# Initial Environmental Examination

Project Number: 33356
Loan Number: 2780-LAO
March 2014

# Lao People's Democratic Republic: Nam Ngum River Basin Development Sector Project

Prepared by the Ministry of Agriculture and Forestry for the Asian Development Bank.

Lao People's Democratic Republic
Peace Independence Democracy Unity Prosperity

# Nam Ngum River Basin Development Sector Project Additional Financing

# INITIAL ENVIRONMENTAL EXAMINATION (UPDATED)

## NAM TING SUB-WATERSHED

**Phoukhoun District**

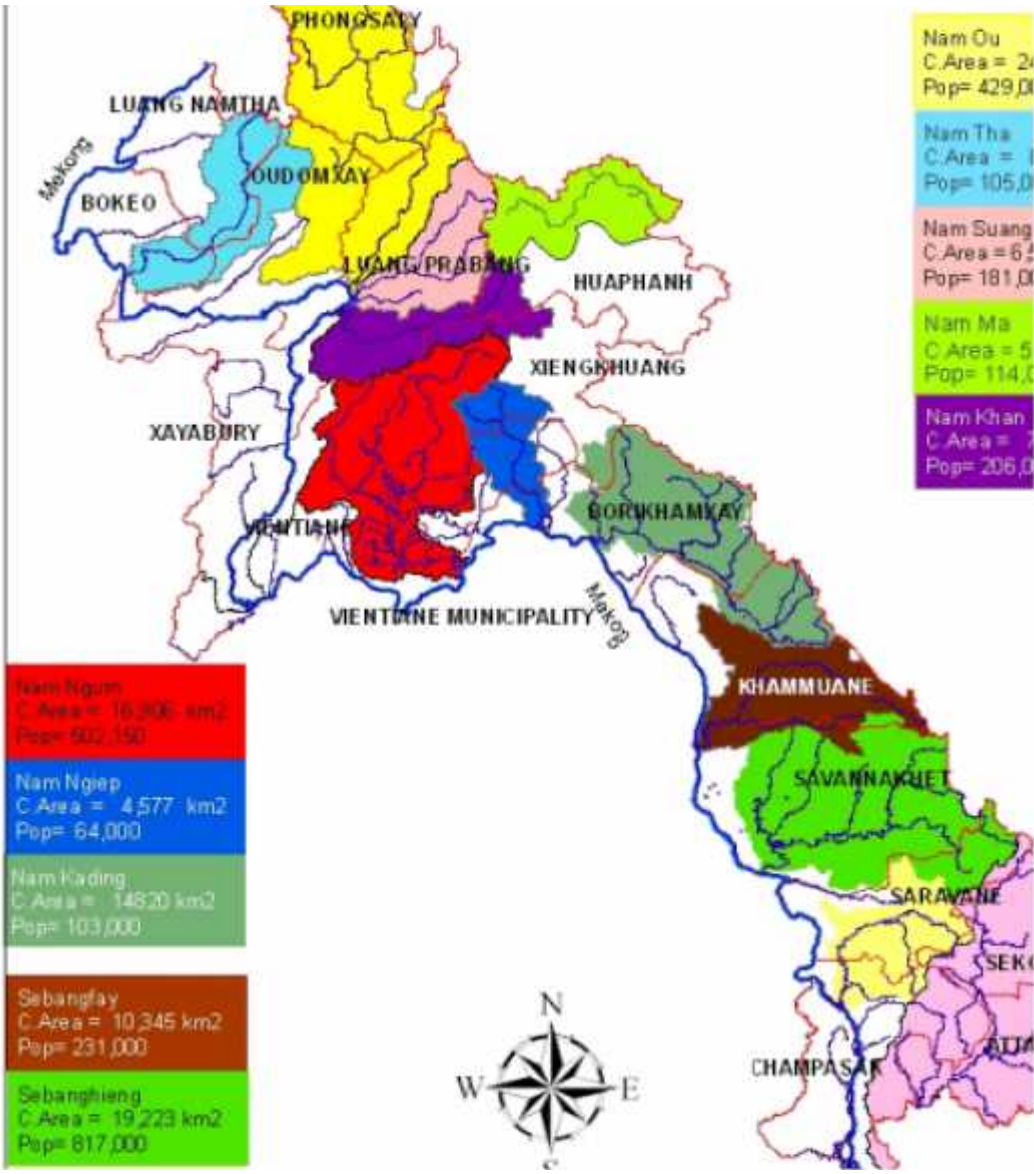
**Luangprabang Province**

**Updated by**: Office of the National Project Management
Nam Ngum River Basin Development Sector Project-Additional Financing

**March, 2014**

## LIST OF ABBREVIATIONS

| | |
|---|---|
| ADB | Asian Development Bank |
| BOL | Bank of Laos |
| CPI | Committee for Planning and Investment |
| CPC | Committee for Planning and Cooperation |
| CEI | Community Environmental Improvements |
| DOF | Department of Forestry |
| DAFO | District Agriculture and Forestry Office |
| DoT | Department of Transportation |
| DoU | Department of Urbanization |
| DoA | Department of Agriculture |
| DOI | Department of Irrigation |
| DOP | Department of Personnel |
| DAFO | District Agriculture and Forestry Office |
| DOAE | Department of Agricultural Extension |
| DoE | Department of Education |
| ERI | Environmental Research Institute |
| EPL | Environmental Protection Law |
| FAO | Food and Agricultural Organization, United Nations |
| GTZ | German Foundation for Internation Development or *GeschellshaftfuerTechnischeZuzammenArbeit* |
| IEE | Initial Environment Examination |
| IWMU | Integrated Water Management Unit |
| IWRM | Integrated Water Resources Management |
| LDC | Least-Developed Country |
| LUP/LA | Land Use Planning and Land Allocation |
| MAF | Ministry of Forestry |
| MIH | Ministry of Health |
| MPV | Marginal Productivity Values |
| MOF | Ministry of Finance |
| MOJ | Ministry of Justice |
| MOE | Ministry of Education |
| NA | National Assembly |
| NAWACOP | NamNgum Watershed and Conservation Project |
| NNRB | NamNgumRiver Basin |
| NTFP | Non-TimberForest Product |
| NNWS | NamNgum Watershed |
| NEQMP | National Environmental Quality Monitoring Program |
| NGPES | National Growth and Poverty Eradication Strategy |
| NAFRI | National Agriculture and Forestry Research Institute |
| NAFES | National Agriculture and Forestry Extension Service |
| NBCA | National Biodiversity and Conservation Area |
| OF | Office of Forestry |
| OA | Office of Agricultural |
| PLUMP/LA | Participatory Land Use Planning and Land Allocation |
| PM | Prime Minister |
| PNE | Potential Negative Effect |
| PAFO | Provincial Agriculture and Forestry Office |
| PSTEO | Provincial Science Technology and Environment Office |
| PPSC | Provincial Project Steering Committee |
| TA | Technical Assistance |
| WRCC | Water Resource Coordination Committee |


PHONGSALY
LUANG NAMTHA
Mekong
BOKEO
OUDOMXAY
LUANG PRABANG
HUAPHANH
XIENGKHUANG
XAYABURY
BORIKHAMXAY
VIENTIANE
VIENTIANE MUNICIPALITY
Mekong
KHAMMUANE
SAVANNAKHET
SARAVANE
CHAMPASAK
N
W
E
S
Nam Ou
Nam Tha
Nam Suang
Nam Ma
Nam Khan
Nam Ngum
Nam Ngiep
C.Area = 4,577 km2
Pop= 64,000
Nam Kading
C.Area = 14820 km2
Pop= 103,000
Sebangfay
C.Area = 10,345 km2
Pop= 231,000
Sebanghieng
C.Area = 19,223 km2
Pop= 817,000

## Table of Contents

## Table



## Figure

## I. Introduction

Nam Ngum River Basin Development Sector Additional Financing (Project) is financed by Asian Development Bank (ADB). It covers 10 districts of 3 provinces (Vientiane, LuangPrabang and Xiengkhuoang Provinces). Project activities are implemented through three components and one office of the national project management:

**Component 1**: Integrated Water Resources Management (IWRM) conducted by the Department of Water Resources (DWR), Ministry of Natural Resources and Environment (MoNRE). It is intended to build capacity in integrated water resource management, including river basin planning and management at the scale of both smaller sub-basin and larger river basins. Integrated river basin management includes developing a river basin plan which coordinates the activities and interests of the various water user sectors including the environment.

**Component 2**: Integrated Watershed Management Unit (IWMU) under Department of Planning and cooperation, Ministry of Agriculture and Forestry. Component's main activities assist in incorporating watershed landscape continuum plans developed under the previous project in district development programs. The activities are disseminate WLCPs to communities through the village development planning process, train district staff in preparing and revising district land use zoning in accordance with the WLCPs to promote environmentally sustainable land use, and update WLCPs based on the development process of district land use plans and sub-basin management plans.

**Component 3**: Agriculture Extension Component assigned under the Ministry of Agriculture and Forestry. Component's activities assist in enhance KESC operational capacity and sustainability, and increasing their beneficiaries intensive support will be provide to 23 KESCs in 10 district within the NNRB which are relatively poor and remote. The KESCs covers 230 villages, which had supported under previous project, and 50 additional villages.

This document provides an updated initial environment examination of the San sub-watershed under the NNRBDP-AF. The updated IEE is prepared according to ADB's Safeguard Policy Statement of June 2009 and the IEA decree of April 2010.

Potential impacts have been analyzed and mitigation measures identified following a visits and collection and examination of secondary information sources. The visit included inspection of project activities and discussions with district agriculture and forestry office, chief of villages and was undertaken jointly with infrastructure engineer from the agriculture and forestry extension component.

## II. Description of the Project

The Nam Ngum River Basin Development Sector Additional Financing Project aims to for the optimal use of water resources, especially in the Nam Ngum River Basin (NNRB). The outcome will be integrated watershed management improved in the NNRB through four expected outputs: (i) Nam Ngum River Basin Committee Secretariat (NNRBCS) strengthened for sub-basin management, (ii) district land use planning enhanced, (iii) agricultural support services improved, and (iv) institutional and human resource capacity strengthened for project implementation.

The NNRBCS will initiate its operations for developing sub-basin plans to facilitate coordinated sub-basin management at the district level. Improved watershed planning is incorporated in district land use plans to align local development programs with sustainable sub-basin and watershed management. Enhanced agricultural support services will promote the adoption of environmentally sustainable and profitable farming and forestry practices.

The project activities will assist the newly established NNRBCS in initiating sub-basin management. These activities will include (i) selecting five priority sub-basins; (ii) undertaking multi-stakeholder consultations for sub-basin planning and monitoring in the selected sub-basins; (iii) establishing a working group for each of the priority sub-basins; (iv) training on sub-basin management; (v) developing and disseminating sub-basin management plans; and (vi) developing guidelines for the implementation and monitoring of the plans. The sub-basin plans will identify specific sub-basin issues to be addressed through a decentralized consultation process with beneficiaries. The key elements of these plans will be incorporated into district development plans.

The project will assist in incorporating watershed landscape continuum plans (WLCPs)[1] developed under the previous project in district development programs. The planned activities will (i) disseminate WLCPs to communities through the village development planning process, (ii) train district staff in preparing and/or revising district land use zoning in accordance with the WLCPs to promote environmentally sustainable land use, and (iii) update WLCPs based on the development process of district land use plans and sub-basin management plans.

The project assistsin enhancing KESC operational capacity and sustainability, and increasing their beneficiaries. Intensive supports are provided to 23 KESCs in 10 districts[2] within the NNRB which are relatively poor and remote. The KESCs will cover 230 villages, which have been supported under the previous project, and 50 additional villages. The project will transform existing VDRFs in 16 districts into sustainable financing institutions. The activities will (i) strengthen KESC capacity for the effective management of the centers by improving technical skills of staff, (ii) train farmer leaders and foster their networks, (iii) implement extension services with income-generating activities such as seed and seedling production and cattle fattening, and (iv) institutionalize the VDRFs as district savings and credit unions or other appropriate credit institutions by registering under the Bank of Lao PDR.

## III. Policy, Legal and Administrative Framework

The law governing the protection of the environment, including the assessment and management of projects, is the Environmental Protection Law (EPL), 1999. An update was prepared and released in 2013, reflecting rapid economic growth and socioeconomic development and the need to address increasing conflict and social impacts as well as pollution issues with some larger projects, increasing foreign investment, and climate change. Responsibilities and procedures for Environmental Assessment, together with requirements for environmental monitoring of projects, have been revised and are set out in a new Decree on Environmental Impact Assessment (EIA decree), dated April 2010.

[1]WLCPs were developed for improved and coordinated watershed management. While sub-basin management under output 1 will focus on water-based natural resources such as quantity and quality of river flows and riverine ecosystems, WLCPs provide guidance for land use planning at the district and village levels with site-specific environmental information and coordinated zoning.

[2]Hinheup, Hom, Kasy, Pek, Phaxay, Phonhong, Phoukhoune, Phoukout, VangVieng, and Xaysomboum districts. The project will monitor and provide minimal support to six KESCs (86 villages) within the other six districts.

The EIA decree states that all investment projects that may create adverse environmental and social impacts, are to be designed with the correct and appropriate environmental and social impact prevention and mitigation measures or environmental management and monitoring plans (EMMP) and social management and monitoring plans (SMMP) (Article 1). According to the decree, primary responsibility for undertaking environmental assessment of projects is with the Office of the National Project Management (ONPM), which for this project is the Ministry of Agriculture and Forestry (MAF). The Ministry of Environment and Natural Resources (MoNRE), acting through the provincial Department of Environment and Natural Resources (DoNRE) is responsible for review and approval of environmental assessment reports, co-ordination of monitoring and evaluation, and issuance of compliance certificates. Public participation and discussion with local administrations is required throughout the environmental assessment process.

Investment projects are categorized according to a schedule to the EIA decree into category 1–small scale, requiring an initial environmental examination (IEE) or category 2 –large scale, requiring an environmental impact assessment (EIA). The schedule lists irrigation scheme, access road improvement, and water supply (item 2.3, 4.14, 3.52, respectively) as category 1.

## IV. Description of the Project Environment

### 4.1 Physical Resources

#### 4.1.1 Topography

Nam Ngum River Basin (NNRB) in north-central Lao PDR, covers an area of approximately 16,906 square kilometers (km²). The upper basin, that covers about 8, 297 km², is the catchment area for Nam Ngum 1 reservoir. NNRB extends northeast from the Vientiane waterfront about 400 km to XiengKhouang and is equivalent to about 2.73% of the entire Lower Mekong Basin. The catchment outlet is 157 metres (m) above sea level, and the highest point is 2,682 m above sea level. Less than one third lies below 300 m above sea level.

Nam Ting sub-watershed is one of Nam Ngum tributary which located in the north-west direction of Phoukoud District, XiengKhouang Province and south-east of PhouKhoune District, LuangPrabang Province. In 2005, the area of Nam Ting-Chat sub-watersheds was merged together which has total area of 131,361 ha and covering 5 target villages which are belonging to PhouKhoun District, Luangprabang Province such as Ban Phakeo, Ban Longpoad, Ban Phawai, Ban Meuangchim, Ban Nam Ma Dow and Ban Xiengdaeth within PhouKoud District, Xiengkhouang Province. Ban Xiengdaet is located between Nam Chat flowing to Nam Ting River and Nam Ting flowing to Nam Ngum.

The location of the Nam Ting sub watershedis situated between Lat. 102°42’’86" - 102° 72’ 76’’E and Long. 19°13’’85"-102° 72’ 76’’ N. The total area of 61,562 ha, the area is attaching to the Phoukhoun District, Luang, PhabangProvince, Phoukoud District, Saysomboun and Kasi Districts, VienianeProvince.

Table 1 Area of Nam Ting Sub-Watershed covers 4 Districts

| No. | Districts | Area (ha) | Percent |
|---|---|---|---|
| 1 | Kasi | 36 | 0.06 |
| 2 | Phoukoud | 2,580 | 4.19 |
| 3 | Saysomboun | 8,324 | 13.52 |
| 4 | Phoukhoun | 50,621 | 82.23 |
| | | **61,562** | **100.00** |

Nam Ting sub-watershed area is a typical upland surrounded by forested hills (pine forests) mountain ridges and a valley. The lower reaches are at an elevation of 262 m and rising to a height of 1,972 m at PhouKongkhao.The majority of land in the watershed is between 876 and 931 ml. An approximately sixtyper cent of the total land area of the watershed is taken up by the most critical slope classes (IV & V) (see topographic Map below at scale of 1/100,000 series number E-48-14). The remaining is shared between classes I, II and III.

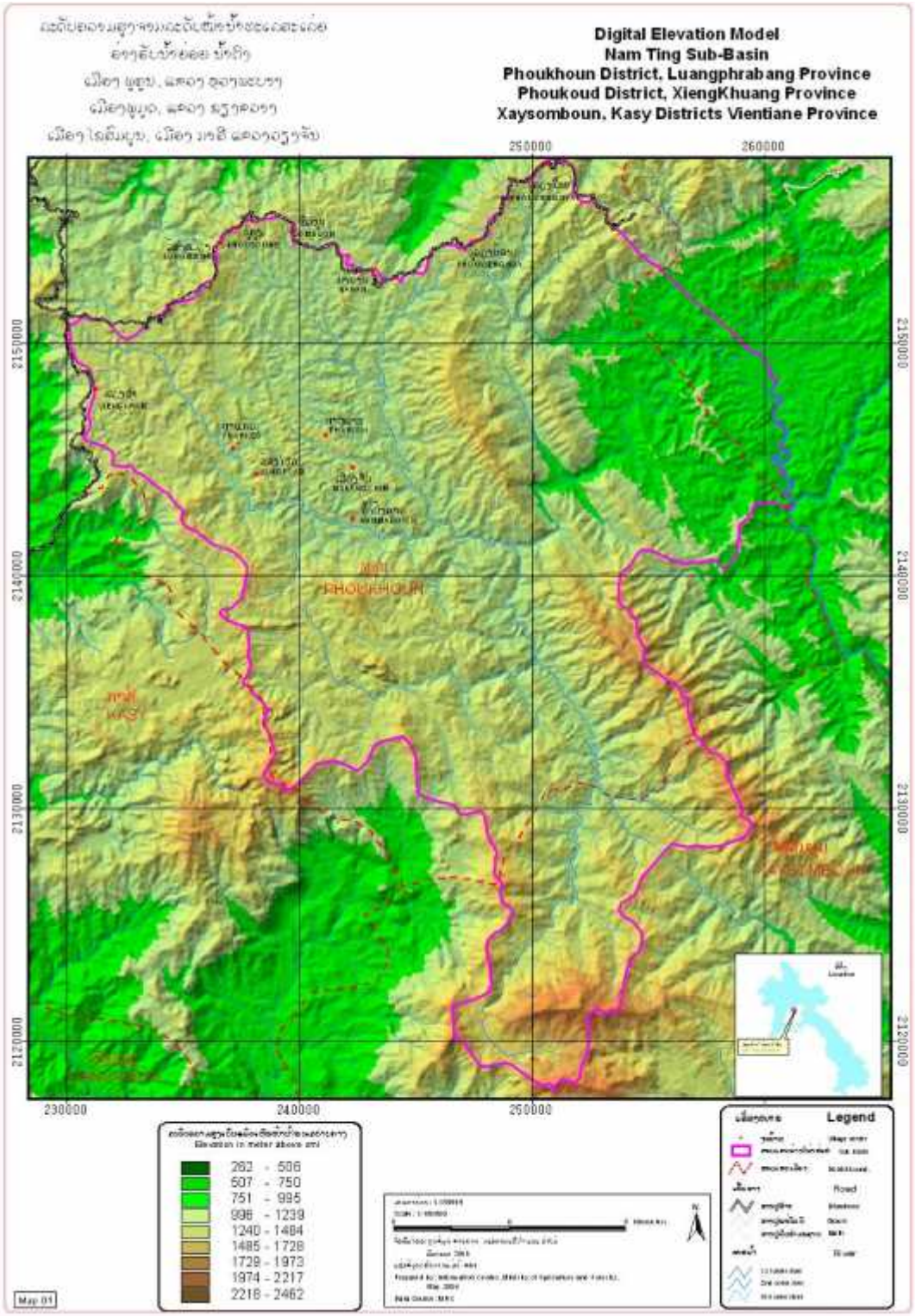



Figure 1Map of Nam Ting sub-watershed

### 4.1.2 Climate

The climate of the Nam Ngum River Basin is largely tropical with distinct wet season from June to October and a mostly dry season for the rest of the year. In the hottest months of March and April, average temperatures range from 30°C to 38°C, depending on location and altitude. Coolest temperatures occur between November and February and at higher elevations, where they may average 15°C. Average rainfall in the river basin is 2,000 mm and ranges from more than 3,500 m near Vanvieng in the Nam Lik Basin, to below 1,400 mm in Phonsavan in Xiengkhouang Province.

Nam Ting Sub-watershed is located at Phoukhoun district where is influenced by seasonal monsoon climate. Mean monthly rainfall collected from the meteorology and hydrology station at Phoukhoud district as referred data for average rainfall within district (1,433 mm). The average annual temperature is about 20.5° Celsius. The coldest month is December with the lowest temperature of about 6° Celsius. The hottest month is May with the highest temperature of about 27° Celsius (Department of Meteorology and Hydrology, 2003).

### 4.1.3 Geology and Soil

Nam Ting sub-watershed area is a typical upland surrounded by forested hills (pine forests) mountain ridges and a valley. The lower reaches are at an elevation of 262M and rising to a height of 1,972M at PhouKongkhao. The majority of land in the watershed is between 876 and 931 m.. An approximately sixty percent of the total land area of the watershed is taken up by the most critical slope classes (IV & V) (see topographic Map below at scale of 1/100,000 series number E-48-14). The remaining is shared between classes I, II and III.

The soil type which is closely related to plant productivity and the slope gradient which is closely related to workability and soil loss for agriculture and forestry are used to represent the natural site condition. Accordingly, the production potential by soil type and slope gradient were combined to classify the site suitability for agriculture and forestry.

The majority soil type in this area is Ferric ACRISOLS covers area of 86,57%. This soil type can find along the road No. 13 N and river side of Nam Ngum River which consists of fragile organic matter and suitable for crop plantations such as banana, cassava, citrus, coffee, maize, cotton, soybean, pineapples, sugarcane, grasslands, rubber, and teak plantation, etc.

Table 2 Soil types within Nam Ting Sub-Watershed

| No. | Soil Types | Area (ha) | Area (%) |
|---|---|---|---|
| 1 | Ferric ACRISOLS | 53,296 | 86.57 |
| 2 | Haplic ACRISOLS | 7,726 | 12.55 |
| 3 | Haplic ALISOLS | 495 | 0.80 |
| 4 | Dystric CAMBISOLS | 45 | 0.07 |
| **Total** | | **61,563** | **100.00** |

Source: Soil survey and Land classification centre,2006

### 4.1.4 Surface Water Resource

Surface water and ground water in the Nam Ting remains good. However, Surface water and ground water resources in the Nam Ting sub-watershed are poorly known as they have not been surveyed on a national scale. Different is the case of water quality in the reservoir. Because of the constant high temperatures, the reservoir tends to stratify, that is, the water in the bottom of the reservoir rarely comes to the surface and vice versa *(Nam Ngum Watershed Management, Final Report, 1999)*. Nam Ting is originated on the top of mountain next to the Nam Ngum River at Ban Xiengdaeth.

Water of the Nam Ngum is good with near neutral pH, high dissolved oxygen, and low conductive and nutrients. The river is located in a relatively disturbed catchment with a lots number of rural people engaged in shifting cultivation. Water temperatures range from 17-31ºC during the dry season (December-April)..

## 4.2 Ecological Resources

### 4.2.1 Protected Areas

Nam Ting Sub-Watershed Areas have none National Biodiversity and Conservation Areas and the best known are better described as community protected areas. Through influencing the general economic status and living conditions of the rural people, they affect the ways in which people use protected area lands and resources. For example the current development policy focus on poverty alleviation has the potential to reduce significantly local dependence on forest products collection, including unsustainable or destructive harvesting.

### 4.2.2 Forests

The forests within Nam Ting sub-watershed (Kasi, Phoukhoun, Phoukoud and Saysomboun Districts) are rich in flora and fauna and many of them are in watershed areas. Because of their plenty biodiversity and their watershed protection functions. Most forests and potential (degraded/recovering) forest areas are important grazing lands for cattle, buffalo and sheep and forage areas for pigs, especially after farm residues have been exhausted. The grassland is covering large area of the Nam Ting sub-watershed. However, almost 11.46 percent of evergreen forests are remaining within the area and more than 28, 85 percent of Wood &Shrubland.

Forest resources play a critical role in social development and poverty alleviation, providing the main or only source of economic activity for many of poorest households.

Table 3. Forest Types, 1997 (Nam Ting sub-watershed)

| Forest Type | Area (Ha) | Area (%) |
|---|---|---|
| Forest Dense | 780 | 1.26 |
| OpenForest | 6,278 | 10.20 |
| Forest Regrowth | 4,168 | 6.77 |
| Wood &Shrubland | 17,758 | 28.85 |
| Shifting Cultivation | 1,325 | 2.15 |
| Grassland | 31,253 | 50.77 |
| **Total** | **61,562** | **100.00** |

Source: MRC/GTZ, 1997. Forest Cover Monitoring Project.

### 4.2.3 Aquatic Ecosystem

With high levels of rainfall and an extensive mountainous terrain, freshwater reserves are diverse, from small, high altitude mountain streams to Nam Ngum River. This gives rise to diversity in aquatic habitats, also reflected in a diversity of fish species, which show a high degree of endemism. Besides stream and rivers, wetlands are significant aquatic habitats in Lao PDR, occurring mainly in the south of the country near the Mekong River. Fish are an important economic resource and fisheries management also needs to strike a balance between commercial exploitation and conservation. Fisheries make up approximately 13% of the GDP.

Fisheries are one an important livelihood activity, particularly in the lowland areas where wetlands, oxbow lake remnants and rice fields are all sources of fish. There are seasonal migrations of fish between the Mekong and its tributaries, with the first major fish migration of the year commencing at the start of the wet season.

### 4.2.4 Terrestrial wildlife

Terrestrial wildlife in the Nam Ting sub-watershed area is also distributed according to the characteristic of entire habitats. Overall, some wildlife species have decreased and other species remain rare. Most of the remaining species are found in the areas of relatively intact forest.

In Nam Ting sub-watershed area, the number of wildlife is unpredictable due to lack of background and current information on this area. In terms of abundance, many bird species were reported to have increased in number, but some rare species remain rare and difficult to sight.

## 4.3 Human and Economic Development

### 4.3.1 Local Economy

Forest resources play a critical role in social development and poverty alleviation, providing the main or only source of economic activities for many of Lao's poorest households. Forest land has been identified to sustain use for fuel wood, housing and fencing materials, source of medicine and non-timber forest products. Forest cover play a significant roles to protect water resources, streams and soil erosion, meanwhile it also provides and regenerates natural fertilizer to the soil and lower part (paddy field)

Hmong and Khamu traditionally build their houses directly on the ground, and this is the case in both of the Hmong villages within the Nam Ting sub-watershed area.

Factors and issues concerned for the rural community access improvement to be based on for making the recommendation are as follows:

- Population growth rates and dynamics has been calculated in order to forecast expected demands on the land.
- Available crop land has been identified for producing sufficient rice or other food stuffs for consumption. Concerning crop land must be given to fallow periods for soil restoration, decree of slope of land, and water course.
- Land for livestock need to be identified as places for pens, pastures and forages for feeding livestock.

### 4.3.2 Population

Nam Ting sub-watershed consists of 20 villages (Table 4), 1,621 households. The total population is about 10,595 inhabitants; in that woman are 5,243 persons. There are three communities, the first community is Lao Lum consists 290 person, woman 146 persons. The Hmong population is 4,586, woman 2,279 persons, who is considered as a minority group and occupied upland and high land, they have skill in practicing shifting cultivation or temporary occupation. Khamu group is about 5,719 persons, woman 2,719 persons.

**Table 3** Villages within the zones of Nam Ting sub-watershed

| Central Zone | Ban Chim Zone | PhouSoung Zone | PhouviengNoy Zone |
|---|---|---|---|
| 1.B. Senesy | 1.B. Chim | 1.B. Long Mieng | 1.B. Phouviengnoi |
| 2.B. Sam Gnek | 2.B. Nammadao | 2.B. Phou Yang | 2.B. Phouvieng Yai |
| 3.B. Bangkalo | 3.B. Phakeo | 3.B. Phou Lang Jang | 3.B. Somboun |
| 4.B. Lak 5 | 4.B. Phavai | 4.B. PhouSoung | 4.B. Phonkham |
| 5.B. Viengkham | 5.B. Longpoth | | 5.B. Nam Ting |
| | | | 6.B. Nanan |

However, there are two major ethnic groups present in the area. One is a Lao Loum who is considered in the Nam Ting sub-watershed area as a community according to their settlement period. Another groups are Hmong and Khamu who are considered as a oldest communities in this area (more than two hundred years). On average there are about seven people per households and some households have two families staying together.

Most of households are engaged in paddy rice cultivation (shifting cultivation). Fishing is considered as a supplementary occupation that plays a key role in the livelihood of three communities. Rainy season is the season that fish population is plenty (mid rainy season). Fish are caught mostly for household consumption, but if there is some surpluses they will be sold to merchants or neighbor. Secondary occupation likes weaving; handicraft and sewing are in few practiced.

Villagers believe in spirits, for which they have great respect. Activities in the villages should be in line with the spiritual belief. There are sometimes special forests reserved as homes for the spirits.

Most of people in the project site are practicing in shifting cultivation, paddy rice field, garden, tree planting, and animal rising.

### 4.3.3 Education

According to the data from the district education office, there are 17 schools located within Nam Ting sub-watershed with the number of student of 2,449 persons, woman 1,173 persons. There are 14 elementary schools which consisted of 387 pupils, woman 189 pupils and 6 teachers, woman 2 persons. The secondary schools are located in the district towns which total number of student of 2,071 persons, woman 984 persons.

### 4.3.4 Health facilities

There are two dispensaries are located at Ban MeuangChim and Ban Phouviengnoi, Phoukhoun District, and 8 medicine boxes is currently serviced in 8 villages including

6 drug stores, 7 drug wells, and 11 water gravity sets in the sub-watershed areas. Preliminary surveys outlined that the general health condition is poor and access to nontraditional medical treatments. Many inhabitants expect from an external assistance, the improvement of their health condition. Moreover, the poor expressed an immediate assistance need in “social welfare”. Eventually, it is obviously that the population will be more available for economic development if in better health condition. Diseases most commonly occurred isdiarrhea and malaria.

### 4.3.5 Cultural heritage

The ethnic groups that Khmu and Hmong are animist. The relationship between ethnicity, settlement location and economic activities, Khmu households are mostly engaged in agricultural activities, at the riverside and in the mountainous area. All Hmong households are living in the mountainous area and engaged in agricultural activities. It is more complicated, since there are significant variation according to both ethnicity and the settlement locations. To understand the occupational structure, both the geographic location of the settlements and ethnicity of their occupants must be considered

### 4.3.6 Industries

There are no industries on this sub-watershed area, just only have some rice saw mill in Ban Xiengdaeth. The government had developed the Nam Ngum III and V hydropower construction at Nam Ting sub-watershed. The goal of the government is to improve livelihood of the people in the rural remote areas. Manufacturing activities play an especially important role in this sector, and have expanded over recent years. The hydropower sector continues to be an important source of investment, and sales of electricity. Future growth strategies aim to diversify the economy further, targeting growth in industrial and service sectors.

**Table 4** summarizes of Nam Ngum Hydropower Projects

| **Project Name** | **NamNgum I** | **NamNgum II** | **NamNgum III** | **NamNgum IV-A** | **NamNgum V** |
|---|---|---|---|---|---|
| Location | KeoOudom District, VientianeProvince | Xaysomboun | Xiengkhouang and Xaysomboun | Xiengkhouang | Xiengkhouang |
| **Installed Capacity** | **150.00 MW** | **615.00 MW** | **461.00 MW** | **54.00 MW** | **60.00 MW** |

Source: MAF, 1999. *Nam Ngum Watershed Management.*Final Report.

### 4.3.7 Mining

Presently, no information on mining resources situated within Nam Ting sub-watershed area. The Government will ensure that development of the mining activities are conducted inenvironmentally and socially sustainable manner, while making a significant contribution toeconomic development at all levels of society (NGPES, 2004).

### 4.3.8 Infrastructure facilities

The results of the inventory survey for existing rural infrastructure and the villagers’ preference for social infrastructure identified through improvement water supply in the Nam Ting sub-watershed area by means of either a gravity fed pipe water supply system or duge wells/shallow tube wells. The pipe system will first be examined in accordance with the guidelines of the Water Supply and Environmental Sanitation

Programmed, and the construction of the wells will be considered for the villages where the pipe system is not feasible or not applicable.

It is strongly believed that the standard of living in the NamTing sub-watershed will be improved. The water supply is of high priority for children who are assigned the task of household water-fetching, as well as females who require a stable water supply for cooking and washing.

According to the para 12.mentioned that there is no available for sewerage system and flood control within this area due to rural upland areas.

At present due to a weakness in the organizational structure, the practical responsibilities for rural water supply lies with each village authority and Nam Saat only provide partial assistance, when requested (MAF, 2001).

### 4.3.9 Transportation

The communities are connected to the district town and province by the road and water transportation system (by Nam Ting and Nam Chat). But no airport is available in this area. There is local port located at Ban Xiangdaeth. The boat loads people and goods from the villages within Nam Ting sub-watershed areas to a port near the road connectionto the district and province.

The improvement of existing roads and construct new roads to link between villages and Road 7B are under ongoing. In some parts of watershed can access to to villages easily.

### 4.3.10 Transmission

There is an electricity facility with the transmission line along the Road No 7B and electricity grid within sub-watershed villages. There is a telephone network which can communicate entire villages.

### 4.3.11 Land use

In the Nam Ting Sub-watershed spreads from hilly area to a mountainous area and the development of forests is essential for watershed conservation. Most of local people are engaged in agriculture which is expected to remain the most important local industry in the future.

Although the village boundaries in the Nam Ting sub-watershed have not yet been delineated and authorized by the local government, the villagers have decided the boundaries to a certain degree. In the estimate, the overlapped areas perceived by the villagers are allocated to the related villages based on the population size of each village.

The land use within the Nam Ting sub-watershed is extensively predominated by the grassland. This type of land use covers the majority in term of areas. According to the interviewing of local communities people that twenty years ago, the shifting cultivation was carried in the older secondary forest (forest regrowth), but to day most of shifting cultivation is carried out in the bush land, bamboo groves and forest regrowth or wood and shrub land.

The paddy cultivation is done where it is possible. The areas under paddy cultivation are very less due to the hilly terrain and it is mainly practiced at the hill foot and in the valley.

The main type of vegetation in this area is the wood and shrub land and forest dense are scattered within the area. Due to shifting cultivation and logging, most of the mature forest has been eradicated. Today, most forest stands are young and semi dense and found in the areas which were previously wood and shrub land and on the steep and most inaccessible hill sides.

## V. Anticipated Environmental Impacts and Mitigation Measures

### 5.1 Method of Assessment

Potential impacts have been assessed by mean site investigation, discussions with local authorities, KESCs and members of the public. Table 1 below present impacts related to various sectors (agriculture and forestry, mining, hydropower, and water resources and environment)

Mitigation measures have been identified to, what possible, avoid potential negative impacts, or otherwise to ameliorate impacts.

### 5.2 Overview

The most significant impacts expected to arise from the project are major improvements to livelihood and quality of life people in the sub-watershed from provision of safe water and the improvement household and community access road, irrigation rehabilitation, and agricultural and extension services. These activities were run by the agricultural extension component

### 5.3 Anticipated Environmental impacts within sub-watershed

#### 5.3.1 Impact on soil erosion

Its predominant soil types and heavy rainfall combine to make a significant part susceptible to erosion, particularly if cultivation on a permanent basis occurs under inadequate cultivation systems. Where vegetative cover is removed, the soil surface becomes exposed to the impact of rain drops which causes a sealing of the soil surface. Less rain then infiltrates the soil. Runoff increases, stream flows fluctuate more than before, flooding becomes more frequent and extensive, and streams and springs becomeephemeral. Land degradation takes several forms, such as nutrient depletion, structural decline and compaction, biological decline, chemical deterioration (e.g. salinization), and soil erosion.

**Mitigation measure**: these include all the problems of transforming shifting cultivation farming systems away from low input/low output systems in order to stabilize communities, enhance resources productivity, improve the socio-economic environmental and minimize the degradation of the natural resource base. The strategic vision for the agricultural sector, 1999 suggest that's the specific development initiatives for the areas (sloping land strategic initiative) respectively are summarized below:

- Land use zoning based on bio-physical (e.g slope and land capability) and socio-economic parameters)

- Participatory land allocation and land use occupancy entitlement
- Community management of natural resources
- Farming systems diversifications on farmer' s field
- Expansion of small-scale community managed irrigation systems
- Farmer demand-driving extension
- Sustainable land use management with soil erosion control, afforestation, plantation forestry and conservation management
- Rural saving mobilization and micro credit extension
- Competitive rural finance system development with market determined interest rates in most areas to promote technology adoption among the poorest socio-economic atrata.
- Strengthening of capacity and legal framework for state owner commercial banks in community market access through feeder road upgrading and expansion and market information delivery.

Expansive land uses for agricultural activity are a major concern in San Sub-watershed, particularly, slash and burn in upland areas extensively among the poor families. Industrial plantations are common found in the areas of sub-watershed, excessive pesticide and chemical fertilizer making unsafe food consumption and water quality, aquatic life.

Encroachment of protective forest and conservation forest are often cited as the main cause of deforestation. However, several studies have pointed that commercial logging and conversion of forests for plantations (rubber) are the main causes of destruction of Lao primary forest. Deforestation for commercial use often destroys the NTFP resources that local communities rely on.

### 5.3.2 Impact on surface water sources

Surface water abstractions particularly from public water supplies, irrigation, industrial process and hydropower plants exert a major pressure on water resources with significant implications for issues of quantity and quality of water resources. Main concerns relate to the inefficient use of water and to its environmental and socio-economic consequences; Low River flows, water shortage, salinization of fresh water bodies, human health problems.

### 5.3.3 Impact on Forest

Deforestation includes shifting cultivation, inappropriate farming system, exploitation timber, absence of a sustainable forest management planning system leading to destroy forest in the watershed area. High price of log and timber in the market make illegal logging and uncontrolled trade resulting to deplete the forest density in watershed area.

**Mitigation Measure**

- Improve villager's living standards in pilot areas through village forestry and village development projects.
- Consult and develop land use and development plans to guide forest concessionaires in logging operations
- Improve villager's ability to manage forest through extensive training
- Involve local participation in ongoing reforestation programs

- Conduct applied, adaptive research on species (including seed and nursery requirements and the use of indigenous species), species/site matching harvesting, thinning and coppicing method, site and soil preparation, fertilization programs and post-plantation management
- Conduct research result available to PAFO and DAFO and thence to potential growers. This would entail assisting DAFO in developing adequate capacity for the task
- Provide tree plantation owners, especially those owning teak plantation in the north, with skills to select seed, plant at the correct density, thin and prune stands for quality improvement and increased sale price
- Carry out market research to determine the effect of market trends and access on specie selection, conditions under which plantation products are sold, how qualities are defined and checked and how prices, premiums and discounts are set

### 5.3.4 Impact on Aquatic

Aquatic resources situated in Nam San sub-watershed are not polluted. There are many of gears are habitats specific and their use can be highly seasonal. Some gears ate unspecialized (e.g barrage fences) and catch a wide variety of species, while others are species specific. Some fishers specialize in the use of one gear type, particularly in the professional/commercial sector, but normally a range of gears will be used.

**Mitigation measure**

Fish conservation zone (FCZ) was set up in 59 villages during 1993 and 1997. The effectiveness of the FCZ is currently being evaluated under auspoces of the living aquatic resources research center (LARReC).

- Increasing co-management as well community based fisheries management.
- Set up fish conservation zones
- Fish capture control
- Prohibit zone for fishing during fish breeds
- Local authorities should enforce government regulations on the use of poisons
- Public awareness programs are also needed to help local people understand the impacts of excessive poisoning of wild life, and agricultural pests such as insects and rats.

### 5.3.5 Impact on Wildlife

Wildlife trade in Lao PDR involves a large internal trade for food and medicine and a substantial international trade for a diverse range of uses including traditional medicine, food, and trophies, in markets and restaurants, it is not uncommon to see displaying of squirrels, monitor lizards, birds, soft shell turtles, snake and sometimes pangolins, as well as fresh and dried deer meat.

The impact on the biodiversity relate to the loss of relatively rich and diverse wildlife. Continued loss of biodiversity correlates to a reduction in species of wildlife and plants of national and local significance, economic development opportunities, food security, national heritage values, and recreational and ecotourism opportunities.

**Mitigation measure:**

- Establish village conservation forest areas and demarcated
- Prohibit hunting during wildlife breeds
- Establish community base wildlife monitoring

### 5.3.6 Impact on Land use

Population growth pressure due to the limitation of arable land for permanent agriculture is considered as a major cause of forest encroachment. Upland farmers, who are mostly engaged in traditional slash and burn cultivation, have been claimed to be a cause of forest destruction and land degradation. Population growth and concomitant growth in deman for land use products. In the given situation of popoution growth and the extent of land conservation leads to annual forest depletion.

**Mitigation Measure**

- Land allocation
- Proper land management
- Farming planning
- Community-based on land use planning and management

### 5.3.7 Agriculture, animal husbandry and aquaculture agriculture

Shifting cultivation is widely practiced on highly elevated sloping land. The major product is upland rice. Farm input for production is considerably low. Production is mainly for home consumption. Living conditions are poor. Wet season rice production is dominant, and irrigation farming is not commonly practiced. Many farmers use animal draft power for crop cultivation, mainly for paddy. Products are mostly for household consumption. Use of chemical fungicides, herbicides, insecticides, molluscicides and rodenticides is currently very low within the project areas. With the increase in cropping intensity, it is expected that there will be a gradual increase in the problems encountered with weeds, insect pests, rats and snails as seen elsewhere in the region. Commonly these problems appear within a few years of intensification of production. It is likely that one of the responses by farmers will be to increase their use of chemical agents to combat these pests. This could have several undesirable effects, both direct and indirect. Direct effects include unsafe application with subsequent ingestion by farmers, incorrect application resulting in unsafe levels of toxic chemical residues in farm produce and buildup of chemical resistance among pests. Indirect effects include toxic residues entering the soil, surface water and ground water with subsequent problems for aquatic flora and fauna as well as the danger of human consumption. These dangers are compounded by the large amount of banned substances that are available because of the lack of regulation and knowledge within Laos of their dangers. This is balanced by the high degree of awareness of farmers about Integrated Pest Management (IPM) including leaf-eating insects and their natural enemies. In addition, the Lao PDR Government has been discouraging the use of chemical pesticides.

**Mitigation Measure**

- Appropriate technology

- The project will have paid and fruit tree to develop method of farming system, in agriculture animal husbandry and fruit tree plantation, using of green manure, compost and animal manure is encouraged under a close follow up by the project.
- Irrigation development and management
- Farmers training in pesticide use and protection
- Support the farmer to use local knowledge and utilize insects itself
- Farmers training on integrated pest management (IPM)
- Animal husbandry

### 5.3.8 Livestock production

Livestock production, which includes buffaloes, cattle, pigs, poultry, and goats, also contributes appreciably to the economy. A considerable amount of agricultural activities are at the subsistence level. Three types of livestock production is envisioned in the sub-watershed areas, with increases in each type in the next few years: (i) upland or mountainous area grazing involving cow, buffalo and goat; (ii) lowland foraging among dry deciduous forest that has been partially converted to improved pasture, again for cow, buffalo and goat; and (iii) animal propagation near village that aim at small livestock (pigs, chickens, ducks and goats).

**Mitigation Measure**

- Develop baseline assessment and monitoring protocols of the natural and cultural resources affected by livestock use. This assessment serves as a baseline against which all grazing-induced changes should be measured and the overall effectiveness of a grazing management plan assessed. Data should be complied at a central location.
- Determine the health of rangelands currently under management that have been affectd by grazing management practice. This be an interdisciplinary approach, which should include range science and related disciplines such soil and watershed science.
- Develop restoration/revegetation techniques that will return lands removed from grazing or no longer subject to trespass grazing to a desired plant community of native vegetation where natural processes will dominate. Restoration techniques should also be developed for lands damaged by grazing activities but are still subject to grazing
- Develop a methodology for monitoring grazing activities for the preservation of cultural and natural resources. Provide recommendations for the protection of resources to be incorporated into allotment management plans. This methodology should consider soils, hydrology, water quality, as well as the desired plant community.

## 5.4 Anticipated environmental Impacts by the project activities and Mitigation

The table shows the assessment of impacts to be brought about by the project and the significance of the change to human populations. In each case, changes may be positive or negative.

Table 5Indicative Mitigation Measures

| Activities potentially impact environment | Anticipated Environmental Impacts | Proposed mitigation measures |
|---|---|---|
| **1. Agricultural support services (Crop, livestock and fishery production improvement)** | | |
| Physical expansion of crop area. | Loss of precious ecological resources, and historical or cultural sites. | Careful site-selection of project activities the sensitivities. |
| | Animal defecation causes water course pollution. | Village level planning for livestock includes measures to keep livestock out of riparian areas and streams through appropriate fencing and off-stream watering points where practical. |
| Improved productivity | Misuse of chemical fertilizers and pesticides negatively affect soil and water quality, causing health and pollution problems. | Train farmers on environmentally appropriate farming practices. |
| | Removed pressure to forest increases biodiversity. | Promote organic fertilizers and integrated pest management techniques. |
| Introduction of new crops and fodder or imported breeds. | Alien species invades conventional species. Imported varieties and breeds cause disease problems. | Promote tested species/breeds or hybrid seeds that produce infertile offspring. |
| **2. Forest management** | | |
| Disturbance or exclusion of conventional practices and historical or cultural sites. | Loss of productive areas, precious ecological resources, and historical or cultural sites. | Careful site-selection of project activities the sensitivities. |
| Introduction of new species. | Alien species invades conventional species. | Promote tested species. Where possible, high value native forestry species be considered rather than exotic species. |
| | Predominance of deciduous species may exacerbate soil erosion. | Limit deciduous species less than 50% of the mixture.<br>No planting on slopes greater than 20% degrees without contour planting. |
| Promotion of Non Timber Forest Products (NTFPs). | Overexploitation of NTFPs. | Training for sustainable NTFP use. |
| Nursery construction | Soil erosion. | Establish on flat land with gravel base. |
| | Water pollution. | Use of slow release fertilizers. Proper drainage. |
| | Workers health and safety. | Enforce personal protective equipment and medical facilities. |
| Seed collection | Existing forest depletion. | Local protocols for sustainable seed collection be established, with specific protection for any rare or threatened species. |
| Herbicide use (e.g., Glyphosate) | Damages on non-target species. | Use proper equipment on days with no wind and rain. |
| Fertilizer application | Leaching to water courses. | Use small quantities next to individual trees. |
| **3. Improved village infrastructure** | | |
| Physical construction works (e.g., small-scale irrigation systems, rural road, and water supply systems) | Soil erosion and Water pollution. | Promote plant cover, where applicable.Careful treatment of soil, especially works in riparian areas. |
| | Workers health and safety. | Enforce personal protective equipment. |
| **4. Land use planning** | | |
| | Exclusion from conventional use of land and water resources. Improved capacity and management facilitate sustainable use and conservation of natural resources. | Involve concerned provinces, districts and communities into planning process. |

## VI. Environmental Management Plan (EMP)

### 6.1 Institutional Arrangements

The project implementation will be in the hand of the office of the national project management (ONPM) located within the department of Planning and Cooperation with links to provinces where implementation take place. Both provincial and district offices of MAF (PAFO and DAFO) are intimately involved in project execution, and some of the environmental functions needed to effectively execute the project are located within these offices.

The ONPM and the consultant engaged to implement activities will be required to oversee the environmental monitoring and compliance activities, and to coordinate among the various subsidiary agencies involves in the project. Further engagement ofconsultants in environmental monitoring is needed alongside the ONPM during the implementation of the componentto assure that environmentally-friendly practices are in corporate into the farmer field demonstration and training work, and to assist in implementing various mitigation measured related to control of fertilizer applications, pesticide use, and IPM.

### 6.2 Environmental Monitoring and Reporting Program

District Project Office (DPO) is responsible for carry out environmental planning and monitoring in collaboration with villagers. A monitoring plan for each target village may be prepared at the activity planning stage. Office of National Project Management (ONPM) is responsible to support and supervise the DPO and also ensure that environmental safeguard requirements are complied. The DPO provides ONPM with reports on the implementation of the EMP on quarterly basis. ONPM regularly prepare quarter progress reports on project progress on environmental aspects, in collaboration with provincial, district and village level stakeholders, to report to the Project Steering Committee (PSC), Ministry of Natural Resources and Environment (MONRE) and Asian Development Bank (ADB).

## VII. Conclusions and Recommendation

The initial Environmental examination process has found that the project will cause significant negative environmental impacts. The project is therefore be classified as Category B according to ADB’s classification system. This refers to projects that are joded to have some adverse environmental impacts, but of lesser degree or significance than those for Category B projects.

It is recommended that the environmental management plan for each component will be monitored by Project staff from ONPM, PPOs and DPOs is responsible to monitoring and reporting approaches.

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