservoir

Mitigations presented here are for the Operation phase:

12.2.2.1 Reduction of sediment inflow

At present it seems the most realistic place candidate for check dams etc. is the tributaries of Ca River. Check dams here, if properly constructed may trap some of the heavy bed load in the streams. Yet it has to be verified that the cost is reasonable when measured against the benefits / sediment volume that is trapped. The local sediment load from its tributaries has not been assessed at this stage.

12.2.2.2 Flushing

It is suggested to remove sediments annually with flushing through bottom gates which are as close as possible to the river bed level to prevent build-up of sediments. Flushing may be performed at beginning of the monsoon season, when reservoir is drawn down and when pre-monsoon floods with initially high sediment loads can be used to flush sediments.

A large majority of the incoming sediments can be flushed within approximately one week during a normal year, provided there are low level flushing gates with sufficient capacity. Also in years with substantially higher sediment load it will be possible to remove nearly all incoming sediment. Most of the time, water will be used to flush the last few percent of sediment which are coarse gravel and stones and which require high discharge / high energy gradient to be mobilized. The time required for flushing will therefore depend how much of the reservoir volume one will maintain.

12.2.3 Air, water and noise

See section on Community Health and Sanitation (Section 12.4.2.1) where mitigation includes these components.

12.2.4 Seismic hazards

The Project is relatively proximal to a faultline therefore seismic hazards have been assessed and included in the Project design considerations. In addition, mitigation measures are proposed and should be in place prior to construction. The Environmetal Health and Safety Plan (EHSP)is one of the proposed plans to be developed for the Project

12.2.4.1 Environmental, Health and Safety Plan (EHSP)

This plan spans across all programs and sectors of the Project. Health and safety is a key issue seen from both an occupational and local public perspective. The EHSP should be made in compliance with MIGA Performance Standards and national requirements. This plan should be formulated during the pre-construction stage.

The plan must include, among others: (i) setting the EHS policies and requirements for the Project covering all components of the Project (including project activity areas and workers, vehicle usage, dam and road safety, waste, visitors and local people in the Project DIA, etc); (ii) training local persons; (iii) ensuring subcontractors complete work to international standards; (iv) develop processes and mechanisms for increasing environmental, health and safety awareness working across the Project's programs and plans; (v) assisting the corporate office with any other environmental, social, health or safety problems and coordinate across other plans of the Project (e.g. Community Health and Sanitation Plan, Community Waste Management Sub-plan, etc); (vi) include or coordinate with the risk/hazard and warning plans, and evacuation planning groups of the Project; (vii) cover all safety measures for the Project and (ix) have regular drills (four times a year) and provision of information to workers and the public.

The Project is expected to adopt an Environment and Social Management System (ESMS) as part of the EHSP in line with international practice which will include, but not limited to, the following key components,: (1). increase the environmental awareness of all employees (see also the Awareness and Capacity Building Plan (ACBP) below); (2). train employees, especially the environmental manager and the section heads; (3). establish procedures within the company for recording, monitoring and reducing pollutants emitted in the atmosphere and water, as well as for improving the handling of toxic waste and hazardous materials; (4). elaborate emergency plans and issue relevant instructions.

The EHSP should ensure that the contractors and sub-contractors carry out their work in accordance with the environmental, labor and safety policies and commitments of the company, and comply with applicable Vietnam and international requirements. Thus the plan should also build on awareness campaigns and modes established in the ACBP.

12.2.4.2 Community Waste Management Subplan

The Community Waste Management Plan (WMP) will identify key sources and types of wastes and the expected management of Project wastes streams, which can be a subplan under EHSP. The construction and subsequent operation of the Project has the potential to create several impacts resulting from the management of wastes (e.g., water quality, sanitation),

The principal materials for construction include excavated materials, cement and steel. The exact quantities of materials will need to be calculated during the detailed design. There would also so be number of other materials such as paint, lubricants plastics and timber, among others. The 3400 estimated construction employees will also generate solid and liquid wastes and need to be managed.

The WMP will identify predicted waste stream streams, appropriate handling, reuse and recycle opportunities and as a last resort, disposal. The WMP will be prepared in accordance with Vietnam's regulations and international best practices.

12.2.4.3 Awareness and Capacity Building Plan (ACBP)

The Awareness and Capacity Building Plan (ACBP) is a Plan that can span across the different environmental programs. Capacity can be defined as the ability of individuals and organizations to perform functions effectively, efficiently and sustainably. Capacity building, or rather capacity development, should be a dynamic process building upon an existing capacity base. Human resources and the way in which they are utilized are central to capacity development, as is the overall context within which organizations undertake their functions. All plans proposed in this ESIA will require the advice of experts, authorities and the training of the stakeholders, especially those directly involved in a particular mitigation or enhancement measures. The degree to which this will be required will need an assessment when each plan is drawn out. All stakeholders, including those not directly involved in mitigation measures, must be kept aware of measures implemented in the Project. More importantly awareness on programs and plans in the ESIA has to be done as proposed in the PCDP. Awareness will also include all protocols and guidelines outlined in the EHSP and awareness campaigns will have to be carried out throughout the life of the Project, with higher frequency during the construction phase. Such campaigns will include among others, for example: road safety; pollution and sanitation; forest and wildlife enhancement; warning systems and drills; etc. Local communities are vulnerable and need to be prioritized in the campaigns through the use of modes of communication that can be easily understood and those that are practical. Where relevant this plan is elaborated upon in the thematic sections.

12.3 Biological environment

12.3.1 Vegetation and forest resources

The impacts during Project construction and operation phases have been assessed in the preceding chapter and came up with the following appropriate mitigation measures. The timing for implementation of the proposed measures is categorically specified as far as it is practicable. Project impacts, mitigation measures, organization responsible for implementation in the environmental and social management matrix. Mitigation actions/measures presented below are elaborated in the environmental mitigation matrix and ESMP as well.

The mitigation and enhancement for forest and wildlife placed in a Biological Environmental Program will include the following plans:

- Reservoir Catchment Management Plan(RCMP)
- Biodiversity Enhancement and Environmental Services Restoration Plan (BCESRP)
- Awareness and Capacity Building Plan (ACBP)

12.3.1.1 Pre-construction Phase

Control damage to standing trees and ground vegetation
Forest surveys and inventory work carried out in forests require alignments to be cleared to maintain good sight and visibility between the pegging points and this implies removal of obstructing tree branches and clearing of shrubs. Chances are the forest survey teams may chop down saplings and branches of trees for the making of pegs and trees. Trees are marked by chopping the bark to denote locations and counted numbers. This practice should avoid unnecessary damage to saplings, shrubs and trees.

12.3.1.2 Construction Phase

The following mitigation measures are to be considered and developed as part of the RCMP (See RCMP). Relevant aspects are also included under the next section on wildlife and birds.

(a) Re-consideration of Project sites to reduce loss of forest areas
The primary impact of the Project is the loss of 34.15ha of lands permanently due to construction of dam, powerhouse and permanent housing and structures. Another 52.61ha will be lost temporarily due to forest areas used for camp sites and establishment of other facilities in auxiliary area. The reservoir will occupy about 988ha. These are secondary forests, scrubs and grasslands, and thus the biodiversity loss would be minimal. The Project does not see any alternatives for land areas for the construction of reservoir, dam and other structures and activities in the planned areas. The impact is largely consolidated along one stretch of the river.

(b) Discourage clear felling
The quality of land in auxiliary areas will depreciate after the construction work and regeneration will take time. Particularly, the forest lands temporarily used will result in permanent loss of vegetation cover and plants. It is recommended that where possible pole size to matured trees are left. A conscious choice to leave trees where possible would

also add to the general greening atmosphere of workers camps, permanent and temporary work areas.

(c) Management of felled trees and areas used for temporary and permanent areas

The total biomass estimated in the main work area (dam, powerhouse, permanent constructions) and auxiliary area is 2,630MT. As the area has disturbed secondary forest, wood standing biomass and yield is low, approximately 50-60% of the total biomass. Project laborers and contractors residing in and around the forest areas may cut trees for various reasons – including cooking and heating in winter. The Project workforce is estimated to be about 3,400 persons during the peak period and approximately 1,500 workers will be residing all year round and these would require almost 900MT of fuel wood per year for cooking daily. Alternative sources must be used for cooking and heating in the project areas – no wood must be used.

(d) Safeguard Buffer Zone Management
See RCMP

(e) Implementing forest management practices
Managing forests can function as a preventive as well as remedial measure to the Project's impact on the existing forests. Management of forests is required to not only protect the forest resources but also to supply forest products in a sustainable manner to the users. After the Project construction, the auxiliary area of about 52.61ha will be relocated to My Ly commune for use and management. The Project shall contribute to improvement and management of this forest area. A forest management plan should be made with the GoV institutions so that pressure of existing forests in the project Area of Influence (AI) are not further deteriorated. It is proposed that this forest management plan will focus on enhancement of biodiversity and restore environmental services.

Biodiversity Enhancement and Environmental Services Restoration Plan (BEESRP)
The main objective of Biodiversity Enhancement and Environmental Services Restoration Plan Plan (BEESRP) is to protect forests and conserve biodiversity in an effective manner, with the active participation of local communities and enhance the contribution of environmental services from forests. This plan is elaborated in key subplans:

Forest Management Subplan
The Project has proposed plantation (revegetation) in the permanently acquired area in dam site /powerhouse and other facility areas and maintaining the area with vegetation on using a landscape approach.

The Proponent will prioritize the greening of the safeguard buffer and adjoining areas through carrying out afforestation or reforestation and enrichment plantation. The buffer area covers 708ha out of which 268ha is scrub and grasslands with few shrubs and other non-woody plants and this degraded area could be available for plantation. Besides, vegetation enrichment could be done in buffer area between settlement and buffer zone. In the DIA villages, local communities largely depend on forests for leafy vegetables, mushroom/fungi, bamboo shoots, roots, etc., for their daily consumption. In the plantation area emphasis should be given to include species which can be used by the local people as food. This would encourage local community to participate in forest protection and management.

(b) Forest protection
During construction of the Project, forests in the adjoining area of campsites would be overused by workforce for fuelwood and other uses such as temporary construction. It is difficult to check as project staff and camp followers themselves, may be involved in such activities. The Project shall seek ways to ensure that forests are not overexploited. The Forest Management subplan must include awareness on avoidance of deforestation, wood collection for fuel use and forest area designations (e.g., protection forests which the local communities are assigned to manage by the commune/province).

(c) Management of forest fire hazards
Incidences of forest fires may occur due to workforce or local communities. The Project shall implement code of conduct and organize orientation programs to its workforce and supervisors on regular basis. This should be included in the Forest Management Subplan.

Endangered Species Restoration Subplan
(a) Relocation of Protected Plant species
Drynaria fortunei, an epiphytic medicinal herb species listed as endangered species and *Pterocarpus indicus*, a hardwood species recorded as regionally extinct are listed in the IUCN and Vietnam red list. Both are heavily exploited for their uses. Impacts on these plant species shall be mitigated by relocating them in the SBZ before felling activities begin in the reservoir. There are continuous belts of forested areas extending from the proposed inundation area to the SBZ which can also be areas where the above species may be relocated. Saplings of the hardwood species are likely to survive replanting as the trees are not possible or costly to replant. These species in the non-affected areas should be protected and awareness of their conservation status be made known to communities, contractors and Project workers. A species plan for relocation of protection plant species and their monitoring should be made and implemented.

Awareness and Capacity Building Plan (ACBP)
See also the main description of ACBP. In the Project DIA, like most parts of upland landscape in Vietnam and Laos, forests serve as the key pillar for the provision and maintenance of ecosystem services. Forest resources are the major source of food for the family (vegetation and small size wild animals e.g. rodents, birds, reptiles and amphibians), medicinal plants and fungi, household energy, construction and other uses, forage for their ruminants, and household economy to sell small size wild animals. Forest catchment area serves as the main source of water used for hydroelectricity power generation and domestic consumption. Despite these benefits, forest resources are exploited and subject to human - caused fires, illegal felling and extract valuable plants for trading.
The reservoir catchment is important nationally in terms of electricity generation and locally as an important source of providing materials for their livelihoods. Therefore its protection, management and sustainable use is primary.

The ACBP will serve to increase awareness of forest protection and management policies, and benefits of reforestation, develop materials for publicity on forest, land and biodiversity enhancement and land (soil) protection in the Project affected areas and in the reservoir catchment in general. The Project will provide funds for producing posters and pamphlets.

12.3.1.3 Operation Phase

Forest protection and management
With the completion of Project construction works, most of the workforce will leave for their respective places and there remain small numbers of skilled man power. They will stay mainly for the maintenance and operation of the Project. Obviously, less pressure on the forest environment is expected during Project operation phase. The Project will continue forest re-vegetation and greening in critical areas in SBZ and high risk erosion areas. This will be a regular work continued at least five years of the operation phase.

12.3.2 Wildlife and birds

12.3.2.1 Construction phase

RCMP, SBZ Management Subplan and BEERSP
The same measures proposed under the section above on forest vegetation are relevant to the mitigation measures for wildlife and birds. To minimize the habitat loss, trees which are not felled need to be protected from logging especially in the SBZ. Native tree species should be prioritized in reforestation regimes. There are no large wild mammals in the Project AI and surrounding forests, however, the reservoir catchment area serves as a good habitat for small mammals like rodent species, bat species and reptiles. The above

programs would improve the quality of wildlife habitat and will include the following features:

(a) Establishment of wildlife habitat
Protection of safeguard buffer zone and adjoining areas in the reservoir catchment will improve habitat quality. The approximately 42km (x2) long SBZ and the adjoining riverine area would provide a habitat for small mammals, bat species, reptiles, amphibians and bird species.

(b) Enforcement of laws
Local communities and workers are to be made aware about the regulations for endangered and vulnerable species and conservations needs. Related information about rules and regulations about wildlife killing/hunting must be displayed in several areas. Where possible, disturbance to wild animals and birds must be avoided.

ACBP

During construction phase, blasting, drilling, heavy vehicle movement and high sound would interrupt normal movement, feeding and other activities of mammals and birds leading to their temporary displacement, and there is high potential for illegal hunting, trapping, poaching for food and trading.

The following aspects are proposed for inclusion into the ACBP. See also the main description of the ACBP.

(a) Production of awareness posters and pamphlets.
General awareness posters and pamphlets enhancement of wildlife species will be published and distributed to the construction workers and to the local community. People support unknowingly in illegal hunting practices due to lack of knowledge of the legal provisions. Such illegal hunting practices need to be informed to local people, workers, contractors and the Project staff. Awareness poster will provide educational information for minimizing negative impacts on wild animals during the Project construction.

(b) Training to local contractors, supervisors and labor force.
Local contractors, supervisors and even followers can influence on local labor force. Training manuals need to be developed for local contractors, supervisors and labor force about existing rules and regulations, importance of biodiversity enhancement, threats to wild fauna and vegetation (trees), responsibility of project implementing agencies, institutes and individuals.

(c) Local people's participation in enhancement
Without active participation of local people, wildlife enhancement is not possible. Formation of biodiversity enhancement groups from different Project impact families and dissemination of information about value of biodiversity and related ecosystem services will help in further participatory management in the area.

12.3.2.2 Operation phase

RCMP and SBZ Management, BEERSP and Endangered Species Restoration Sub-plan

The same measures proposed under the section above on forest vegetation and construction phase are relevant to the mitigation measures for wildlife and birds during the operation phase. Additional specific actions are listed below:

(a) Awareness and environmental protection
The programs set-up by the ESMU during the construction should be continued although the awareness campaigns can be reduced in number, and training would consist mainly of renewing knowledge bases and reviewing experiences to include in on-going programs.

(b) Regular monitoring on migratory birds
The formation of dams may serve as a favorable habitat for waterfowls and migratory wetland birds. Regular monitoring and seasonal counting of birds would be an essential contribution on the census information on migratory birds of global significance.

12.3.3 Aquatic ecology and fisheries

12.3.3.1 Construction phase

RCMP
Most of the impacts in this Project affecting the aquatic environment, impact the whole freshwater ecosystem. For example, increased erosion will affect water quality, increasing turbidity and reducing visibility. The increased amounts of sediments can change the habitat quality, impacting both macro invertebrates and fish. Reduced visibility will normally reduce primary production (algae and planktons) affecting the invertebrates and fish, thus eventually fishery activities. Water quality issues are also dealt with under the EHSP, and the section on the Social and Cultural Environment Program.

See sections under the Physical Environment Program, the RCMP covering erosion, ACBP and the EHSP. The RCMP will manage the following:

(a) Erosion in the reservoir – vegetation removal
To avoid erosion in the reservoir area, clearance of woody vegetation from the inundation zone prior to flooding (nutrient removal) should be carried out as well as weed control measures should be taken. In similar lines, sedimentation in the reservoir and subsequent loss of storage capacity may be minimized by control of land use in the watershed (especially prevention of conversion of forests to agriculture). These require reforestation and/or soil enhancement activities in watersheds coupled with the hydraulic removal of sediments (flushing, sluicing, release of density currents) and the operation of reservoir to minimize sedimentation (which can entail loss of power benefits).

(b) Runoff from tunnel blasting and tunnel drilling and sediment deposits
The water from the tunnel excavation performed either by blasting or full profile drilling, should pass a sedimentation pond prior to be discharged into the river, if the pressure is expected to be very high.

In the low flow period, the sedimentation pond should be monitored with respect to ammonium, free ammonia and pH. If necessary, pH should be adjusted to neutrality before any discharge into the river. In the wet season, the ammonia discharge will not harm the river biota.

In the first period after a major tunnel and hydropower construction work, the spoil rock deposit is normally used for construction purposes, filling material for road construction, quarries, etc. After some years they are abandoned, and should be closed in a proper way. To prevent impact on water environment, the location, water handling and the final rehabilitation are necessary. The sites for the soil and spoil deposits should be strategically positioned to avoid runoff directly in the river, and provide lining, if necessary.

Location and water handling. The deposits should not be placed in steep terrain. The best location would be in natural depression with infiltration outlet. Such depressions are, however, not always easy to find in the terrain near the construction area. The second best would be to place the spoil rock deposit in a flat area with little runoff (i.e. upstream catchment) and with good infiltration capacities (sandy soils). If the deposits are placed in a valley-like depression, incoming water shall be drained through by a pipeline of necessary capacity to safely by-pass storm runoff. Downstream of the deposits, a sedimentation pond to settle out as much as possible of the eroded particles should be constructed. The drainage from areas upstream of the deposit shall by-pass the sedimentation basin. If possible the runoff from the spoil rock deposit should be infiltrated in the terrain.

Runoff from blasted tunnel material shall be controlled with respect to the content of nitrogen and particularly ammonia and pH. Water with high concentration of ammonia and high pH can cause fish kills in low flow periods. In such cases, the pH in the sedimentation pond shall be adjusted to neutrality before released from the pond.

Final rehabilitation of the spoil rock deposit. When there is no more use of the spoil rock, the deposit should be leveled and formed into nature-looking terrain and covered by vegetation. Deposits with material from full profile drilling can often be sowed and planted directly, while material from blasted tunnels must be covered by fertile top soil.

The top soil, gravel and soil from the tunnel ideally need to be separately deposited. Upon spoil deposition, top soil needs to spread unto the spoil material, and a multilayered technique ought to be used. This will allow roots of trees to reach and proliferate into rich soil zones within the spoil, thus increasing anchorage and overall stability of the spoil. Most of the top soil must be placed on top. Planting of tree species needs to be done immediately at edges and grass lines on contours. Open flat areas of the spoil deposits where top soil is deposited, should be immediately made available to the local people for agricultural practices of agro-forestry. It is vital that the rehabilitated areas is not open for grazing until all vegetation is established, six years minimum, as this will result in spoil slope weakening.

EHSP

See also the main description of this plan in the section on Physical Environment Program The following measures must be included in the EHSP.

(a) Sanitary effluents from the construction workers camp

During the construction phase there will be much activity at the different construction sites. There will partly be residential camps for construction workers, administration buildings, workshops, machine parks etc., as mentioned above. At these sites there have to be built sanitary systems with no direct discharge to the river. If possible, the camps shal be placed in areas with good infiltration capacity. In such areas standard pit latrines may prevent hygienic pollution to enter the river.

(b) Oil and chemical spill

During construction there will be a large park of machineries such as trucks, tractors, excavators, bulldozers, drilling machines, cars, etc. These will need diesel and gasoline, motor oil, hydraulic oil, battery acids, etc. Storage places for such chemicals must be established in secure areas where such compounds cannot enter the Ca river. The storage and fuel filling shall take place on paved area, which is water-tightly drained to a collecting tank in case of accident spills. Workshop floors shall be drained to a collecting tank from where the content can be removed and correctly treated. Parking areas shall consist of loose material with infiltration capacity which can absorb small spills. Such area shall be constructed of stones, gravel, sand and silt.

(c) Accidental water releases and dry-ups – testing and warning systems

The functioning of the spillway gates shall be tested out properly with respect to both opening and closing before filling the reservoir. A flood warning system to people living downstream the dam and the outlet of the power plant construction site shall be established. The initial filling of the reservoir is suggested to be done only in the wet season with bypass of at least of the proposed environmental flow. It is important that the river is not dry.

12.3.3.2 Operation phase

(i) Proper design of spillway or addition of structures to favor degassing

One of the problems of taking water from deep in the reservoir might be the super saturation of gasses in the deeper levels. If these gasses are not released before the water is in contact aquatic life – gas sickness will result. The design of the spillway, therefore, should be constructed to avoid these problems. The same problem might arise if water for the minimum flow is taken from the bottom of the reservoir. Taking the water from this level will also involve a risk for toxic water and low water temperature. The final design and operation should take into account the above issues.

(ii) Compensatory environmental flow
Releasing of water flow for environmental requirements and downstream users is a new concept in Vietnam. There is no regulatory requirement for environmental release, however most of the large dams had a provision for releasing 10 % of the average minimum flow for ecosystem and social needs.

A minimum average monthly flow increasing down the river course of the dam would be required. This discharge from an ecological perspective must consider that it is sufficient for the maintenance of adequate wetness conditions to support the ecosystems that may exist in the boulder bed river, riparian vegetation, water resources, and fisheries. Provision shall thus be made to release such quantum of water which is able to sustain fish and local use of the river.

The fish and river use activities as such should be monitored and if the findings reveal that the recommended release is not adequate, the operator should be willing to adjust the minimum environmental flow. Thus an adaptive approach should be taken in the long run. Any adjustment to the environmental flow after 3-5 years of monitoring should reflect the building blocks (low flows, channel flushing, habitat maintenance and spawning/migration freshest).

(iii) Evaluating the building of a bypass system for fish at the dam
Among the 77 identified fish species, five species are listed as vulnerable (VU) in the IUCN Red List and two as vulnerable in the Vietnam Red Book (Table 7.13). *Anguilla mamorata* and *Bagarius rutilus* are listed as Vulnerable according to the Vietnam Red Data Book (2007) while, *A. mamorata*, *Acrossocheilus annamensis*, *Hemibagrus guttatus*, *Bagarius rutilus and Bangana lemassoni* are listed as Vulnerable according to IUCN. Some of these are mid- to -long range migrants. Among them, *A. mamorata* has already been impacted by dams constructed downstream; its migratory route has already been obstructed. All these species are over exploited. Most other species found are residents and these resident species are known to undertake short distant migration within stretches of the river. <u>In the case of My Ly HPP the likelihood that a bypass system like a fish ladder will work are remote</u>. Consideration of screen as discussed below should be considered.

(iv) Consideration of a screen in front of the intake in the dam
One of the main risks of fish mortality occurs during the downstream migration phase of migratory fish species since all or a large part of the river flow is diverted through the turbines. Also fish that live in the reservoir meet the risk of being lost in the intake. Various techniques exist to prevent this, like fine meshed screens across the turbine inlets. This technique is however most effective if the fishes are diverted back to the river, e.g. if not all the water is diverted through the turbines. Furthermore, these screens impose a heavy maintenance burden that can reduce electric production. Thus there are alternatives to traditional fish screens like acoustic, louvre, bubble or electric screens that are considered in various places. <u>Even if the dam design cannot allow for the fish to migrate downstream with the help of the screen system, it can be of considerable help to avoid the fish populations living in the reservoir to be caught in the intake. This has to be looked into during the design phase</u>.

(v) Fish Adaptation Study
The three species, *Anguilla mamorata*, *Acrossocheilus annamensis*, *Bagarius rutilus* are medium to long -range migratory species and they have already been impacted by Ban Ve Dam constructed downstream; i.e., their migratory route has already been obstructed. These fish were reported from the river during the sampling reported in this ESIA pointing to their continued presence and likely adaptation. In total, more than 60 species appear to inhabit the main river system (a total of 77 reported included those identified in tributaries). Thus, there are several other fish which are already perceived to be adapted to the reservoir environment of Ban Ve HPP especially to its length. Similarly the My Ly HPP may be expected to allow for adaptation of many of the fish species. It has to be noted that long-distant migrants are likely to disappear eventually due to the lack of stage of sea-

water life-stage, if highly dependent on having this stage. A study is proposed to monitor fish species diversity and populations in the My Ly reservoir and downstream stretches including Ban Ve HPP.

(vi) Mitigation against peaking
The daily peaking activity will degrade aquatic life, fish and fishery and be a risk to people, especially children downstream the outlet of the power plant.

(vii)Starting the peaking for the first time
Experiences from other peaking operations, shows that the first peaking operations should be gentler both in volume and have a long up and down peaking time. This gives especially the fish a possibility to adapt the rapid and high changes coming.

EHSP
The EHSP should include full guidelines for the set-up of a system for early warning of floods, spillway releases from the outlet and downstream the dam as well as rapid changes in water quality which can affect people and animals. The warning system should be based on direct warning from the operation staff at the My Ly HPP station to the people living along the Ca river. This system could be based on battery/solar cell-operated sirens with wireless transmission.

(viii) Fish stocking programs
A common course is to promote aquaculture as mitigation. In many cases aquaculture actually exacerbates biodiversity losses, for example by introduction of exotic species which affect indigenous species negatively. Proper controls are advised through monitoring. A fisheries support programs and is part of the overall livelihoods restoration initiative is recommended and is detailed below:

Fisheries Support Plan (FSP)

This plan has two subplans to elaborate a more detailed approach.

Cage Fish Farming Sub-plan
Introducing fish cages in the reservoir face some of the same problems regarding exotic species as in dam projects. However by using fish cages the risk of escaping and introducing new species and possibly fish sicknesses in the river ecosystem is even higher than in fish dams. We therefore strongly recommend using local fish species because in many cases aquaculture actually exacerbates biodiversity losses, by affecting indigenous species negatively.

Big size fish species, with rapid growth and feed on planktons are used in cage fish culture. In Vietnam, cage fish culture in dams is common. During the construction phase which is assumed to take five years, a more close investigation should be done to evaluate the risk of using exotic species, and to evaluate new equipment that in a higher degree than what seems to be available today, can give a higher guarantee against escapes. Because of the high daily and yearly fluctuations of the water level and the flushing of the reservoir once a year the effect of this mitigation is somewhat uncertain. The recommendation is to start carefully with not more than 10 fishermen, each using five cages.

Community Fish Farming Sub-Plan
In all sections of the Project AI there is expected loss in fish production which will negatively affect the outcome for the fishermen. In some DIA villages, households have built fish ponds and are raising carp and other native species stocked from the river. This seems to work well. The experiences gained in by these farmers will be used as mitigation in the My Ly HPP.

From an ecological point of view, we strongly recommend using local fish species because in many cases aquaculture actually exacerbates biodiversity losses, for example by introduction of exotic species which affect indigenous species negatively and are virtually impossible to eradicate once established. Fingerlings are available outside the DIA area. Feeding fish pellets would provide a reasonable growth.

ACBP
Given that the water flow will be reduced substantially in the low flow season, the risk of over fishing and use of illegal fishing methods may increase. Similarly, during construction phase over fishing is expected. This may be managed through establishing controls and increasing awareness. An awareness programs dealing with over fishing and use of illegal fishing methods as well as other threats to the environment should be worked out. Workers, permanent and non-permanent technical project staff, project administrators, local people, children, district and local level GoVernment personnel should be well informed.

12.4 Social environment

12.4.1 Agriculture improvement

The loss of land and properties, and the displacement of population from their settlement areas are probably among the major social and cultural impacts of the My Ly HPP. Livelihoods of the local communities comprising mostly of ethnic minority population depend upon forest and water resources, and land resources in the form of upland farming. Forests provide the much needed food items like vegetables, materials for household energy, construction and other use, and animal protein through small mammals, lizards and amphibians for home consumption. River resources provide animal protein. Both these resources are helpful in generating some cash to maintain households through sale of small mammals and rodents. Livestock is another source providing animal protein and cash through the sale of live animals, but disease outbreaks cause immense loss. Agriculture in the form of swidden systems is influenced by weather patterns and poor soil quality, provides rice as a staple food, and maize and cassava for livestock feeding and some sale, however, rice production is not sufficient all year round for the many poor families. Farming practices are traditional and subsistence oriented, and all livestock are free-ranged; uncontrolled disease outbreaks cause immense loss to livestock. The ethnic minorities have little to no access to agricultural extension services of district or commune agencies, and moreover the local extension technical staff have poor technical capacity to manage livestock diseases.

In the context of My Ly HPP, the local community though resettled in new location, will not loss all their upland farming area; currently they cultivate 940ha annually and they have access to about 1180ha additional swidden land for crop cultivation used on rotation. However the loss of approximately 988ha forests in reservoir could significantly reduce grazing areas for their domestic animals.

All mitigation and enhancement measures are organized in integral plans. These plans are integral in the sense that they integrate both compensatory and enhancement measures in specific fields aiming to improve living conditions of the population in the DIA. In order to present the contents of each of these plans and avoid repetitions, a general introduction to the plans is made below and elaborations done in the sections that follow.

The compensatory and enhancement measures, in the context of agriculture and livestock are organized into three main areas of intervention under Agriculture and Livestock Support Program:

Agriculture, Livestock and Fisheries Support Program
- Upland Farming Diversification Plan (UFDP)
- Soil Fertility Enhancement Plan (SFEP)
- Animal Husbandry and Veterinary Services Plan (AHVSP)

These are also integrated across programs plans, namely the RCMP, BEESRP, SBZ Management Plan, and the ACBP.

12.4.1.1 Upland farming diversification plan

This programs includes measures and plans aiming to compensate the production losses, enhance productivity, diversify production and improve marketing in agriculture. These measures are organized into different sub-plans, including:

- Crop diversification and Multiple Cropping Sub-plan
- Fruit and Vegetable Production Sub-plan
- Bee Keeping Sub-plan
- Forage Production Sub-plan

The Project will implement these plans in the Project DIA in collaboration with the extension services at commune and district levels. The plans below are to be formulated during the design phase of the Project and implemented during the Project construction phase.

Crop Diversification and Multiple Cropping Sub-plan

The Crop diversification and Multiple Cropping Sub-plan will be executed as compensatory and enhancement measures in 20 households in each Project affected village as a pilot project in the first 2-3 years and then extended to other households. This will include growing crops such as ginger, peanuts, beans, pumpkins and other vegetables and similar other crops intercropped with traditionally grown maize and cassava. This will also include planting fodder trees.

The plan will include improved farming practices, improved drought tolerant seeds, fertilizers, and other necessary inputs such as capacity building of farmers. The Project will facilitate the farmers in order to effectively implement the proposed mitigation plan. The project will collaborate with state extension services for seeds and improved agronomic practices.

Capacity building of farmers (part of the ACBP)

A series of training programs will be organized, in collaboration with extension services at commune and district level. The training is expected to enhance the skills and capacity of farmers to efficiently utilize land resources adopting improved farming practices and change in cropping patterns. Training will also include the components of crops, vegetables, horticulture, beekeeping, soil fertility enhancement, compost making and related fields.

Implementation approach

Crop diversification on uplands will be a new initiative among the ethnic minorities as few households cultivate more than upland rice, maize and cassava. The Project will prepare a plan and introduce the local community to new farming approach, growing more types of crops alone or intercropped on uplands. Adoption of appropriate farming techniques and agronomic practices will be necessary.

The Project will select 5-6 households in each village, discuss with them about this new initiative, make a household group, provide training and involve them in the programs. A good technical support will be required. The Project will collaborate with state extension agencies at the commune and district levels for technology and materials as well as draw from other experiences in Vietnam and Laos. The Project will financially support extension services with manpower and technology.

Fruit tree and vegetable production sub-plan

The Project will implement the Fruit Tree and Vegetable Production Sub-plan on homestead areas and on river bank. The Project will collaborate with concerned communes to allocate suitable area with gentle topography in the SBZ on the riverbank or near streams in other areas for cultivation. Initially, five households will be involved in fruit tree production in riverbank cultivation and all other households in homestead area. Most households have a small plot for farming. The Project in collaboration with state extension agencies will provide improved seeds and fertilizers to participating farmers. If water source is available, provision will be made for drip irrigation.

Bee keeping Sub-plan

This will be a new farming initiation in the ethnic minority. Honey production using forest vegetation is a common activity in upland areas. Initially, two willing households will be selected in each village, trained and provided with beehives and bees. (See capacity building explained earlier). If successful, this will gradually involve more households. The Project will prepare and implement a Bee Keeping Plan.

Forage Production Farming Sub-plan

Forage scarcity was reported in most Project affected villages and very few farmers grow local maize seeds for fodder production. It has not been a common practice among ethnic minorities to grow forage crops. Since a large forest area covering 988ha will be inundated which would reduce grazing area, the Project will prepare and implement forage production programs in all the Project affected villages. In Laos, households have more access to grazing area than in Vietnam side. Forage crops will be grown on upland farms as a single crop or intercropped with cassava. Locally available fodder tree species will be planted on uplands.

12.4.1.2 Soil Fertility Enhancement Plan (SFEP)

This programs includes activities aiming to improve soil fertility, enhance crop productivity, and eventually increase crop production. Soils are very poor and less productive. Slash and burn just before rainy season and planting seeds at early rainy season aggravates soil erosion. Yields of hybrid maize in such areas are less than one third of its potential grain production. These measures are organized into different sub-plans, including:

- Growing Legumes and Similar crops in Multiple Cropping Sub-plan
- Compost Making and Mulching Sub-plan

Growing Legumes and Similar Crops in Multiple Cropping Sub-plan

Farmers are growing beans in home gardens and occasionally on uplands. Legumes such as soya beans, beans and similar crops could be grown inter cropped with maize and other plants. These legumes can provide pulses and their roots will add nitrogen to the soil. Capacity building will be provided to local farmers (See Crop Diversification).

Compost Making and Mulching Sub-plan

The Project will prepare and implement a compost making plan. Simple compost making process will be adopted using biomass collected from nearby forests (only if needed), crop residue and cattle dung. Farmers usually have a temporary house in upland farming areas and live there during crop maturity and harvest. Cattle while grazing on fallow land can be put in paddocks at night and dung collected for compost. A simple technique is to have a ditch/pit for biomass and dung decomposing. The decomposing process will take some time, but it is an easy and viable cost-free option. Compost can be used during crop planting. Compost making is to be introduced and practiced at homesteads where all the organic waste can be dumped into a ditch (or compost bins) and then harvested after 3-4 months. This compost can be used in home gardens and field vegetable plots.

Farmers at present leave all crop residues after harvesting grain and they just get blown off with to wind. Crop residues could instead be collected, put aside and used during cropping as mulch or dumped into compost pits.

12.4.1.3 Animal Husbandry and Veterinary Services Plan

Farmers rear a range of domestic livestock e.g. cattle, goats, buffaloes, pigs and poultry. All animals are free-ranged although a few farmers rear hybrid pigs in confinement. During the HH survey, a few households expressed intension to keep their pigs and poultry confined (sheds and sties [pigpens]). Disease outbreaks are common and many animals die. Forage scarcity particularly during winter has been a major problem in the My Ly HPP Project affected areas, more so in Vietnam than in Laos.

This programs includes plans aiming to improve animal husbandry practices, management of livestock, improved feeding, reducing incidence of diseases and improving animal health services. Farming pigs and poultry in confinement could be considered as environmental programs reducing litter and waste in the village area. Proposed measures are organized into three different sub-plans:

- Animal Husbandry Improvement Sub-plan
- Extension and Veterinary Services Sub-plan
- Forage Production Sub-plan

Animal Husbandry Improvement Sub-plan

This will include feeding, breeding and management of all kinds of livestock in the Project DIA villages (resettled in most cases) and will involve a large number of households. Special attention will be paid to pig farming and poultry rearing in terms of feeding, management and breed improvement. The Project will prepare and implement an Animal Husbandry Improvement Plan giving emphasis to improve feeding, breeding, and management of livestock, particularly of pigs and poultry.

The Project will financially support the construction of a pigsty (pigpens) for 5-6 pigs and a small poultry shed for 15-20 poultry birds for every household in the DIA villages, agreed with each household. Farmers will be encouraged to rear hybrid pigs in pigsties and additionally use commercial livestock feed for better growth. Poultry can be managed at a semi free-range system. Some of the households will also be persuaded to rear improved poultry.

Extension and Veterinary Services Sub-plan

The Project will prepare and implement a comprehensive Extension and Veterinary Services program which will include (i) support to extension service centers at commune and district level both in terms of manpower and technology, including medicines and vaccines; (ii) awareness and training to at least one person from each DIA household on animal hygiene and primary treatment, (iii) equipment and appliances needed for improved husbandry and treatment.

This will be an important program in the Project DIA and its adoption rate by farmers is expected to be very high.

Forage Production Sub-plan

See section 2.4.1.1, above on Forage Production Sub-plan

12.4.2 Social improvement

12.4.2.1 Community Health and Sanitation Plan

A Community Health and Sanitation Plan will be developed prior to Project construction with the aim of improving health status of communities in the Project DIA. The plan will be developed for both construction and post construction phases of the Project. The plan will incorporate the following specific programs that will be implemented in the Project villages:

(a) Household Water Supply and Management

Household water supply will be provided in all the relocated villages with the same type of system as in the existing villages, and with a proper filtering system to allow safer drinking water. The Project will also support villages losing land and in the DIA to develop drinking water systems. Such support will be in the form of remediating and augmenting existing drinking water systems. The Project will collaborate with villages to support the access to safe piped drinking water to relocated households. Similarly, the Project will support drinking water quality analysis in villages. The aim is that the Project will contribute to the establishment of treatment practices for safe drinking water to Project-affected households and bring the quality of drinking water up to the standard prescribed by the National Drinking Water Quality Standards.

(b) Sanitation Enhancement Sub-plan

Approximately more than 80% of the households in the Project DIA do not have toilet facilities. They use nearby forest areas, river/stream banks and open lands for open defecation. This low hygienic standard contributes to high prevalence of diarrhea and related health problems. In the relocation villages, every household will be provided with a toilet. The Project will also provide support for construction of the toilets with septic systems and flushing mechanisms in other affected villages in the DIA.

(c) Community Waste Management

Villages at present lack waste management practices and people dispose waste haphazardly in and outside the village. There is no awareness of the health risks from litter around the houses, which the free roaming animals are partly eating. The Project will support developing simple waste management systems in relocated villages that are sustainable, based on the local culture and designed together with the villagers in order to be managed by the community. Such a waste management system may include e.g., construction of an open but fenced area for waste disposal outside the village, composting development for organic waste, and organization of community rubbish collection team.

(d) Improved Cooking Devices

Smoke from traditional cooking oven open fire is a serious health hazard, especially for women, who are cooking inside the house and children staying with their mothers. The Project will provide support for Improved Cooking Stoves (ICS) in the relocated households that should be included in the house kitchen design. ICS has a range of benefits compared to traditional fuel wood stoves; ranging from reduced emission of smoke and noxious gases in the atmosphere consequently aiding in reduced incidence of respiratory diseases. ICS requires less fuel wood and accordingly also contributes to less firewood needed from the forest areas surrounding villages. Consequently, reduced firewood collection will contribute to lessen women’s work load both physically and timewise.

(e) Awareness and Capacity Building Plan (ACBP)

The Project will launch health and sanitation awareness programs in different locations in the Project DIA. Such awareness programs will be conducted in villages. The awareness will focus on water use and treatment practices, pollution of water sources, personal hygiene and households as well as community sanitation. The Project will collaborate with state agencies at district/commune level to effectively implement such awareness and education programs.

(f) Public Health Support

Availability of health services is very poor in the Project DIA. Villages lack any health services, and the distance and travel to the available services in commune and district health centers is long, difficult and in many cases too costly for the poor people. There are trained health workers in many Vietnamese villages, but these are trained only in delivery of government health information and without medical training. It is proposed that the Proponent will: (i) develop health services availability for the local PAPs connected to the construction workers’ health facilities, (ii) support training of health workers in villages, and (iii) develop mobile health services to the villages in cooperation with the commune/district health providers. Health services that are built up in the construction area will be in operation during the construction period, but could remain after the construction and run by a local administration.

(vii) Emergency Medical Response

An Emergency Medical Response Unit (EMRU) will be established in each construction site for first aid and emergency assistance. One medical doctor will be employed in the ESMU of the Project during construction.

12.4.2.2 Community Labor and Employment Plan

Most of the people in the Project DIA are farmers and there are hardly any labor opportunities apart from agriculture and forestry. Seasonal and permanent labor out-migration of especially young people, both men and women, from the affected villages to other provinces and major cities is high. There will be many labor opportunities for unskilled workers in the HPP construction and it is required that local workers from the affected communities will be prioritized whenever possible. Requirements for local employment among the unskilled labor force and measures to ensure are required to be included in all the procurement documents and construction contracts and sub-contracts. It is required that:

- Contractor has to prioritize employment of local unskilled labor force (through subcontracting) so that at least 30% of the unskilled labor force over the Project construction time are workers from the Project DIA communities.
- A total of 30% of the local unskilled labor force has to be women. Contractor has to implement measures to enhance employment of women, including awareness raising to prevent sexual harassment of women.
- Male and female unskilled workers will receive equal pay for equal work.
- Contractor is not allowed to use any child labor (workers under 16 years of age).
- Contractor has to provide basic facilities (such as water and latrines) separately for men and women in the construction sites. The quality of these facilities has to meet the locally acceptable standard.
- Contractor is required to provide adequate working conditions and facilities for their workers, as well as ensure health and safety measures in the workplace. Contractor is required to coordinate with local health centers in order to ensure that necessary arrangements will be made for prevention of accidents and epidemics, and that first aid facilities and access to basic health care and emergency care are available at all times for all employees at the construction site and at workers' camps.

12.4.2.3 Influx Management Plan

The HPP construction will contribute to an influx of people to the Project DIA who may far outnumber the local people. There will be large numbers of workers, mostly male, camp followers (entrepreneurs) and other people taking the appearing economic opportunities (small business, commercial sex-workers) in the Project DIA, especially around the construction area and in the existing local population centers[100]. New people with culture and habits different from the local ones will greatly increase the risk of sexually transmitted diseases such as HIV/AIDS and the risk of human trafficking especially women and children. There is also an apparent risk of increasing drug trafficking and drug use added to the already existing problem of drug addiction in some Project-affected villages. Influx of people also can have a significant impact on local natural resources and can create conflicts with local communities that rely on the limited resources on a daily basis. <u>Awareness of potential risk and social problems should be enhanced among vulnerable local people, especially women and girls. See also forest related plans on awareness raising.</u>

(a) Increased number of people in project affected area: work force, camp followers etc.

A peak workforce presence over 3400 individuals (and at 1800 at a single period) will trigger related influx of entrepreneurs, commercial sex-workers, increase in entertainment centers (e.g., karaoke bars), food shops with local wild meats and forest medicinal herbs, etc. There is usually pressure on local resources, including wood, land and hunting. Both monitoring and a worker and community based awareness program have to be implemented (described below and in the Physical Program). Particularly vulnerable are the young girls and women from villages in the vicinity of camps and populated areas.

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[100] MIGA, 2009. Projects and People. A handbook for addressing project-induced in-migration. http://www.MIGA.org/wps/wcm/connect/topics_ext_content/MIGA_external_corporate_site/sustainability-at-MIGA/publications/publications_handbook_inmigration__wci__1319576839994

(b) Community-based Public Awareness Program in Project DIA communities

Experience shows that the risk of HIV/AIDS and other sexually transmitted diseases (STDs) as well as of human trafficking will increase during big infrastructure construction projects. With usually provided better connectivity leading to increased mobility, these risks remain even after the construction period.

In order to mitigate these potential negative consequences of the HPP, a community-based Public Awareness Program with two components will be implemented in the Project DIA:

1) HIV/AIDS and other sexually transmitted diseases prevention; and

2) Human trafficking prevention.

The intention of the Public Awareness Program is to increase the risk awareness of the local people through information dissemination in the Project-affected villages and communes. Better knowledge of the sexually transmitted infections and of protection against them is expected to obstruct the increase in HIV/AIDS and STD cases. Likewise understanding of the ways and methods of human trafficking will hinder individuals falling easy victim for it. The awareness programs will be designed to be appropriate for the local culture, using local language and appropriate communication methods for ensuring that the information is understandable and accessible for the local ethnic minority communities with low educational level; pictorial information is prioritized. The Project will provide funds for information materials and for engaging Women's Union at province, district and commune level for implementation of the Program.

(c) Construction Workers' HIV/AIDS Awareness Program

All Project contractors are required to implement an HIV/AIDS Awareness Program among construction workers and to undertake measures to reduce the risk of the transfer of the HIV virus and other sexually transmitted infections between and among the construction personnel and the local communities. Contractor is requested to subcontract an approved service provider, such as the Province HIV/AIDS Prevention Centre to:

- Carry out regular awareness raising among the employees throughout the construction time through information, education and communication activities that address HIV/AIDS and other STDs, transmission risks and promote preventive measures. The awareness programs shall cover all the contractor's employees, all subcontractors and any other employees, as well as all truck drivers and crew making deliveries to the construction site.

- Promote early diagnosis of HIV: Ensure workers have access to and know how to access voluntary counselling, screening and diagnosis for HIV/AIDS, so that all workers can find out their HIV status.

- Provide free condoms at the workers' camps.

Contractor will include the HIV/AIDS awareness program as a sub-clause in the execution of the works, budget it as a lump sum covering all the costs related to the program and clearly indicate when, how and at what cost the program with all the required measures will be implemented. Contractor shall detail the resources to be utilized and the proposed sub-contracting arrangements and provide a cost estimate with supporting documentation. Payment to contractor for preparation and implementation of this program shall not exceed the budgeted sum for the purpose.

PO will assure that the HIV/AIDS awareness program is included in the construction bidding documents and accordingly included in the construction contracts and implemented by eligible contractors.

HIV/AIDS, STDs and Human Trafficking Prevention Plans should be developed.

12.5 Resettlement Policy Framework (RPF)

The Proponent is responsible for preparing and implementing a Resettlement Action Plan (RAP) for each of the villages that have to be relocated due to the HPP, based on the Resettlement Policy Framework (RPF) and the Entitlement Matrix for lost land and assets, provided in the ESIA. Details are provided in Volume VI. In the ESIA, Chapter 8 provides a baseline assessment of the people to be physically and economically displaced, and the impacts assessment is included in Chapter 11. The RAP will be prepared through an informed consultation process with the affected communities and with each affected household according to the mechanism given in the PCDP enclosed in Volume V. The RAP will be prepared based on the applicable resettlement policy of the government and of MIGA on the outcome from the consultations with the PAP and following the Entitlements Matrix for resettlement and compensation.

12.5.1 Legal basis and standards

The Project Policy and Entitlement Matrix is based on the following legal documents and standards:

- Agreement Between the Government of the Lao Peoples Democratic Front and the Government of the Socialist Republic of Vietnam of 11 March 2016;
- Decree on Compensation and Resettlement of People Affected by Development Projects (Decree No. 84/GOL, 2016);
- Land Law 2013 which is effective from Jul. 1st, 2014 of the GoV and Decree No. 01/2017 / ND-CP amending the decree guiding the Land Law;
- Decree No.38/2013/NĐ-CP on management and utilization of official development assistance (ODA) and concessional loans from donors;
- Decree No.44/2014 of the Government regulating land prices, Decree No. 104/2014/ND-CP on land prices, and Circular detailing a number of articles of the Government's decree no. 43/2014/NĐ-CP and decree no. 44/2014/NĐ-CP dated May 15, 2014 (GoV);
- Decree No.47/2014/NĐ-CP of the Government of May 5th, 2014 on compensation, support and resettlement upon land expropriation by the State, which is effective from Jul. 1st, 2014 (GoV);
- Circular No. 37/2014/TT-BTNMT of June 30th, 2014 on detailed regulations on compensation, support, and resettlement upon land expropriation by the State (GoV);
- International Finance Corporation (MIGA, 2012) guidelines and Performance Standards (PS), PS 1, PS 5 and PS 7.

12.5.2 Proposed My Ly Hydropower Project Policy for PAPs in Vietnam and Laos

- Project impacts shall be avoided or minimized wherever possible by exploring viable alternatives in design and location.
- Full assessments shall be conducted to ensure all impacts are identified and mitigated.
- PAPs shall be compensated and resettled in order to improve their standard of living, including access to community services and resources.
- Land acquisition and resettlement shall be planned and implemented to cause least possible amount of social, cultural and economic disruption.
- All measures shall be implemented without detriment to the environment.
- Special measures shall be incorporated to protect socially and economically vulnerable groups, and groups that cannot for various reasons participate in restoration programs.
- All persons residing within the areas directly impacted by the Project shall be considered as PAPs and will be entitled to compensation and resettlement if the

impact influences their residences and livelihoods negatively. Those without legal titles or required documentation shall be assisted in acquiring the necessary documents that will give entitlement to compensation or replacement.

- The previous level of community services and resources shall be improved after compensation and resettlement.
- The Project development costs take into account the costs of resettlement. The resettlement programs shall be planned and implemented with the consent and agreement of the affected people through a participatory involvement process.
- All households will have access to effective mechanisms for hearing and resolving grievances during the implementation of compensation and resettlement programs.
- Proponent will carry out monitoring of PAPs until compensation is completed and livelihoods are fully restored, and until development targets are achieved.

12.6 Public Consultation and Disclosure Plan (PCDP)

To guide future consultation and engagement activities a Public Consultation and Disclosure Plan (PCDP, see Volume V) according to MIGA (World Bank Group) guidelines has been prepared. The PCDP is cross-cutting over all the ESMP programs and has to be applied related to all environmental and social impacts from the HPP.The PCDP provides details on consultations that have been conducted, stakeholder concerns, policy and regulations, key principles for planned consultations, tasks for an effective PCDP, management organization, and a grievance redress mechanism.

The PCDP aims to:

- Identify key stakeholders and ensure there are adequate mechanisms for stakeholder feedback and information sharing;
- Carry out *meaningful consultation* in accordance with PS1, PS5 and PS7, where PS7 calls for FPIC process where *broad community support* is confirmed;
- Provide a framework for consultation at the local, national and international levels;
- Ensure issues raised by key stakeholders are addressed in the ESIA report as well as in the project decision-making and detailed design phase;
- Provide mechanisms that ensure the formulation of the RAP based on the framework prepared as part of the My Ly HPP ESIA;
- Identify the level of resources required to implement the plan and procedures to monitor implementation including timeline; and
- Outline a grievance mechanism for local stakeholders.

In line with MIGA policies, as noted above, the PCDP is intended to enhance community benefits and related environmental issues by minimizing negative effects through engaging the community. The purpose of community engagement is to build and maintain over time a constructive relationship with communities. The nature and frequency of community engagement will reflect the Project's risks to and adverse impacts on the affected communities. Through functioning as a means to fully integrate with all phases of the project - planning, design and implementation - the PCDP goes beyond only describing what has already been undertaken and is thus proactive in nature. It more saliently sets outs a roadmap for achieving the aims of the community plans, and guides the overall long term social and environmental management systems of the Project.

The PCDP has built on public consultation and disclosure procedures carried out during the ESIA period, and built on Project IA information in 2017 and experiences in the region.

12.6.1 Contractor's responsibility

The Contractor shall develop its own Environment Management Plan (Contractor's EMP). The Contractor shall ensure that the contractors and its sub-contractors carry out their work in accordance with the environmental, labor and safety policies and commitments of the company, and comply with applicable Vietnam and International requirements. It shall develop its own Environmental Health and Safety Procedures (EHSP) patterned according to the EHS policy of the PO. This shall be included in the contractual obligations of the Contractor.

An Emergency Preparedness and Response Plan (EPRP) will also be developed by the Contractor. Key hazards to the Project and to workers which present potential emergency situations will be considered in developing the EPRP and it shall have the following components:

- Landslides and rockfalls;
- Earthquakes;
- Coffer dam failure;
- Road traffic accidents;
- Flooding of tunnels during construction;
- Working in confined spaces;
- Flood discharges and impacts on major structures (especially those higher than the return period design flood level);
- Operational phase flushing (of sediment traps, if used based on final design) and significant increases in downstream levels / discharge rates
- Power cuts / outages;
- Storage, handling and use of explosives;
- Fuel and chemical storage, handling and use;
- Fire hazard;
- Weather and climatic events;
- Site security; and
- Border conflicts or civil unrest.

12.7 Resettlement and Ethnic Minority Livelihoods Restoration Plan

The Resettlement and Ethnic Minority Livelihoods Restoration Plan (REMLRP) has been prepared for the Project with the purpose to minimize adverse socio-economic and cultural impacts from the Project on the people to be affected by the HPP and to ensure that the status of their livelihoods and living standards after the Project will be at least at the same level or improved compared to their current situation. The REMLRP provides instruments to mitigate both physical and non-physical losses that will affect the PAP and restoration and improvement measures for community/HH livelihoods and living standard. The Resettlement Policy Framework (RPF) provides a policy and an entitlement matrix for the preparation of a detailed Resettlement Action Plan (RAP) for the affected villages and households. The various livelihoods restoration plans will support rehabilitation of livelihoods through activities within fishery, farming and animal husbandry. The Community Health and Sanitation Plan puts focus on water, sanitation and health standards of the relocated villages and related community awareness building. The Community Labour and Employment Plan through requirements for local employment in the HPP construction, is to guarantee that local communities will benefit from the project-related labour opportunities. The Influx Management Plan contains awareness raising among the PAP and construction workers in order to reduce the potential social and health risks related to large infrastructure construction projects such as My Ly HPP. The Proponent will be responsible for implementing the REMLRP with full consultation and participation of the affected people, following the PCDP.

CHAPTER 13: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

13.1 Introduction

An integrated Environmental and Social Management Plan (ESMP) has been prepared for the My Ly HPP to set out environmental and social management requirements[101]. Besides, it also proposes procedural frameworks to ensure that all mitigation measures and monitoring requirements specified in the Environmental and Social Impact Assessment (ESIA) report will actually be carried out in subsequent stages of Project construction and operation.

13.2 Environmental program

The ESMP as written now is to function as a framework for the formulation of in-depth plans, programs and specific mitigation measures during construction phase. When its contents are fully formulated it is envisaged to serve as an environmental operation manual for the My Ly HPP management group and staff employed by the management. In addition, it will be an advisory document to the regulatory authorities such as Ministry of Industry and Trade (MOIT), Ministry of Natural Resources and Environment (MONRE, both Vietnam and Laos) and The Ministry of Agriculture and Rural Development (MARD).

The ESMP will require a revision during the detailed design and tender stage and the development of specific contract clauses concerning the required environmental and social mitigation; the revision will also address any required changes to the current design of My Ly HPP.

The basic objectives of the ESMP are to:

- formulate environmental management requirements to ensure that all mitigation measures and monitoring requirements specified in the ESIA report is actually be carried out in different stages of My Ly HPP implementation;
- define environmental management principles and guidelines for the pre-construction, construction, post construction and operation phase of My Ly HPP;
- establish environmental resource needs;
- recommend a plan of action and a means of testing this plan to meet existing and projected environmental problems;
- establish the roles and responsibilities of all parties involved in project environmental management;

[101] MIGA and MIGA. Performance Standards (MIGA, 2013) and Guidance Notes (MIGA, 2012). https://www.miga.org/projects/environmental-and-social-sustainability/performance-standards

- describe mitigation measures that shall be implemented to avoid or mitigate adverse environmental impacts by maximizing the positive ones;
- establish a supervision, monitoring, auditing and reporting framework;
- ensure implementation of recommended corrective actions aimed for environmental management and its enhancement; and
- ensure that the environment of My Ly HPP construction sites and the region of influence is protected and developed to meet the needs of the local people, the stakeholders and safeguard the national interest.

13.3 Implementation approach and mechanism

The Proponent will be the overall responsible for the implementation of the ESMP. It will hire the experts and staff necessary to formulate the proposed plans in the ESMP through consultative processes with relevant stakeholders. Each plan/programs/measure will be disclosed to the stakeholders and agreements made with them to ensure implementation viability. The ESMP is meant to be adaptable to changes that may occur in the Project area, policy and regulatory mechanisms, and stakeholder concerns and views. An Environmental and Social Management Plan Unit (ESMP Unit) of the Social and Environmental Management Division (SEMD) of the Proponent will actively liaison with the state agencies to assure that implementation is smooth. The Public Communication and Disclosure Plan (PCDP) will provide a frame for consultative and disclosure during the ESMP formulation and implementation.

Different parties to be involved directly and indirectly for environmental management of the proposed My Ly HPP components include among others:

- Ministry of Industry and Trade (MOIT), Vietnam
- Ministry of Natural Resources and Environment (MONRE), Vietnam
- The Ministry of Agriculture and Rural Development (MARD), Vietnam
- Committee on Ethnic Minority Affairs, Vietnam
- Ministry of Energy and Mine, Laos
- Ministry of Natural Resources and Environment (MONRE), Laos
- Ministry of Agriculture and Forestry, Laos
- Ministry of Labor and Social Welfare, Laos
- Environment and Social Management Plan Unit of Proponent
- Supervising Engineers for My Ly HPP implementation;
- Construction Contractor; and
- Provincial, District and Commune level state institutions, etc.

<u>The effective implementation of ESMP will require a continuous monitoring of its environmental performance, and where necessary initiate appropriate planning and implement corrective actions to rectify any shortfalls in performance that may occur</u>. The standard is based on the methodology known as Plan-Do-Check-Act principle, which can be briefly described as follows:

- Plan: establish the objectives and processes necessary to deliver results in accordance with the organization's environmental policy
- Do: implement the processes
- Check: monitor and measure processes against environmental policy, objectives, targets, legal and other requirements, and report the results
- Act: take actions to continually improve performance of the environmental management system

To complete this cycle, My Ly HPP will adopt the following approaches in the implementation of the ESMP:

Partnership approach: The partnership principle implies close cooperation between the My Ly HPP and the state agencies at commune, district, provincial and national stakeholders, village level committee at local level at different stages of the implementation cycle of the Project. Although, My Ly HPP ESMP Unit will lead the environmental project under the SEMD, it will accommodate all the concerned people and institutions that have roles and responsibilities in the planning, implementation and monitoring of environmental mitigations. Similarly, a monitoring committee will be developed in the district to perform joint monitoring of the impact mitigation measures carried out by different service providers. Basically the service providers will be commune agencies and contractors and their roles should be defined in the elaborated mitigation plan based on agreements.

Community based: Community organizations, e.g., village level committees are non-profit based made civil-group representatives that operate within a single local community. The recent studies and understanding of roles of community organizations has strengthened the view that these bottom-up organizations are more effective addressing local needs than larger charitable organizations. Local involvement from villages in all decision making is essential and the Proponent can foster local community groups/committee to be formed to be part of, e.g., final definition of mitigation decisions, decision on relocation areas, resettlement and mitigation monitoring, grievance redress and equitable resource use.

Capacity building: Capacity building is a key strategy within all My Ly HPP programs with focus on both individual and institutional development, understanding that both must be addressed together in order to achieve meaningful changes. The My Ly HPP will design and run training programs by coordinating with the district and commune line agencies and experts working in similar fields elsewhere. The main aim is to help in achieving the Project’s objectives. The local Government, communities and village level committees are the main clients of My Ly HPP, but the private sector also needs support.

Information sharing: Throughout the project period, My Ly HPP ESMP Unit will play coordinating roles with aforementioned line agencies and stakeholders in the commune and district. Information sharing is another important aspect to building cooperation between the stakeholders and the project.

13.4 Institutional arrangement

13.4.1 Institutional arrangement and responsibility

My Ly -Nam Mo Hydropower JSC headed by a General Manager (GM) will implement the proposed Project. There will be a provision for My Ly HPP Board which will guide the implementation of the Project during construction and operation phase. Under the GM, among with other divisions, the SEMD will be established and later will have Resettlement and Livelihoods Restoration Unit (RLRU), Grievances Redressal Unit (GRU), Monitoring and Evaluation Unit and Environmental and Social Management Project Unit (ESMP Unit). The organizational setup for environmental management is shown in Figure 13.1.

13.4.1.1 My Ly HPP General Manager Office

The My Ly HPP General Manager Office will establish My Ly HPP SEMD as implementing agency for environmental programs. The GM will coordinate and make final decisions on the implementation of environment mitigation and monitoring plan, however, the GM may delegate some authority to My Ly HPP SEMD. Most of the mitigation measures will be implemented during the construction phase as part of tender document clauses and by the Project with technical assistance or in partnership with line agencies, and Village Level Committees. The GM will approve the Contractors ESMP and other relevant environmental programs prepared by the Contractors as recommended by My Ly HPP SEMD. The My Ly HPP Board may authorize the Project Director Office to stop work or penalize Contractors for breaching environmental tender clauses, non-compliance or non-performance. The GM Office will ensure timely and quality implementation of mitigation and enhancement measures as well as monitoring. The GM will sign agreements with public and private agencies to implement approved environmental and social programs as recommended by My Ly HPP SEMD.

13.4.1.2 My Ly HPP Social and Environment Management Division

The My Ly HPP SEMD headed by the Social and Environmental Manager will be established in the GM Office at the very beginning of the Project implementation. SEMD will report directly to the GM Office. As shown in Figure 13.1, SEMD will have four sections namely Resettlement and Livelihoods Restoration Unit (RLRU), Grievances Redressal Unit (GRU), Monitoring and Evaluation Unit and Environmental and Social Management Project Unit (ESMPU). Since the ESMP implementation will also need to cover Laos there is a need to assure that units are represented by individuals from both nations having both language and cultural knowhow to implement and conduct themselves. In this regard the Proponent will compose two terms where required, i.e., covering Laos and Vietnam.

The ESMP Unit will be responsible for implementing physical and biological mitigation and enhancement programs while the RLRU will work on land acquisition and compensation, resettlement and rehabilitation, community development, livelihood programs, health related programs and other social activities. The Monitoring and Evaluation Unit will be responsible for monitoring of environmental and social programs implemented by the Project and the contractors as per contractual agreement, and will report on compliance. (See Volume V-PCDP and Volume VI - REMLRP for related details of organization).

During the Project construction phase, SEMD will be a full-fledged office but it will be reduced in size as SEMU during the operation phase. Functions and responsibility of SEMU will be influenced by the findings of an environmental audit conducted by the Project through outsourced agency within three months of the completion of the construction work, which will assess the environmental compliance during construction phase, identify the emerging problems, assess the environmental and social works to be done, and recommend mitigation and enhancement measures to be implemented during the operation phase. After the environmental audit, regular works of SEMD may be considerably reduced or cease. My Ly-Nam Mo Hydropower JSC can opt to have certain aspects on monitoring to be managed by the SEMD (or if reduced, SEMU). These aspects have to be formulated during the pre-construction stage.

The My Ly HPP SEMD will review the Contractor’s EMP and other social plans prepared by the contractors and assist the GM Office for their timely approval. The SEMD will prepare annual ESMP for implementation, coordinate with My Ly HPP Divisions and other commune, district, provincial or national level, private agencies for program implementation, and prepare monthly, quarterly and annual reports (as required). Liaison with local communities, agencies, and other major stakeholders will be the major task of SEMD Environment Manager. The My Ly HPP SEMD will manage the Project Information Centre established in Hanoi, project districts, and project sites.

13.4.1.3 Staff positions and responsibility

The staff positions and their qualification, staff responsibilities, duration of staff, reporting types and frequencies, and other related matters will be developed during the design phase of the Project.

13.4.1.4 Construction contractors

Environmental and social responsibility of construction contractors, contractual agreements, mitigation measures to be implemented by contractors as per contractual agreement, and contractual notification procedures will be developed during the design phase.

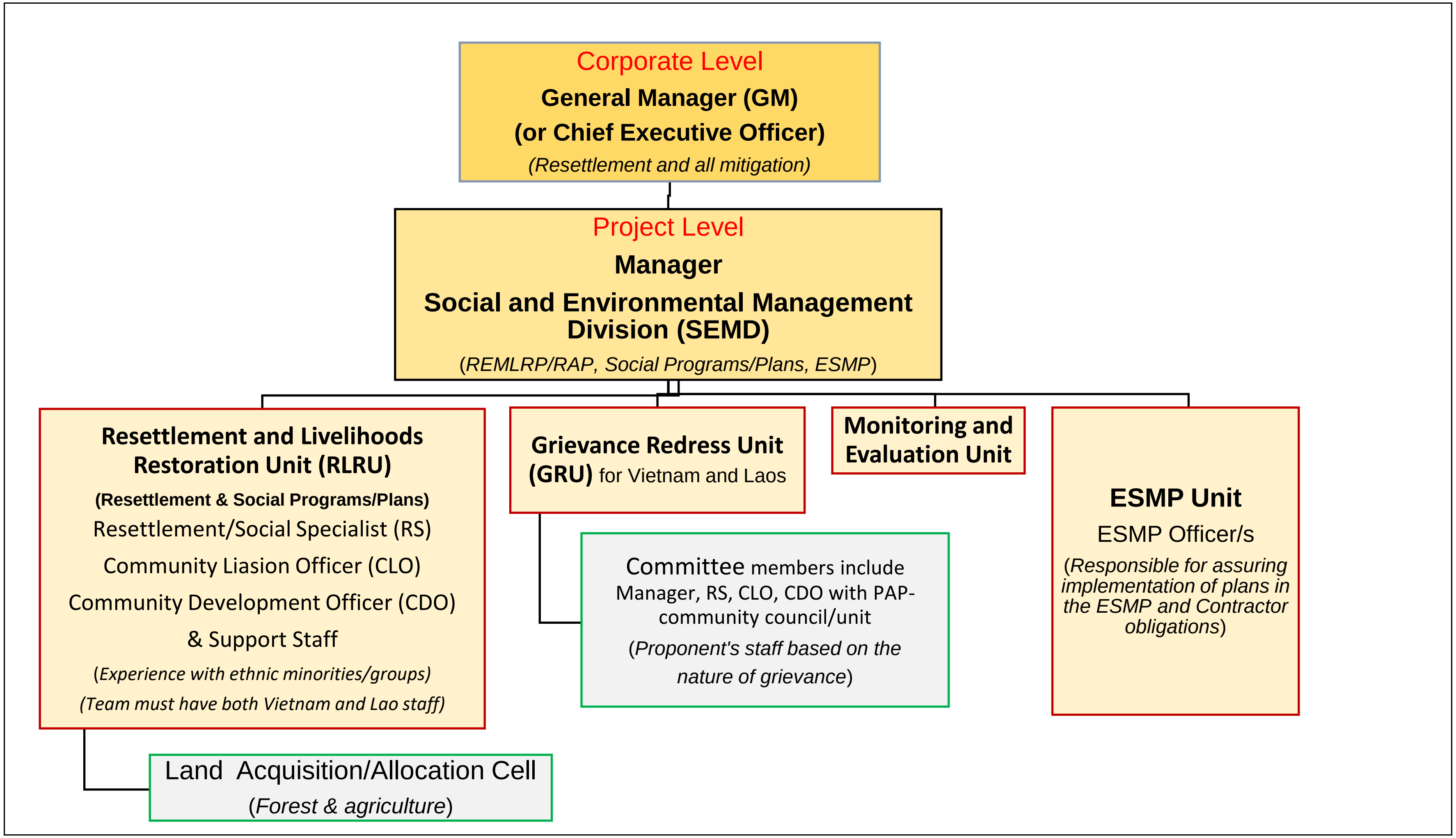

Figure 13.1 Organisational Set-up for Social and Environmental Management

13.4.2 Regulatory mechanism and environmental permits and approval

Implementation of environmental and social mitigation measures will be regulated by the GoVernment of Vietnam (GoV) and GoVernment of Laos (GoL) policies and legal framework (see Chapter 2 on policy, ESIA) which have made provisions for the compliance of ESIA Report, monitoring and evaluation, environmental audit, and restrict discharge of radio-active emission and other waste materials in convention to the criteria fixed by the GoVernment. There are many other Acts, Rules and policies which directly or indirectly regulate the socio-economic and environmental activities to be implemented by the Project. The detail will need to be reviewed in detail during design phase.

The My Ly HPP GM will acquire permits for clear felling or cutting trees in the national forests in the Project area from the Forest Protection Department, Vietnam and Department of Forestry, Laos. In the Project construction sites, contractors will make request to the GM through My Ly HPP SEMD for the approval for clear felling or felling few trees, and with the recommendation of SEMD, the GM would make official request to District/Commune Forest Office for tree felling approval.

13.4.3 Environmental standards

Benchmarks for limits must be established based on GoV, GoL, and MIGA.

13.4.4 Construction contractor

Construction contractor will prepare specific plans based on the Project ESMP, labor, health, safety plans, among others. The contractor will ensure (i) properly and timely implementation of all mitigation measures as mentioned in ESMP; (ii) timely inform emerging environmental and social problems during construction works to ESMP Unit; and (iii) implement corrective actions to safeguard environment in response to requests made by the Project.

The Contractor will be responsible for the implementation of spoil disposal, waste management, occupational safety, structural bioengineering measures, air, noise and water quality protection measures, etc. The Contractor will provide Quarterly and Annual Reports regarding their performance on these issues to SEMD.

13.4.5 Public communication and disclosure

The ESMP implementation reports prepared by ESMP Unit will be disclosed to local community, commune and district agencies. They will regularly prepare disclosure documents (flyers, bulletin, etc) also in the local language that will cover Project activities including environmental and social mitigation measures and monitoring works. In addition, a regular meeting will be conducted with district-level line agencies, Commune Office and Village level Committees at the Project site to brief them about the status of the Project, ongoing environmental and social activities and problems that have arisen during implementation. The PCDP of My Ly HPP will guide the stakeholder consultation and disclosure process.

13.5 Reporting

My Ly HPP ESMP Unit will prepare monthly, quarterly and annual progress reports (based on the agreed requirements), and send them to district line agencies. The My Ly HPP ESMP Unit will organize regular meetings, which can also be called as project coordination meeting. Frequency of progress reporting of the project activities can be reviewed and openly discussed. The Project will organize the annual meeting either in Hanoi or in Project’s district headquarters, Ky Son district in Vietnam and Kouan district in Laos (and in Nonghed district in Laos if required) to review yearly progress of the project activities. It will be targeted to concerned line ministries and departments and other principal stakeholders in the districts. The reporting may be altered to fit MIGA requirements.

13.6 Environmental monitoring

13.6.1 Rational for environmental monitoring

As per the regulatory requirements in Vietnam and Laos the proponent shall comply with the matters mentioned in the approved ESIA report while the concerned agency has to monitor the impact on environment, resulting from the implementation of the Project.

The effective monitoring of the mitigation measures requires a constant feedback between those charged with administering the compensation schedule and the intended beneficiaries. The monitoring should include, among other environmental and social aspects:

- Disbursement of compensation should take place promptly and according to procedures;
- Communities in the affected areas share some benefits from the implementation of the Project;
- Local population is engaged/hired whenever possible;
- Access to health care facilities is provided and clinics are staffed and stocked;
- Assure proper safety material, training and information meeting international standards (MIGA, World Bank Group);
- Rates of disease infection are monitored, with special attention to STDs; and
- Resettlement arrangements are effective and minimize the level of conflict between re-settlers and host populations..

13.6.2 Objectives of monitoring

Environmental monitoring is needed to ensure compliance of the implementation measures and to assess the actual effects of these measures as well as the emerging impacts during project construction and operation phases. Environmental monitoring for this Project will be undertaken to meet the following objectives:

- To fully comprehend the physical, social and environmental conditions in the Project area such as inundation area, safeguard buffer area and Project structure and activity area prior to the implementation of the Project;
- To understand the compliance status of the implementation of mitigation measures and other regulatory standards;
- To ensure effectiveness of mitigation measures implemented by contractors as per contractual clauses and obligations;
- To check the effectiveness of mitigation and enhancement measures, implemented by the Project; and,
- To verify the accuracy of ESIA predictions and assess the emerging and cumulative environmental problems, which could provide timely warning of potential environmental damage.

A more detailed monitoring plan in the form of a fully formulated ESMP based on formulated plans/programs/mitigation will be prepared at design phase. The SEMD will develop detailed monitoring for each programs in the ESMP as each plan is fully formulated, and will require that contractors adhere to the regime set-up and the recommended international standards.

13.6.3 Site inspections

The SEMD will carry out site inspections prior to construction, during construction and at the end of construction in coordination with the contractors. In general, the 'Initial Inspections' conducted in the pre-construction phase will brief the contractors of environmental and social sensitivities in the Project area and document pre-project conditions. The 'Progress Inspections' of project sites during construction would refer to the compliance monitoring. The 'Final Inspection" will be carried out at the end of construction phase which documents that the contractors have met their contractual obligations with regard to environmental contract clauses.

(i) Initial Inspections

My Ly HPP ESMD will conduct the following initial inspections:

- Monitor the environmental and social condition of various project sites prior to contractor's mobilisation. It will confirm the location of project sites for temporary and permanent use.
- Establish standards for construction and required environmental controls, under the guidance of the GM. Sites will be surveyed jointly by My Ly HPP SEMD and Contractor's representative. Photographic record of the sites will be prepared.
- Prepare the project site document.

(ii) Progress inspections

My Ly HPP ESMD will conduct the following progress inspections:

- Prepare environmental and social checklists, reporting procedures, etc., soon after the commencement of construction works.
- Put emphasis on early identification of any environmental and social problems and suitable remedial action;
- Carry out regular and frequent monitoring of project sites without prior notification to the contractors. Daily, weekly and monthly site inspections of all works such as vegetation clearance, excavation and spoil disposal activities, blasting, tunnelling, chemical storage, drainage and erosion hazards, campsites., etc., will be carried out. The Contractors will be notified to take necessary measures to minimise the level of impacts.
- Provide the inspection reports to the construction Contractors for action. Any deficiency or inadequacy that is noted during inspection will be immediately drawn to the Contractor's attention and reported to the Project Director. The Contractors will prepare a monthly site inspection report and submit to My Ly HPP SEMD.

(iii) Final inspection

My Ly HPP ESMD will conduct the following final inspections:

- Conduct final inspection of the project sites at the end of project construction which will determine whether assigned works are completed and necessary mitigation measures are implemented.
- Contractor's obligations and requirements as per the contractual agreement will be verified and deficiencies will be identified. In case of non-compliance, the Contractors will be enforced to implement the remaining works.
- Recommend the compliance of contractor's works to the Project Director, and prepare a 'Final Inspection Report" documenting site conditions and compliance with contractual obligations.

13.6.4 Monitoring types

Monitoring will be done throughout the project life. Apart from external expert monitoring, internal monitoring by the project will be done as well as participatory monitoring involving various stakeholders. Below are the main types of monitoring that will be conducted.

(i) Pre-construction monitoring

The My Ly HPP will have the principal responsibility for environmental and social monitoring during the pre-construction phase.

(a) Baseline monitoring

Data and information will be collected on key physical, biological and social aspects in the Project DIA such as inundation area, project structure and activity areas, safeguard buffer area and other environmentally sensitive areas, and the data provided by ESIA report will be updated. The My Ly HPP SEMD will be responsible for baseline monitoring during the pre-construction phase. Physical, biological and social aspects are highlighted here.

The primary concern during this phase will be to collect field data needed to enhance the knowledge of baseline conditions. Focus will be on gathering key physical, biological and sociological information needed to verify and update the data provided by the ESIA process such as river water quality, air quality in project sites, number of trees to be felled, number of project affected families and their assets., etc. Some of the monitoring activities are given below:

Physical aspects

- Monitor river flow/discharge to establish environmental flow that can sustain the riverine life and river uses;
- Monitor river water quality and drinking water quality in settlements close to project camps and sites for physical, chemical and biological parameters.
- Monitor air quality at the proposed dam and powerhouse sites, crushing plant, batching plant, haul and service roads, quarry site, spoil disposal area and nearest sensitive receptors to the various construction areas.
- Monitor geological/soil erosion hazards.

Biological aspects

- Pegging of forest sites to be used by contractors;
- Counting and marking the trees to be felled from the temporary and permanent sites; Concerned state agency at commune and district levels will jointly count and mark the trees to be felled.
- Approval from the concerned state agency at commune and district levels for felling the trees from forests;
- Wildlife habitat, and wildlife species and their abundance;
- Edible plants and wildlife;
- Medicinal plants;
- Population status of threatened species just before clearing forests in inundation area and project construction and activity areas; and,
- Monitoring spawning ground and fisheries activity.

Social aspects

- Monitor/update detailed information on land, buildings and other housing structures, and biological assets on land to be temporarily or permanently acquired by the Project. The Project Affected People (PAP) and village; level committee will participate while carrying out such activity; and,
- The Resettlement and Ethnic Minority Livelihood Restoration Plan (REMLRP) will be discussed and agreed with the project affected families, village level committee and other stakeholders.

(ii) Construction monitoring

Environmental and social monitoring during project construction will include two major groups of activities:

- Review of the contractor's plans such as 'storage and construction waste management plan', 'domestic waste management plan', 'health and safety plan', 'emergency medical response unit' and other environmental plans. Monitor implementation arrangements, compliance and impacts.
- Systematic observation to check that contract arrangements by contractors, and other requirements of agencies of the GoV and GoL, and concerns (where relevant) of NGOs, community based organisations/committees or user groups are in fact complied with, and that emerging impacts are properly mitigated and concerns are addressed.

(a) Compliance monitoring

During construction phase, compliance monitoring will be important and will play bigger role in checking whether recommended mitigation measures and environmental management plans have been properly and timely implemented or not. It will determine the overall environmental and social performance of the Project. Compliance monitoring will mainly focus on:

- Compliance with tender clauses;
- Compliance with mitigation measures;
- Timely and adequate implementation of the ESMP; and
- The overall environmental and social performance of the Project.

(b) Impact monitoring

The impact monitoring will examine the effectiveness of the mitigation measures, identify the emerging impacts due to Project activities or natural process and develop remedial actions. Impact monitoring will focus on key indicators to assess whether the impacts have been accurately predicted, and whether the mitigation measures are sufficient and effective. The actual impacts caused by the project implementation and the emerging impacts will be closely monitored during the construction period.

A single summary table with the main aspects to be included in the Monitoring Plan of the ESMP will be developed. Salient features of monitoring physical, biological and socio-economic activities during construction phase are presented in tables, and need to be detailed according to location. The annual environmental monitoring report will be incorporated in the Annual Environment Report which would include the current status of environment in the Project area, emerging and cumulative impacts, and remedial tasks implemented.

(iii) Operational monitoring

Both compliance and impact monitoring will be carried out during the Project operation phase. The compliance monitoring will focus on determining that the prescribed mitigation and enhancement measures in the operation phase are being fully and properly carried out by the Project. Impacts of activities implemented during construction phase and operation phase will be monitored at regular intervals. However, the monitoring intensity will be much lower compared to the construction phase. Some of the monitoring tasks will be as follows:

- Water discharge level below the dam; the minimum flow which is agreed and approved by MOIT (in Vietnam);
- Reservoir shore erosion due to peaking operation;
- Physical stability in and around the dam site, powerhouse site and other vulnerable areas'
- Siren warning system in low flow area and downstream of tailrace outlet;
- Vegetation cover in safeguard buffer zone/area;
- Fish population and biodiversity in reservoir, low flow area and downstream of tailrace outlet;
- Agriculture and livestock improvement programs such as crop diversification, fertility enhancement, raising pigs and poultry under confinement and animal disease control; and,
- Socio-economic status of displaced people resettled in another place.

13.6.5 Environmental monitoring program

All plans will have monitoring tailored to the final formulated ESMP.

Physical Environment Program

For the Physical Environment Program, the monitoring will implicitly be part of the biological, socio-economic and cultural environments. It is likely that upon full formulation that there will be a number of over lapping parameters which will allow more rational monitoring. The construction section will be involved in slope stabilization mitigation and monitoring should be worked out as appropriate based on the techniques used (see also relevant forest monitoring). In addition, the Environmental Health and Safety Plan (EHS) will address the monitoring of water, air and noise apart from all safety aspects.

Biological Environment Program

(i)Vegetation and forestry

Monitoring plan in vegetation and forestry includes both compliance and impact monitoring during construction and operation phase.

(ii) Wildlife and birds

Baseline monitoring will include population status of threatened and rare species and clearing forest area while impact monitoring will include incidents of wildlife killing and hunting.

(iii) Aquatic ecology and fisheries

Below is a description and rational for monitoring for aquatic ecology and fisheries.

Monitoring during the construction phase

(a) Water quality

Samples from the river

It is relevant to monitor the water quality upstream and downstream of the dam and other construction areas due to high activity. Monitoring sites will be decided at detailed design phase, with consideration to the baseline stations that has been monitored.

The sampling frequency is recommended to be monthly during construction phase However, the frequency and the number of stations have to be evaluated. Physical, chemical and biological parameters will be measured. The limits of the different parameters suitable for drinking water are set by National Drinking Water Quality Standard of Vietnam and Laos and the drinking water standard of WHO (2008).

Waste water

The potential polluting constructions sites situated close to the river and with high activity or with a runoff that can end in tributaries and the main river should be selected for sampling monthly at least for the first year during the construction period, and evaluated on the second year The indicative values for treated sanitary sewage discharges should follow the IFC guidelines, and the standards of Vietnamese and Lao governments, i.e. QCVN 08:2008/BTNMT and Lao PDR No 2734 respectively.

(b) Periphyton/Phyto- and zoo plankton Macro invertebrates

Impacts due to chemicals, erosions or other incidents on aquatic life can be detected a long time after the incident happened, and are in that way more suitable than water quality samples. For example, a spill of chemicals ending up in the river will drift away with the flow and will not be detected in water quality samples a short time after the incident. Both species and abundance of periphyton, phyto- and zoo-plankton and macro invertebrates should be analysed. Samples should be collected at the same stations where water quality is collected. The number of stations and number of time might be reconsidered based on the experiences gained. The collectors have to be trained in sampling.

(c) Fish / fishery

Monitoring of fish is also important especially for the livelihoods point of view. Due to little knowledge of the life history of most of the fish species, more information is needed to follow up with proper mitigation. The Fish Adaptation Study proposed should be developed with monitoring as part of the baseline data gathering. Monitoring should be done twice a year (April and November (before and after rainy season). In addition, important spawning grounds should be examined during spawning time. Every second year an estimate of density should be obtained over the long run during the operation period. This gives a more accurate measurement of density and collects important information about the fry which are most sensitive to impacts.

Monitoring in the operation phase

(a) Water quality

The water quality monitoring regime during the first year of operation phase should be the same as in the construction phase. This is because the biggest impacts in the operation phase are expected in this period. In addition, water samples should be taken in the reservoir at the deepest point; probably close to the dam (however, this should not be done when the power plant is operational).

The sampling frequency should be done once a month. However, the frequency has to be evaluated, after the first year.

(e) Green house gas monitoring

The green house gas monitoring will not be done with the aim of assessing the total amount of greenhouse gas emission, i.e. 1) the diffusion of gas from the reservoir surface and 2) the breakdown of the above-water biomass, will not be included – the need for this must be agreed with MIGA. The release through the turbines, (spillway, if the deep water type is chosen), as well as through the minimum release, will be monitored. This will be done by measuring the concentration of methane and carbon dioxide in the reservoir at the same station and depth as in WQ-monitoring in the reservoir. At the same time the corresponding concentration will be measured in the 3 effluents (turbine, spillway, minimum release) and the river downstream. The differences in concentration will indicate how much has stripped off into the atmosphere by pressure fall combined with turbulent mixing and heating.

To measure the surface diffusion of the gases from the reservoir and from the above water degradation of organic material, is regarded as a too big task for this monitoring programme. The degree of super saturation of methane and carbon dioxide in the deepwater of the reservoir will tell a lot of the total emission potential from the reservoir, and how it develops.

The cost of this monitoring is to be included in the water quality monitoring.

(b) Periphyton / Phyto- and zoo plankton/ Macro-invertebrates

The monitoring of aquatic life during the first year of operation phase should be the same as in the construction phase and later its effectiveness is evaluated and adjusted based on the need of the Project.

(d) Fish and fishery plans

The monitoring of fish and fishery in the first four years of the operation phase should be the same as in the construction phase regarding samples taken from the river. Adjustment of flow regimes may be needed if populations decline (see Fish Adaption Plan also). This is because the biggest impacts are expected in this period.

Social and Livelihoods Restoration Program

Under this program, the following will be monitored:

- Monitoring resettlement and livelihood restoration measures;
- Livelihoods status over time, e.g., improvement and enhancement of livelihoods;
- Enhanced forest resources and access to natural resources and continuity in daily cultural and livelihood activities; and,
- Overall wellbeing improvements.

Details are also given in the REMLRP.

13.3 Environmental auditing

In this ESIA, an Environmental Audit (EA) has been proposed to assess the actual environmental impact of the project, the accuracy of impact predictions, the effectiveness of environmental impact mitigation and enhancement measures applied during construction and operation phase, and the functioning of monitoring mechanisms. It is intended that EA should relate actual impacts with predicted impacts, which help in evaluating the accuracy and adequacy of ESIA predictions.

There is regulatory requirement both in Vietnam and Laos for conducting EA.

Besides fulfilling the formal requirements, an environmental audit is a good tool for promoting environmental best management practices and procedures. In general, environmental auditing is conducted with the following aim:

- Assessing compliance with formal requirement;
- Facilitating management control of environmental practices;
- Promoting good environmental management and minimizing the risks;
- Examining environmental changes arising from Project implementation; and
- Establishing the performance baseline for an environment management system.

13.6.6 Planning an environmental audit

Environmental audit critically examines the methods and approach assessment procedure adopted during the ESIA.

At the Project approval stage, both project proponent and authorizing agency should make a decision on implementation of one or more audits mentioned above with particular attention given to the project cost-effectiveness of audit and to technical difficulties likely to be encountered. The cost estimation for the task depends on the decision made of the number and types of environmental audits. Although the anticipated costs are included into the ESMP, it is recommended that a detailed budget for the audit should be planned during the elaboration of the ESMP.

13.4 The ESMP

The Project will implement environmental programmes as compensatory, protective and enhancement measures in the Project DIA and in Project influenced villages in the direct impact area. These programmes will be implemented directly by the project in partnership /association with local and district level public and private stakeholders, and by contractors as per contractual agreement under the guidance and supervision of the Project Social and Environment Management Division (My Ly HPP SEMD). Environmental and social programmes are summarised in Chapter 12 and the ESMP matrix is in Volume 7 ESMP.

Table 13.1 presents the matrix for environmental and social management plans for the My Ly HPP.

13.5 Project costs

The costs of mitigation and enhancement measures will need to worked out as when the ESMP and other safeguards are elaborated.

Table 13.1 Environmental and Social Management Plans Matrix, My Ly HPP.

Objective	Project Activity (reference to ESMP, REMLRP)	Mitigation/Enhancement/ Environmental and Social Management Plan (ESMP), Restoration and Ethnic Minority Livelihood Restoration Plan (REMLRP)	Standards	Institutional Responsibility	Time-line	Monitoring	Implementation Route/Plan
Construction Phase							
Enhancement /Beneficial Impacts							
Livelihoods Enhancement	Employment to local people	Priority given to local people from affected villages and commune	MIGA GOV GOL	Contractor	C	Project-monitoring unit	Contractor's program
Skilled manpower development	Work experience	Contractor will provide on job skill enhancement training to semi-skilled workers	MIGA GOV GOL	Contractor	C	Project-monitoring unit	Contractor's program
Income generation	Increased economic activities	A large work force would create demand for agriculture and livestock products	GOV/GOL	Contractor	C	Project-monitoring unit	Workforce and commune
Social safeguard of local community	Provision of drinking water, sanitation and health facility	Project will provide social services to DIA village and DIA households e.g. electricity, drinking water, sanitation facility, health service as compensatory activities	MIGA GOV GOL	Project	PC, C, O	Project-monitoring unit	Project to commune and DIA households
Improvement in mobility and transport	Road construction	Project will construct roads for HPP	GOL/GOV	Project	PC, C, O	Project	Project's program ESMP, REMLRP
Adverse Impacts: Physical Environment							
Improvement in the landscape construction area and reservoir	Rehabilitation and revegetation of construction sites	Rehabilitation and revegetation in construction sites, auxiliary area and quarry site	GOV GOL	Contractor & Project	O	Project	Contractor's program
	Reservoir Catchment Management Plan, SBZ	The 50m buffer zone along the perimeter of the reservoir will enhance the reservoir landscape	GOV GOL	Project	O	Project	Involving district & commune state agencies and community

Objective	Project Activity (reference to ESMP, REMLRP)	Mitigation/Enhancement/ Environmental and Social Management Plan (ESMP), Restoration and Ethnic Minority Livelihood Restoration Plan (REMLRP)	Standards	Institutional Responsibility	Time-line	Monitoring	Implementation Route/Plan
Slope stability in construction area	Rehabilitation and revegetation	Implementation of slope reinforcement and erosion risk measures & regular monitoring of erodible areas • Minimize land clearance, proper disposal of mucks, slope protection methods such as retaining walls, slope stabilization and erosion control works. • Bioengineering works in soil erosion prone area • Avoidance of clearing vegetation along the high erosion prone areas • Modification of slope geometry • Well designed drainage system • Retaining structures	GOV GOL	Contractor	C, O	Project SEMD	Contractor's program
Minimize sediment load to reservoir	Management of reservoir immediate catchment	Plan and implement the **Reservoir Catchment Management Plan (RCMP)** and establish Safeguard Buffer Zone (SBZ). Inventory of high erosion prone area and critical areas in reservoir catchment will be made during design phase and RCMP will be developed and implemented • Implementation of high risk erosion measures • Bioengineering works to control erodible area • Control of faulty road construction in catchment and activities triggering high erosion • Maintain slope stability through using new and efficient slope engineering techniques • Install upstream sediment check structures, protect dam outlets	GOV GOL	Project	C, O	SEMD	Project though contractor for physical work; collaboration with state agency and community

Objective	Project Activity (reference to ESMP, REMLRP)	Mitigation/Enhancement/ Environmental and Social Management Plan (ESMP), Restoration and Ethnic Minority Livelihood Restoration Plan (REMLRP)	Standards	Institutional Responsibility	Time-line	Monitoring	Implementation Route/Plan
		• Forest plantation in degraded forest area and in vulnerable areas (See details in Biological Environment)					
Muck and spoil management		• Avoid dumping mucks and spoils in river • Manage the spoil tip area	GOV GOL, MIGA	Contractor	C	SEMD-Monitoring	Contractor's program
Management of air pollution	Construction works	Prepare and implement **Environmental Health and Safety Plan (EHSP)** The following dust control mechanisms and construction good practices will be adopted: • The aggregate crushing plants, batching plants and concrete mixing plants will be located far from the camp areas and provided with smoke/exhaust stacks. • Scrubbers will be installed in vehicles and other machines emitting air pollutants. Heavy vehicles, generators etc. should have controlled smoke/exhaust stacks • Periodic maintenance of vehicles and other machinery and monitoring of engine emissions to comply with GOV and MIGA criteria • Reduce dust pollution and minimize dispersion of pollutants through frequently spraying of road surfaces with water during dry days in vulnerable areas • The borrow vehicles will be covered during the transportation of dusty materials in the construction sites. • Monitor air quality monthly at construction sites	MIGA GOV GOL	Contractor	C	SEMD-Monitoring	Contractor's program

Objective	Project Activity (reference to ESMP, REMLRP)	Mitigation/Enhancement/ Environmental and Social Management Plan (ESMP), Restoration and Ethnic Minority Livelihood Restoration Plan (REMLRP)	Standards	Institutional Responsibility	Time-line	Monitoring	Implementation Route/Plan
		(a) Health and sanitation program to prevent and cure respiratory infection and other air-borne diseases. Avoid workforce camps in the air pollution prone area (b) Provision of masks to workforce working in air pollution prone area					
Management of water pollution	Construction works	a) Prepare and implement Waste Management component including storage and construction waste of EHSP; this should include use and management of toxic and hazardous materials. b) Prepare and implement **Community Health and Sanitation Plan** which should include toilet facilities in camps and construction sites, waste management etc. including, • Workshop facilities will be located at least 100m away from the water sources. Spilled oil and grease trapping systems will be built in the workshop. • Proper management and regular monitoring of storage sites and scrap-yard sites. Control of spillage of oils, chemicals and other substance. • Carry out the first tunnel flushing during high flow conditions or adopt appropriate measures to dilute polluted tunnel water for protection of downstream aquatic life. • Provision of sanitation and medical support; awareness program as preventive measures; free treatment of water borne diseases to workforce; compensation for the loss of life	MIGA GOV GOL	Contractor	C	SEMD-Monitoring	Contractor's program

Objective	Project Activity (reference to ESMP, REMLRP)	Mitigation/Enhancement/ Environmental and Social Management Plan (ESMP), Restoration and Ethnic Minority Livelihood Restoration Plan (REMLRP)	Standards	Institutional Responsibility	Time-line	Monitoring	Implementation Route/Plan
		Regular monitoring of water quality in river (See Biology Environment – Fishery)					
Management of noise pollution	Construction works	a) Control of blast related noise and vibration • Avoid blasting operation during nights, and control blasting using controlled limited detonators in small lot. • Provision of protective gears such as ear mufflers or plugs to the laborers and other workforce working in vulnerable sites b) Control of noise producing vehicles and equipment • Minimize use of pressure horns. Pressure horns in the vehicles will be prohibited. • The noise generating machineries and equipment such as generators, crushers, concrete mixers will be placed far from the residential areas • Periodic maintenance of heavy machinery and generators • Monitor noise intensity level regularly in the major construction sites	MIGA GOV GOL	Contractor	C	SEMD-Monitoring	Contractor's program
Adverse Impacts: Biological Environment							
Minimize loss of forest vegetation in construction site	Forest Inventory in construction site	• Mechanisms to control damages to standing trees and ground vegetation will be adopted • Avoid cutting saplings and poles for making pegs, • Marking of the trees by enamel or chalk rather than chopping the outer bark of the trees particularly in temporarily acquired forest areas	GOV GOL MIGA	Proponent	PC	Project	Project with commune & district agency

Objective	Project Activity (reference to ESMP, REMLRP)	Mitigation/Enhancement/ Environmental and Social Management Plan (ESMP), Restoration and Ethnic Minority Livelihood Restoration Plan (REMLRP)	Standards	Institutional Responsibility	Time-line	Monitoring	Implementation Route/Plan
	Construction in powerhouse and auxiliary area	• Clear felling shall be discouraged in project structure and activity areas of temporary nature. Permanently acquired forest areas for building housing and office complexes should not be clear felled; trees and shrubs will be planted in such facility sites • Good phenotypic trees and matured trees will be retained for future seeding and regenerating purpose • Re-consideration of temporary project structures in good forest area	GOV GOL	Contractor	C	Project ESMP	Contractor-site preparation
Proper utilization of felled trees	Clear felling of vegetation in Inundation area	A proper management of felled trees is recommended which includes: • Contractor will clear fell the inundation area 962ha (20,400mt biomass); timber logs will be segregated and piled up in one place. Similarly, fuel wood will be stacked separately • All the felled trees and other forest vegetation will be handed over to the concerned commune • Project will pay approximately US$20 (see GoV/GOL) for each ha as compensatory management cost to the concerned commune. Commune will use this money as well as sale of timber and firewood for forest protection in SBZ • The workforce will require about 450mt fuelwood/year; fuelwood demand of workforce could be met. • Project will consider support for the establishment of Fuelwood Supply Depot	GOV/GOL	Contractor	C	Project ESMP	Contractor-site preparation

Objective	Project Activity (reference to ESMP, REMLRP)	Mitigation/Enhancement/ Environmental and Social Management Plan (ESMP), Restoration and Ethnic Minority Livelihood Restoration Plan (REMLRP)	Standards	Institutional Responsibility	Time-line	Monitoring	Implementation Route/Plan
		managed by commune for the sale of firewood and timber from the felled trees.					
Restoration of vulnerable plant species	Construction in powerhouse and auxiliary area, Inundation area	Seedlings of vulnerable species *Drynaria fortune* & *Hopea mollissima* and other species of high ecological value if found in inundation and construction site shall be transplanted in SBZ. Pole to matured plants would be left growing in construction site. See **Endangered Species Restoration Plan**.	MIGA GOV GOL	Contractor	PC C	Project ESMP	Contractor-site preparation
Forest biodiversity conservation & environmental services restoration	Plantation and management in Reservoir catchment area RCA) including SBZ	Prepare the **Forest Management Plan** based on **BEESRP**. Compensatory plantation in SBZ, and in degraded reservoir catchment area (RCA). Plantation areas will be identified by concerned agency in district/commune. It could be made mandatory to plant at least 10 saplings for each tree felled. (This is to be agreed between the Proponent and GOL/GOV)Approximately 205,000 trees will be felled. The following activities will be implemented: • Almost 2.1 million tree seedlings will be planted in RCA and SBZ. This is equivalent to 1,050 ha area, if planting numbers are estimated at 2000 /ha. • Production of required number of saplings (20% more than to be planted) in the RCA. • Nurseries will be established in Safeguard buffer area. Village committee will be encouraged to establish nursery and produce saplings	MIGA GOV GOL	Contractor	C	Project ESMP	Contractor-site preparation

Objective	Project Activity (reference to ESMP, REMLRP)	Mitigation/Enhancement/ Environmental and Social Management Plan (ESMP), Restoration and Ethnic Minority Livelihood Restoration Plan (REMLRP)	Standards	Institutional Responsibility	Time-line	Monitoring	Implementation Route/Plan
		• Initially, for the first two years, project will support establishing nurseries in all DIA villages & commune centers. • Provision of logistic and technical support to Nursery; training will be provided to nursery men. • Replacement planting and management of planted areas up to 4 years from the plantation date • Project will sign Memorandum of Understanding (MOU) in line with the Government rules and regulations with district and province Forest Office and district/commune will implement the plantation program. • Species with larger ethno-botanical values will be grown & planted. The sapling species to be planted in the project area will represent the species of the trees felled					
Reduce pressure on forest resources & enhance biodiversity quality	Distribution of smokeless oven	Implementation of energy efficiency measures which could reduce pressure on forest resource such as: • Distribution of improved smokeless oven to households in DIA villages.	MIGA	Project	C	ESMP	Project's program with community
	Timber and fuelwood management in construction site	The contractors will bring required timber from the timber depots outside the project area. Contractor may establish fuelwood depot in site.	GOV GOL	Contractor	C	ESMP	Contractor's program
Minimizing disturbances to wildlife habitat	Construction work, traffic	• Develop and implement 'Wildlife and Fisheries Management Guidelines' in the project area. This would include working	MIGA GOV GOL	Contractor	C	ESMP	Contractor's program

Objective	Project Activity (reference to ESMP, REMLRP)	Mitigation/Enhancement/ Environmental and Social Management Plan (ESMP), Restoration and Ethnic Minority Livelihood Restoration Plan (REMLRP)	Standards	Institutional Responsibility	Time-line	Monitoring	Implementation Route/Plan
		procedure during wildlife movement, control of poaching activity etc. • Avoid blasting, heavy vehicular movement and excessive noise generating activities during the period of wildlife movement. • Awareness to local contractors, supervisors and labor force					
Protection of vulnerable wildlife species	Awareness and anti-poaching in construction area	**ACBP**. Project will brief contractors, and the later to brief workers regarding GOV / GOL laws and regulations and project requirements (MIGA) for protecting wildlife resources. Project will penalize workforce for their non-compliance • Posters, pamphlets, sign boards & hoarding boards in project area as awareness materials.	MIGA GOL GON	Project and contractor	C	ESMP	Contractor's program
Minimizing disturbance to fish habitat at dam site and downstream	Passage to fish movement during dam construction	Maintain river channel at dam site and further down during upward and downward movement of fish	MIGA GOL GOV	Contractor	C	ESMP	Contractor's program
Minimizing habitat disturbances to fish & other aquatic life	Reducing pollution level at dam site and downstream area	Contractor should prepare waste management plans and get approval from Project and implement it. Contractor should: • Maintain proper storage for used petrochemical and other toxic material • The water from the tunnel excavations should pass a sedimentation pond prior to be discharged into the river	MIGA GOL GOV	Contractor	C	ESMP	Contractor's program

Objective	Project Activity (reference to ESMP, REMLRP)	Mitigation/Enhancement/ Environmental and Social Management Plan (ESMP), Restoration and Ethnic Minority Livelihood Restoration Plan (REMLRP)	Standards	Institutional Responsibility	Time-line	Monitoring	Implementation Route/Plan
		• Monitor sedimentation pond taking water quality samples both in the dam and downstream the dam in the river. • Runoff water from blasted tunnel material should be controlled with respect to the content of nitrogen and particularly ammonia and pH.					
Control illegal & over fishing	Awareness and enforcement of regulatory conditions	• Control Illegal fishing and overexploitation upstream and downstream of dam construction site • Use posters and signboards/ hoarding boards for controlling excessive and illegal fishing.	MIGA	Contractor Project	C	ESMP	Contractor's program
4. Adverse impacts on Social Environment							
Management of sanitation	Health and sanitation	**Community Health and Sanitation Plan (CHSP)** A health and sanitation program will be developed with the aim of improving health status of communities in the project area. Project will provide all households in the relocation villages with a toilet; support for construction of the toilets with septic systems and flushing mechanisms in other affected villages in the DIA. Project will launch health and sanitation awareness program as a component of 'Awareness Building Plan' in all DIA villages, focusing on water use and treatment practices, pollution of water sources, personal hygiene	MIGA	Project	PC C	ESMP	Project through contractor

Objective	Project Activity (reference to ESMP, REMLRP)	Mitigation/Enhancement/ Environmental and Social Management Plan (ESMP), Restoration and Ethnic Minority Livelihood Restoration Plan (REMLRP)	Standards	Institutional Responsibility	Time-line	Monitoring	Implementation Route/Plan
		and households as well as community sanitation.					
Provision of drinking water supply	Health and sanitation	Household water supply will be provided in all the relocated villages with the same type of system as in the existing villages, and with a proper filtering system to allow safer drinking water. Project will also support villages losing land in the DIA to develop drinking water systems. Such support will be in form of remediating and augmenting existing drinking water systems. Project will support drinking water quality analysis in villages.	MIGA	Project	C	ESMP	Project through contractor
Managing waste in villages	Health and sanitation	**Community waste management** Project will support developing simple waste management systems in relocated villages based on the local culture and designed together with the villagers. It will include construction of an open but fenced area for waste disposal outside the village, composting development for organic waste, and organization of community rubbish collection team.	MIGA GOV GOL	Project	C	ESMP	Project through contractor
Reduce pressure on forest resources	Forest conservation	Project will provide support for Improved Cooking Stoves (ICS) in the relocated households that should be included in the house kitchen design	MIGA	Project	C	ESMP	Project through contractor
Availability of emergency medical assistance	Construction, traffic	Project will establish an Emergency Medical Response Unit (EMRU) at the construction site with a medical doctor and trained staff with sufficient medicines for first aid and emergency	MIGA GOL, GOV	Contractor	C	ESMP	Contractor’s program

Objective	**Project Activity** (reference to ESMP, REMLRP)	**Mitigation/Enhancement/** Environmental and Social Management Plan (ESMP), Restoration and Ethnic Minority Livelihood Restoration Plan (REMLRP)	Standards	Institutional Responsibility	Time-line	Monitoring	Implementation Route/Plan
		assistance. See **EHSP** and **Emergency Preparedness and Response Plan**.					
Labor management	Equal opportunity for employment	Plan and implement **Community Employment and Labor Plan** which will include (i) work opportunities to local people on the basis of capability in construction works on priority basis, emphasis on women on job, (ii) equal wages to men and women on similar work, (iii) separate toilet facility for men and women, (iv) drinking water and health facilities, and (v) general awareness about sexual harassment.	MIGA GOL, GOV	Project / contractor	C	ESMP	Project - contractor
STD management	Health improvement	Plan and implement construction workers HIV/AIDS awareness program to reduce the risk of the transfer of the HIV and other STDs between and among the construction personnel and the local communities. See **Influx Management Plan**.	MIGA GOL GOV	Project / contractor	c	ESMP	Project - contractor
Awareness of potential risk and social problems among local people	Community-based Public Awareness Program (Influx management plan)	Plan and implement Community-based Public Awareness Program in Project DIA communities about HIV/AIDS and other STDs and human trafficking prevention to reduce the risk among vulnerable local communities, especially among young women and men, girls and boys.	MIGA GOL GOV	Project / contractor	c	ESMP	Project - contractor

Objective	Project Activity (reference to ESMP, REMLRP)	Mitigation/Enhancement/ Environmental and Social Management Plan (ESMP), Restoration and Ethnic Minority Livelihood Restoration Plan (REMLRP)	Standards	Institutional Responsibility	Time-line	Monitoring	Implementation Route/Plan
Management of displaced families	Relocation and rehabilitation	The Proponent is responsible for preparing and implementing a Resettlement Action Plan (RAP) for each of the villages that have to be relocated due to the HPP, based on the **Resettlement Policy Framework** and the entitlement matrix for lost land and assets, provided in the **REMLRP**.	MIGA GOL GOV	Project	C	Project	Project and state agency at district and commune
Improvement in upland farming system and increase in crop production for enhancing livelihoods	Implementation of upland farming plan	Prepare and implement **Upland Farming Diversification Plan, Soil Fertility Enhancement Plan, Animal Husbandry and Veterinary Services Plan and Fisheries Support Plan** as components of the **REMLRP** in the Social Program. **Crop diversification and multiple cropping sub-plan** will compensate the production losses, enhance productivity, diversify production • Capacity building of local community on growing multiple crops, and management of upland farms • Provide seeds, rootstocks, and some fertilizer to participating farmers	MIGA GOL, GOV	Project	C	Project	Project and state agency at district and commune
Improvement in upland farming system and increase in crop	Implementation of upland farming plan	Prepare and implement **fruit and vegetable production sub-plan** on upland farmlands, and at homesteads in all DIA villages. It will compensate for crop production losses, enhance productivity, and provide nutrition to families and some cash from sale	MIGA GOL, GOV	Project	PC C	Project	Project and state agency at district and commune

Objective	Project Activity (reference to ESMP, REMLRP)	Mitigation/Enhancement/ Environmental and Social Management Plan (ESMP), Restoration and Ethnic Minority Livelihood Restoration Plan (REMLRP)	Standards	Institutional Responsibility	Time-line	Monitoring	Implementation Route/Plan
production for enhancing livelihoods		• Capacity building of local community on growing vegetables and fruits, and cultivation technique • Provide seeds, rootstocks, and fertilizer to participating farmers • Install drip irrigation or sprinkle irrigation on riverbank cultivation.					
Livelihoods improvement of local community	Implementation of upland farming plan	Prepare and implement **Bee keeping** in all DIA villages, based on available land and interest. It will enhance livelihoods of local community • Capacity building of local community on rearing bees, and beehive management of upland farms • Provide beehives, bees and necessary gear to participating farmers	MIGA GOL, GOV	Project	PC C	Project	Project and state agency at district and commune
Improvement in Soil productivity for increased crop production	Implementation of Soil Fertility Enhancement Plan	Prepare and implement the **soil fertility enhancement plan**. Upland soils are degraded and poor in quality. Its components are: (i) growing leguminous crops on upland usually intercropped with maize/cassava, and (ii) Compost making and mulching. • Implement this plan on pilot project basis as these are new concepts in ethnic minority. • Awareness raising and capacity building will make local farmers to adopt this technique. • Form groups each with 5 households, and practically train them in compost making	MIGA GOV, GOL	Project	PC C	Project	Project and state agency at district and commune

Objective	Project Activity (reference to ESMP, REMLRP)	Mitigation/Enhancement/ Environmental and Social Management Plan (ESMP), Restoration and Ethnic Minority Livelihood Restoration Plan (REMLRP)	Standards	Institutional Responsibility	Time-line	Monitoring	Implementation Route/Plan
		• Encourage households to make compost pit in home garden and use all biodegradable residues as compost material.					
Improvement in animal husbandry practices for household nutrition and cash income	Implementation of Animal Husbandry and Veterinary Services Plan	Prepare and implement animal husbandry in all DIA villages: **Animal husbandry and Veterinary Services Plan**. All kind of livestock is free-ranged and productivity is very low. Emphasis has been given on improving husbandry practices and use of improved breeds of small number of animals: 1) Project will financially support construction of pig sty for 5-6 pigs and a small poultry barn for 15-20 poultry birds to households in DIA villages, which express interest and have the basic requirements. 2) Farmers would be encouraged to rear hybrid pigs in pigsties (pigpens) and be able to provide appropriate feed for the growth of these hybrid species. Thus managing resources for this would be necessary for the farmers. 3) It is suggested to manage poultry at semi-free ranged systems. Few of the households will be persuaded to rear improved poultry. 4) Awareness and capacity building would increase adoption of this program.	MIGA GOV, GOL	Project	PC C	Project	Project and state agency at district and commune

Objective	Project Activity (reference to ESMP, REMLRP)	Mitigation/Enhancement/ Environmental and Social Management Plan (ESMP), Restoration and Ethnic Minority Livelihood Restoration Plan (REMLRP)	Standards	Institutional Responsibility	Time-line	Monitoring	Implementation Route/Plan
		5) As the households will be relocated, the Project will initially supply at least 2-3 pigs and 5-6 chicks to each household as well as some feed as part of the compensatory program.					
		Project will prepare and implement a comprehensive **Extension and Veterinary Services program**. Capacity, technical and support and knowhow is poor in the districts of the DIA. 1. Support to extension service center at commune and district level both in terms of manpower and technology including medicines and vaccines to cater the needs of the DIA villages 2. Awareness on livestock sanitation and health through pamphlets and other means 3. Training of at least 1 person from each DIA household on animal hygiene and primary treatment, 4. Provide basic tools needed for improved husbandry and treatment to all households involved, shared among households. 5. Basic animal health services, treatments and vaccines, to be provided at no cost, at least until households have established income generating activities (monitoring). 6. Prevention and control of diseases	MIGA GOL GOV	Project	PC C	Project	Project and state agency at district and commune

Objective	Project Activity (reference to ESMP, REMLRP)	Mitigation/Enhancement/ Environmental and Social Management Plan (ESMP), Restoration and Ethnic Minority Livelihood Restoration Plan (REMLRP)	Standards	Institutional Responsibility	Time-line	Monitoring	Implementation Route/Plan
		7. Regular visits and extension services of commune animal health staff to DIA villages					
Operation Phase							
Enhancement /Beneficial Impacts: social, biological and physical							
Livelihoods enhancement of DIA community	Implementing livelihoods plans	Project will implement various livelihoods improvement plans, e.g., upland farming improvement, livestock and health program, bee-keeping	MIGA GOV GOL	Project	C O	Project	Project's program
Increased environmental resources for the use of local community	Improving forests, better riverine wildlife habitat implementing RCMP and BEESRP	Various catchment protection (RCMP), revegetation and biodiversity conservation management plans implemented in DIA villages	MIGA GOV GOL	Project	C O	Project	Project's program
Transformation in upland farming	Implementing the REMLRP	Project will implement soil restoration on upland farmland, crop diversification and other related plans in the REMLRP	MIGA GOV GOL	Project	C O	Project	Project's program
Greening of the Safeguard Buffer Zone	Implementing the RCMP	Project will plant trees and other vegetation in the SBZ to maximize a green belt around the reservoir	MIGA GOV GOL	Project	C, O	Project	Project's program
Adverse Impacts: Physical Environment							
Sediment collection and management in the reservoir	Removal of sediment	Remove sediments annually with flushing through bottom gates which are as close as possible to the river bed level to prevent build-up of sediments. A flushing model will be reviewed during design phase.	GOV GOL	Project	O	Project -	Project's program

Objective	Project Activity (reference to ESMP, REMLRP)	Mitigation/Enhancement/ Environmental and Social Management Plan (ESMP), Restoration and Ethnic Minority Livelihood Restoration Plan (REMLRP)	Standards	Institutional Responsibility	Time-line	Monitoring	Implementation Route/Plan
		• Develop appropriate flushing schedule – flushing should be done in rainy season (See Biology Environment –Fishery). • Install siren system in the low flow area					
Management of water level fluctuation in reservoir	Reservoir shore	Preventive and corrective measures such as check dams, vegetation plantation and bioengineering works will be carried out to control erosion and landslides in the reservoir shore area. • Regular monitoring of reservoir shores	GOV GOL	Project	O	ESMU	Project's program
Adverse Impacts: Biological Environment							
Forest biodiversity conservation & environmental services restoration	Plantation and management in Reservoir catchment area RCA) including SBZ	Continuation of mitigation and enhancement program as mentioned during Construction Phase	MIGA GOV GOL	Project	O	ESMU	Project's program
Minimizing stress on aquatic life habitat in reservoir and downstream area	Flushing sediments from reservoir	• All flushing should be done during the onset of the wet season to ensure water availability for aquatic life in reservoir & to minimize stress on aquatic life habitat in downstream area due to high sediment load. • Project must increase awareness among affected communities of flushing periods. There needs to be an agreement with cage fish farmers about flushing mechanisms and their impacts.	GOV GOL	Project	O	ESMU	Project's program

Objective	Project Activity (reference to ESMP, REMLRP)	Mitigation/Enhancement/ Environmental and Social Management Plan (ESMP), Restoration and Ethnic Minority Livelihood Restoration Plan (REMLRP)	Standards	Institutional Responsibility	Time-line	Monitoring	Implementation Route/Plan
Maintain aquatic life habitat in the immediate downstream area	Release of environmental flow	• Compensatory release of environmental flow from the dam is recommended to be at least 10% of the monthly average water flow in the low flow season to maintain riverine ecosystems (water flow regime will be worked out during design phase). Lining riverbed on the immediate downstream stretch will be considered. • Monitor water availability bimonthly in the low flow period and adjust release of environment flow accordingly. • Monitor aquatic habitat at the immediate downstream annually • Adaptation of the required flow based on data from downstream users and fish studies. • Note that the exact release level may be set once the final operation is decided.	MIGA GOV GOL	Project	O	ESMU	Project's program
Minimize stress of peaking operation on riverine ecosystems in immediate downstream area	Peaking operation	• Peaking operation mechanism and its duration should be worked out in design phase. • Monitor spawning and feeding area, growth of planktons, fish species /population, stranded fish species in immediate downstream area. • Make the local people aware of the peaking releases downstream of the powerhouse for safety purposes.	MIGA GOV, GOL	Project	O	ESMU	Project's program

Objective	Project Activity (reference to ESMP, REMLRP)	Mitigation/Enhancement/ Environmental and Social Management Plan (ESMP), Restoration and Ethnic Minority Livelihood Restoration Plan (REMLRP)	Standards	Institutional Responsibility	Time-line	Monitoring	Implementation Route/Plan
		• Install siren warning systems and signboard warnings all along the riverbanks at critical areas about the peaking releases.					
Facilitating movement of migratory fish species	Picking fingerlings at the immediate downstream area	• Since movement of migratory species already blocked by Ban Ve HPP dam 80 km downstream area, a bypass *fish ladder* is not a viable option, due to the height of the dam. Fish data indicates that there are populations in the long stretch upstream from Ban Ve HPP dam. • Picking up fingerlings of migratory species at the downstream base of dam and manually transferring to upstream area of the dam may be an option to assure survival of mid- to long-range migratory species, which will be monitored in the fish adaptation study.	MIGA GOV GOL	Project	O	ESMU	Project's program
Adverse Impacts: Social Environment and Livelihoods							

Objective	Project Activity (reference to ESMP, REMLRP)	Mitigation/Enhancement/ Environmental and Social Management Plan (ESMP), Restoration and Ethnic Minority Livelihood Restoration Plan (REMLRP)	Standards	Institutional Responsibility	Time-line	Monitoring	Implementation Route/Plan
Improvement in fish resources, livelihoods enhancement	Implementation of Fisheries Support Plan due to loss of river resources	Project will plan **Cage Fish Farming** in reservoir during the design phase and implement it during operation period. Review experiences in other hydropower reservoirs. • An approach may be: form 20 fishermen groups with 5 households each. Each group having 5 fish cages to rear fish • Provide training, technical support, fish cages and fingerlings • Preference should be given to the use of native species of fish	GOV GOL MIGA	Project in collaboration with district/commune agency	O	ESMU	Project's program
Livelihoods enhancement	Implementation of the REMLRP due to loss of river resources	Plan and implement "**Community Fish farming**" with the following components: • Form 15 community pond groups each having 5 households, provide them training and support on pond fish farming. • 15 community ponds, 10 in reservoir area and 2 in downstream area in the first 5 years. Total grant fund to local community • Each pond of up to 625 m^2 size with capacity to culture 1,000 fingerlings, assuming production of 625 kg of fishes annually. • Provide fingerlings and fish pellets in the first 2 years. Use fast growing fish species like carp	GOV GOL MIGA	Project in collaboration with district/commune agency	O	ESMU	Project's program

CHAPTER 14: MONITORING MATRIX

14.1 Monitoring approach and program

The Project shall ensure compliance of the implementation of the environmental and social programs and mitigation measures, and shall assess the actual effects of these measures as well as the emerging impacts during project construction and operation phases on environment. The Social and Environment Management Division (SEMD) will develop detailed monitoring for each plan formulated, and will require that construction contractors adhere to the regime set-up and the recommended international standards.

Monitoring aspects of physical, biological and social environments, monitoring actions, location of monitoring, frequency, indicators and monitoring schedule are given in Table 14.1. Physical aspects to be monitored include air, water and noise quality, geological hazards e.g. erosion, river cutting, and hydrological features, e.g., water flow and sediment load. The biological aspects include forest vegetation, wildlife, aquatic life and fish, and their biodiversity and species vulnerability status. Farming and livestock, resettlement of displaced households and restoration of livelihoods are the major social aspects. Implementation progress of various programs, plans and actions are to be monitored.

14.3 Monitoring responsibility and compliance

The ESMP Unit of the SEMD of the Proponent would be responsible for most environmental compliance and monitoring. The construction contractors shall also be responsible for compliance and environmental monitoring during construction works (e.g. monitoring of slope stabilisation and erosion control in dam, construction sites and reservoir). The construction contractor will send monitoring reports to ESMP Unit at agreed frequency, the latter will prepare monthly, quarterly and annual monitoring reports (as agreed) and submit to Social and Environmental Management Division.

Table 14.2 Monitoring matrix for My Ly HPP

Monitoring Aspect	Monitoring action and indicator	Location	Frequency	Monitoring criteria/indicators	Monitoring schedule PC, C, O	Responsible agency	Compliance (GoV, GoL, MIGA)
Physical							
Water quality	Water sampling	Reservoir, downstream of dam	Monthly, quarterly or biannually based on project activity during development. Ad hoc checks as well.	Water quality parameters (e.g., physical and biological)	Pre-construction (PC) Construction (C) Construction (C) Operation (O)	Proponent (ESMU) Contractor	GoV, GoL, MIGA)
Air quality	Air sampling	Major construction sites	Monthly, quarterly or biannually based on project activity during development. Ad hoc checks as well.	TSP, PM_{10}, SO2, NOx, CO	PC, C, O	Proponent (ESMU) Contractor	GoV, GoL, MIGA)
Noise quality	Air sampling	Major construction sites	Monthly, quarterly or biannually based on project activity during development.	Noise level	PC, C, O	Proponent (ESMU) Contractor	GoV, GoL, MIGA)
Geological hazards	Observation	Construction site, reservoir shore, buffer zone, reservoir catchment area, immediate downstream area	Bi-annually, annually	Number of gully erosion, slides, river cutting	PC, C, O	Proponent (ESMU) Contractor	GoV, GoL, MIGA)

Monitoring Aspect	**Monitoring action and indicator**	**Location**	**Frequency**	**Monitoring criteria/indicators**	**Monitoring schedule** PC, C, O	**Responsible agency**	**Compliance** (GoV, GoL, MIGA)
Hydrology	Measurement	Reservoir, downstream of dam	Monthly, quarterly or biannually based on project activity during development.	River discharge Sediment load	PC, C,O	Proponent (ESMU) Contractor	GoV, GoL, MIGA)
Effluent discharge	Measurements	Construction camps	Quarterly	pH, Arsenic, BOD, COD, Faecal, E-Coli	PC, C,O	Proponent (ESMU) Contractor	GoV, GoL, MIGA)
Waste management	Observation	Permanent and auxiliary sites	Monthly, quarterly or biannually based on project activity during development.	Assessment of construction waste, solid waste and sanitary waste	PC, C,O	Proponent (ESMU) Contractor	GoV, GoL, MIGA)
Environmental Health and Safety Plan (EHSP)	Observation, interviews	Construction sites	Quarterly	Assessment of plan	C, O	Proponent (ESMU) Contractor	MIGA
Reservoir Catchment Management Plan	Observation, interviews	Reservoir catchment area (RCA)	Quarterly	Assessment of plan	C, O	Proponent (ESMU) Contractor	MIGA
Road and Transport Management Plan	Observation, interviews	Construction sites and	Quarterly	Assessment of plan	C, O	Proponent (ESMU) Contractor	MIGA
Waste Management Plan	Observation, interviews	Construction area	Quarterly	Assessment of plan	C, O	Proponent (ESMU) Contractor	MIGA
Emergency Preparedness and Response Plan	Observation, interviews	Construction area	Quarterly	Assessment of plan	C, O	Proponent (ESMU) Contractor	MIGA
High erosion risk management	Observation, interviews	Construction area	Quarterly	Assessment of plan	C, O	Proponent (ESMU) Contractor	MIGA

Monitoring Aspect	Monitoring action and indicator	Location	Frequency	Monitoring criteria/indicators	Monitoring schedule PC, C, O	Responsible agency	Compliance (GoV, GoL, MIGA)
Safeguard Buffer Zone	Observation, interviews	RCA	Quarterly	Assessment of plan	C, O	Proponent (ESMU)	MIGA
Biological							
Forest vegetation	Observation and measurement	Permanent construction site, auxiliary area, inundation area, SBZ	Quarterly, annually	Tree/shrub/herb species, tree/pole/sapling/seedling counts, biomass, ethno-botanical status, forest ecosystem services, biodiversity status	PC, C,O	Proponent (ESMU) Contractor	GoV, GoL, MIGA)
Wildlife	Observation	Construction area, SBZ, the whole reservoir catchment area	Quarterly, annually	Habitat, species distribution, abundance, biodiversity status (only of conservation species), ecosystem services	PC, C,O	Proponent (ESMU) Contractor	GoV, GoL, MIGA)
Fish	Fish catch, Focus Group Discussion	Reservoir, downstream area	Quarterly, bi-annually	Habitat, species distribution, abundance, biodiversity status	PC, C,O	Proponent (ESMU) Contractor	GoV, GoL, MIGA)
Aquatic life	Measurements	Reservoir, downstream area	Quarterly, bi-annually	Phytoplankton, zooplankton, zoo - benthos	PC, C,O	Proponent (ESMU) Contractor	GoV, GoL, MIGA)

Monitoring Aspect	Monitoring action and indicator	Location	Frequency	Monitoring criteria/indicators	Monitoring schedule PC, C, O	Responsible agency	Compliance (GoV, GoL, MIGA)
Environment services from forests and river/ stream	Interview at household level	Forests, river/reservoir, streams	Quarterly and adapted as needed	Vegetation: kind, season, quantity Wildlife: kind, season, quantity	PC, O	Proponent	Information for Project
Biodiversity Enhancement and Environment Services Restoration Plan	Observation, interviews	Reservoir catchment area (RCA), SBZ	Quarterly and adapted as needed	Assessment of plan	C, O	Proponent (ESMU)	MIGA
Endangered species Restoration Plan	Observation, interviews	RCA, construction sites	Quarterly and adapted as needed	Assessment of plan	C, O	Proponent (ESMU)	MIGA
Fisheries Support Plan	Observation, interviews	Reservoir and DIA villages	Quarterly and adapted as needed	Assessment of plan	C, O	Proponent (ESMU)	MIGA
Social							
Agriculture	Measurements /interview at household level	DIA villages	Quarterly and adapted as needed	Land: land cover under various crops, single crop, multiple crop Crops: types, area, production Disease/pest: Use: Home consumption, feed to livestock, sale	PC, O	Proponent	Information for Project
Livestock	Counts at household level	DIA villages	Quarterly and adapted as needed	Livestock kind and their numbers: Cattle, buffaloes, goats, pigs, poultry	PC, O	Proponent	Information for Project

Monitoring Aspect	Monitoring action and indicator	Location	Frequency	Monitoring criteria/indicators	Monitoring schedule PC, C, O	Responsible agency	Compliance (GoV, GoL, MIGA)
				Diseases: Mortality: number in one year Use No.: home consumption, sale			
Demography	Count at household level	DIA villages	Quarterly and adapted as needed	Adult: male/female Children: male/female	PC, O	Proponent	Information for Project
Upland farming Diversification Plan	Observation, interviews	RCA	Quarterly and adapted as needed	Assessment of plan	C, O	Proponent (ESMU)	MIGA
Soil Fertility Enhancement Plan	Observation, interviews	RCA	Quarterly and adapted as needed	Assessment of plan	C, O	Proponent (ESMU)	MIGA
Animal Husbandry and Veterinary services Plan	Observation, interviews	RCA	Quarterly and adapted as needed	Assessment of plan	C, O	Proponent (ESMU)	MIGA
Resettlement and compensation	Assessment of RAP implementatio n progress	Inundation area and project structure and activity areas	Internal: monthly & quarterly Independent: bi-annual	Relocation and compensation based on the entitlement matrix;	PC, C, O	Proponent (SEMD: RLRU) Independent third-party monitoring agency	MIGA, GoV, GoL
Community health and sanitation plan	Assessment of the implementatio n progress of the programs of the CHSP	Resettlement villages and DIA	Internal: monthly & quarterly, Independent: bi-annual	Number of activities and beneficiaries according to a detailed plan to be prepared by Proponent	PC,C	Proponent (SEMD: ESMP) Independent third-party monitoring agency	MIGA, GoV, GoL
Community labor and employment plan	Employment of local labor in	Project construction area	Internal: monthly & quarterly, Independent: bi-annual	Gender separated data on construction	C	Proponent (SEMD: ESMP) Contractor	GoV, GoL, MIGA

Monitoring Aspect	Monitoring action and indicator	Location	Frequency	Monitoring criteria/indicators	Monitoring schedule PC, C, O	Responsible agency	Compliance (GoV, GoL, MIGA)
	HPP construction			workers and paid wages			
HIV/AIDS, STDs and human trafficking prevention plan	Assessment of the implementation progress of the (i) community program and (ii) construction workers' program	DIA	Internal: quarterly, Independent: bi-annual	Number and locality of program information meetings; number of information materials distributed, area of distribution	PC, C	Proponent (SEMD: ESMP) Contractor	MIGA
FPIC	Assessment of the Free, Prior and Informed Consent process Grievance Redress Process	DIA	Internal: quarterly, Independent: bi-annual	Number and locality of HHs and PAPs consulted, meetings and information disclosure Review the Grievance Redress process. Time taken to address grievances.	PC, C, O	Proponent (SEMD) Independent third-party monitoring agency	MIGA

Note: PC – Pre-construction phase; **C**-Construction phase; **O-**Operation phase
GoV – GoVernment of Vietnam; **GoL** – GoVernment of Lao PDR; **MIGA** – Multilateral Investment Guarantee Agency

CHAPTER 15: REFERENCES

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CHAPTER 16: TEAMS INVOLVED

The ESIA TEAM is composed of specialists covering the core needs for the impact assessment and impact management planning for My Ly HPP. Table 16.1 presents the members of the team involved.

Table 16.1 List of core experts of the international and national consultant teams

Position / Area	Name	Contribution/Role
International Consultant (IC), ENVIRO-DEV		
International Team Leader (TL) ESIA and Safeguards Specialist	Dr. Shivcharn Dhillion	Overall responsible for design-approach and shaping content of ESIA and international compliance. Covered human ecology, mitigation, communication and plans. Liaise with MIGA-GS.
SIA and Socio-economic Development Specialist	Ms. Tiia Riitta Granfelt	Covered social, livelihoods and communication with TL
ESIA-ESMP, Agriculture and Ecology Specialist	Dr. Shree Govind Shah	Covered gap filling on biology-agricultural aspects and E&S management planning
Environment Management Planning Expert	Ms. Leah Bufi	Assisted with environmental aspects of ESIA and ESMP with TL
Assistant to IC Team and Bridging Consultant	Ms. Ngoc Trang Vu	Assisting in report formating, translation, interpretation, communication with NC.
Assistant to IC Team and Bridging Consultant	Ms Mui Phan Thi	Assisting with report formating and document/report web search
Expert Consultations (ad hoc)	Various international	Hydrology, plant operation, technical and aquatic
National Consultant (NC), PECC1: *inhouse and subcontracted specialists*		
NC TL. Environmental Engineering and Sustainable Infrastructure. GoV EIA	Ms. Thi Thu Yen Cao	Overall responsible for providing input for the ESIA and field baseline updates. Interpretation of technical FS
Pedology and Environment, National EIA Expert	Ms. Thi Doan Trang Vu	Key national expert responsible for providing input for the ESIA, field logistics, interpretation of GoV reports
Social Expert	Dr. Thi Thanh Van Khuc	Led the conducting of FGDs, IIK and Reporting (in Vietnamese)
Agriculture and Livelihood Expert	Dr. Duy Phuong Nguyen	Led the conducting of FGDs and IIK related to livelihood and agriculture reporting (in Vietnamese)
Biologist - Flora Expert	Dr. The C. Nguyen	Vegetation field work and reporting
Biologist - Fauna Expert	Dr. Hung Anh Le	Fauna and aquatic reporting
Hydropower- engineer	Mr. Huu Chinh Nguyen	Input during field visits by IC, technical feasibility report clarification
Map creator, GIS Expert	Mr. Anh Tuan Tran	Made maps
Translation /Interpreter	Ms. Ngoc Trang Vu	Conducted translation.
National Consultation Team: *contracted by Proponent under the supervision and guidance of the IC*		
TL for FPIC (Senior)	Ms. Thi Hien Vu	Conducted ICP employing the FPIC process.
FPIC consultant (Senior)	Mr. Van Anh Nguyen	Same as above
FPIC consultant (Senior)	Mr. Quoc Long Truong	Same as above
Assistant to FPIC consultant	Mr. Sy Luan Mai	Same as above
Assistant to FPIC consultant	Ms. Thi Hoai An Nguyen	Same as above
Assistant to FPIC consultant	Mr. Hong Quang Mai	Same as above

CHAPTER 17: CONCLUSION

The My Ly HPP is planned along a stretch of the Ca River at the border of Vietnam and Laos. The technical feasibility of the project has been performed for an installed capacity of 180 MW.

The main anticipated negative impacts of the Project include:

(i) the loss of land and assets of Project Affected People due to land permanently acquired and used by the Project both in Laos and Vietnam;

(ii) resettlement and social change;

(iii) changes related to the loss of production and protection forests, agricultural land and associated wildlife habitat;

(iv) changes related to the change of the river into a reservoir affecting connectivity/transport and fisheries;

(v) loss of forest-river related ecosystem services affecting livelihoods which are dependent on these systems.

The main anticipated positive impacts of the Project include:

(i) Increase in mobility and accessibility to the affected villages and Project area in general due to improved roads and provisions of new roads to the villages. This may trigger positive impacts on livelihoods, in making markets accessible, easier access to health care and other services;

(ii) Restoration of forest-grassland areas so that the vegetated areas improve in quality, such that sediments are reduced, availability of forest products are assured overtime and wildlife habitat is increased. This will ensure that ecosystem services are enhanced, maintained and is sustainable;

(iii) Improvement in agricultural methods and products whereby food insufficiency does not occur;

(iv) Improved energy availability and use, better cooking methods and electricity; and

(v) Increase in well being is expected, provided proposed measures are implemented.

Mitigation and enhancement measures on potential social-cultural, forest, agricultural, biological and physical impacts are proposed to minimize the effects and therefore enhance community well being and forest-agriculture central to livelihoods. Measures include, among others, plans for livelihood restoration, immediate catchment management, ecosystem services enhancement, health and safety measures. The measures proposed in the ESMP will help minimize the ecological footprint of the Project. Safeguard documents include the REMLRP and ESMP guided by the PCDP. An adaptive management process should be adopted to adjust plans according to findings from monitoring, consultations, and audits. A Social and Environment Division (SEMD) of My Ly HPP will administer the ESMP through the establishment of a Social and Environmental Management Unit (SEMU).