Initial Environmental Examination

Project Number: 33356
Loan Number: 2780-LAO
July 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)

NAMHIN NAM NOR SUB-WATERSHED

Long Cheng District

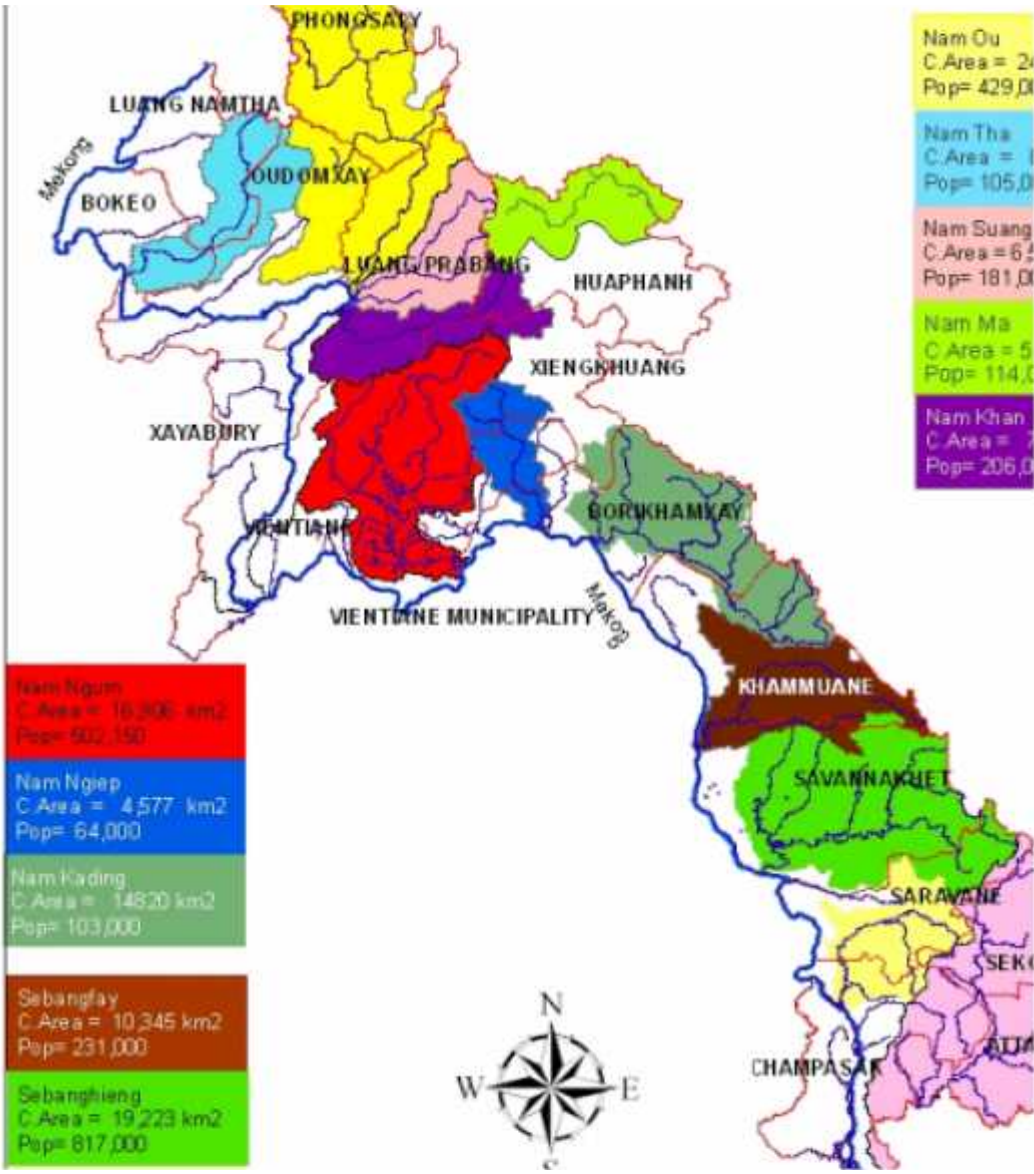
Xaysomboun Province

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

July, 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

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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 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 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.

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

[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.

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.

Hin Nam Nor Sub-watershed is located between latitude 21^{o}14’ and 21^{o}24’ and longitude 102^{o} 52’ and 102^{o} 70’ with an approximated area 15,500 ha (Topography map 2). The Sub-watershed is joining boundary with Kasy district and sharply delineated with elevation ranging from 1081 at former MuangPhoun to 2,254 mat PhouNiangSiniaoMean Sea Level (MSL),Hin Nam Nor is the one in several of Nam Ngum tributary.

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.

Hin Nam Nor Sub-watershed has a tropical monsoon climate, typical of the central region area with two annual seasons, a dry season from October to March and a wet season from April to September. The actual climatic data is not available due to there is no Metrology station. However, Department of Meteorological and Hydrology

rainfall data for Xaysomboun indicated that the average rainfall is 1,803 mm in the year 2002. Rainfall is generally greatest in June, July, August and September, with maximum monthly rainfall of 282mm.Monthly temperature and relative humidity data for Xaysomboun province are from 13^{o}C to 24^{o}C and from 70% to 93% respectively. Wind direction and speed are highly dependent on local topography.

4.1.3 Geology and Soil

This area dominated by terrigenous continental sedimentation of Mesozoic age and shallow marine sedimentation of Paleozoic age, characterized by reddish and gray colors. Compression stresses led to the folding of Paleozoic beds during the late Carboniferous followed by post-organic deposition of sandstones. Slight folding and faulting of sediment cover started during the late Mesozoic. The geomorphology is strongly controlled by the lithology. Dip slopes and scarpes are common for the hard sandstone and limestone beds, while the weaker sandstone and mudstone units result into more gentle topography.In the river valleys, debris deposits are common. They consist of large blocks and slabs, detached from the sandstone ridges on the upper slopes, as a result of stress relieve, parallel to trace of valley.

According to the soil survey conducted by Soil Survey and Land Classification Centre in 1994, the area was identified into major soil types. One is a steep slope complex (STP) where the topography is very steep, the slope is more than 55%, soil is relatively fragile and easy to erode. The second type is Humid ACRISOLS (Acu) which consists of fragile organic matter, soil depth ranges between 30 to 100 centimetres and slope ranges from moderately steep 16-30% to steep slope (30-55%).

During1994,soilsurveyhasconducted SoilSurveybytheSoilSurveyandLandClassification Centreinordertomeettheobjectivewithinthiszone. Itwasidentified intotwomajorsoiltypes (Appendix1).Oneisasteepslopecomplex(STP)wherethetopographyisverysteep,theslope is more than 55%, soil is relatively fragile and easy to erode. The secondtype is Humid ACRISOLS (Acu)whichconsistsoffragileorganicmatter,soildepthrangesbetween30to100 centimetresandsloperangesfrommoderately steep16-30%tosteepslope(30-55%),soilinthis typeshouldbeprotectedandcoveredbyforestanddensevegetationinordertoavoidsoil erosion. Human intervention shouldbe carefully made. Especially, agricultural development shouldhaveappropriatemeasuresforsoilerosionprotection.

4.1.4 Surface Water Resource

Hin Nam Nor is originated on the top of the mountain next to the Nam Ngum River at Ban Long Cheng. Due to the physical structure of Hin Nam Nor, water runs very fast and combines with shallow course, resulting in limitations to hold the water in the streams, annual rainfall is considerably high, but irregular rainfall and its distribution has created droughts in some years that impacted the water regime in the streams. As a result, crops that entirely rely on rain water have faced low yields and it created rice deficit for local people.

Surface and groundwater of Hin Nam Nor sub-watershed are poorly known as they have not been surveyed on a national scale. Nonetheless, groundwater resource remains the main source of potential rural and small town water supply.

4.2 Ecological Resources

4.2.1 Protected Areas

Nam Hin Nam Nor 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 are rich in flora and fauna and many of them are in watershed areas. The forests comprise open forests, conifer forests, mixed hardwood-conifer forests, dense mountain conifer forests and degraded forest mountain forests. Most forests and potential (degraded/recovering) forest areas are important grazing lands for cattle, buffalos, and sheep and forage areas for pigs, especially after farm residues have been exhausted.

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 Hin Nam Nor 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 Hin Nam Norsub-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

The major economies of people in Hin Nam Nor sub-watershed are primarily based on agricultural and the natural environment. Non-Timber Forest Products (NTFP)arealso important for the local communities as they are used for both subsistence and trade. Income from non-timber forest products is the biggest cash income source for the villages located in the Hin Mam Nor sub-watershed area. There are many kinds of NTFPs in the area, for example: bamboo, honey, sesame, cardamom, benzoic, rattan, tiger grass see *(Thysanolaenamaxima)*andPuackMuack.

4.3.2 Population

Therearetwomajorethnicgroupspresentinthearea.OneisLaoLoum,anoldcommunitywhois consideredastheirsettlementperiodintheHinNamNorsub-watershed area(morethantwenty years).Another groupisHmong, anewapproachingcommunity inthisarea.Thetotalpopulation ofthe Hin NamNorsub-watershedispresentedatthe Table1below.Theaveragedensityofthe populationis aboutsevenpeopleperhouseholdswhilesomehouseholdshavetwofamilies stayingtogether.

Most of households are engaged in paddy rice cultivation (shifting cultivation). Fishing is consideredasasupplementary occupationthatplaysakeyroleinthelivelihoodofthetwo communities.Rainyseasonistheseasonthatfishpopulationisplenty(midrainyseason).Fish arecaughtmostlyforhouseholdconsumption;however,thesurplusesfromtheirself-consumption willbesoldtomerchantsorneighbors. Secondaryoccupationlikesweaving;handicraftand sewingareinfewpracticed.

4.3.3 Education

Thelevelof educationamongthesurveypopulationis relativelylow. Approximately 12.7%oftheindividualssurveyedareilliterate,withthemajority(54.0%)reporting schoolattendancetoprimarylevel,andsmallerproportionshavingattendedlowersecondary.

School(17.8%)anduppersecondary school(11.9%), averysmallproportion hadcompleted university(0.3%)andapproximately2.4%and1.1%respectivelyhadcompletedmiddlean d higherlevelsofvocation,technicaltraining.Malerespondents havegenerallyreceivedhigher educationthanfemales.

Theeducationandsupportsectorisaveryimportanttohelpthevillagesdevelopment ofHin NamNorsub-watershed. Averagefamilysizeis6,4persons, withapparentlylittlevariation betweenthethreemajorethnicgroups,educationallevelislow.Only8,8%ofthepopulation over6years complete theirprimaryeducation, 2,9% complete lowersecondary, 0,7% complete upper their secondary and1,3%complete higherlevels ofeducation. Just0,3%ofpopulation graduates atuniversity degreelevel.Inspiteofthislowlevelofschoolattendance,literacyinthe above15yearsagegroupis69,5%formenand30,9%forwomen, alargeproportion of the populationreceivesadditionaltuitionatlocal Watts orthroughtheLaoWomen'sUnion(LWU).Of

theeconomicallyactivepopulationsegment68,1%of malesand72,4%offemalesarereportedas economicallyactive.

4.3.4 Health

ThehealthstatusoftheLaopopulationismarkedbyalowlifeexpectancyatbirthof60year(59 formales and61forfemales),(NSC,2000). There isaveryhighmaternalandinfantmortalityrate (530,100.000livebirths,and82,1.000livebirthsrespectively)andthemortalityrateinunder fiveyearoldsis 106,1.000live births(NSC2000).However,infantandchildmortalityrateinLaohave declinedsignificantly overthepast5-10year(UNFPA,2001).Thetotalfertilityrateis6.4per womanofreproductiveage,butvariesamongsteachoftheprovincesfromaveragesof4.4to 10.0(NSC,2000).TotalfertilityratesinLaoarehigherthanmostothersouth-east Asiancountries (UNFPA200)andover18%ofLaotianadolescentgirlshavestartedchildbearing, aratethatis extremelyhighcomparedwithothercountriesintheregion. Anestimated50%ofthepopulationhasaccesstosafedrinkingwater,75%haveaccessto healthservice,and29%haveaccesstosanitation(UNDP2003).Thecommonly identifieddiseases (bothinfectiousandparasitic) intheLaoPDRare:malaria, dengue fever, tuberculosis, leprosy, acute respiratory infections (ARI), gastroenteritis and hepatitis.Inaddition,therearesomediseasescommonly relatedtothehealthofthelocalpeople includedthemotherandchildemergencies. Injuriesfromunexplodedbombs,trafficaccident trauma,drugadditions(insomenorthernprovinces),sexuallytransmitteddiseases(STDs) and HIV(AIDS) areexistedinthisarea.Healthproblems relatedtotobacco andalcoholseemtobe appearing

4.3.5 Tourism (facilities, handicraft)

Touristarepoorly known fortheHinNamNorsub-watershedareabecauseistheruralhinterland.

4.3.6 Industries

Manufacturing activities include manufacturing, construction; electricity and water play an important role in this sector and have expanded over recent years. The hydropower sector continuously becomes an important source of income and sales of electricity. The strategies for the further growth aim at diversifying the further, targeting growth of economy in industrial and service sectors.

4.3.7 Mining

Presently, there is an information on mining resources situated within Hin Nam Nor sub-watershed area. Copper-gold project is currently operating and further development of thPhukham deposit u birder to incorporate the underlying copper-gold resource. The government of Lao PDR has encouraged the private sectors to develop mineral resources in the mode of avoiding negative impacts on the environment. The environmental impact assessment system needs to be established for the mining sectors. This system should clarify a regulatory body and subsequent tasks and set out the clear guidelines regarding environmental management for planning, design and operations. Not only copper and gold operations in this sub-watershed but also small scale gold mining is panning along the river that region therefore, some years water pollution issues have been reported.

4.3.8 Infrastructural facilities (Water supply, sewerage, flood control)

Protectingthewatercatchmentsis importantfortheagriculturaldevelopment.Thecatchmentarea ofallthetributariespresentsmorethanone-quarter ofthetotalMekongcatchmentandtherivers contribute anestimated35%ofitsannualflow.DuetotheHinNamNorsub-watershed geographically, andmountainouswithlimitedflatlandblockthevillageandlessirrigable\land areas,thus,thegravityfeedsystems arethemainsourcesofpotential ruralandsmalltownwater supply,especiallyinuplandareaslocatedfarfromthesurfacewatersources.

Annualfloodinganddroughtaremajorconstraints toproduction stabilityinthedominantrained ecosystemofLaos(Lindquistetal1998).Improvedagronomicpracticesweredevelopedto reducethelossfromdrought/flooding. Farmersthroughouttheuplandecosystemsregarding droughtasamajorconstraint,whichreducesthegrainyieldonaverageby30%(Fukaietal19 98)

4.3.9 Transportation (road, airport, navigation)

Thecommunitiesareconnectedtothedistricttownandprovincebytheroadtransportation system. ThereisaroadgettingthroughBanLongchengandBanXamthong.

Oneofthebenefits fromthePhuBiaGoldprojectatalocallevelisthatanyimprovementsof the localroadsmayimproveaccesstohealthfacilities,particularly duringthewetseason.Apotential impactmaybe the additionaltraumason theroadsbecauseof the increasingroadtraffic, particularlytheheavymachinerytransportation.Amitigationstrategyneedstoinclude appropriate drivertrainingalongwithcarefulplanningofhaulageroutesandtimetoavoidusingthepeak roadswithinthiswatershedareaduringthesusceptibletime.

Newaccessroadstotherelocatedvillageswillhavetobeconstructed.Thevillagesaffected by the plannedreservoirare presentlywell accessible.Theirpresentand futurelivelihoodand economicactivitieslargelydependontheconnection toothervillagesandmarkets.Itiscrucialto re-establish accessroadstoallthenewresettlementareasnotonlytoenablethepeopleto rehabilitate theirlivelihood,butalsotopromotefurthermarketactivitieswithagriculturalandnon-agriculturalproductsandservices.

4.3.10 Transmission

There is an electricity facility with the transmission line along the Road to Xaysomboun province and electricity grid within sub-watershed villages. There is a telephone network which can communicate entire villages.

4.3.11 Power sources

Villagershave collectedfirewood fromboththeMountainousforest and theareawhereslash and burncultivation/shiftingcultivationwerepracticed.However,thecharcoalproductionissui tablefor indooruseas itproduceslesssmokethanfirewood,contributingto

thehealthwhoareresponsible forcooking,thepriceof charcoalsoldinHouaymovillageis15,000-20,000kip/bag./30-40kg butthepriceinVientianecapitalisashighas30.000kip/bage/30-40kg.

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, infrastructural facilities, 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 Environmental impactswithin 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

The construction of the roads, development projects if not well controlled could deposit resultant construction wastes such as sediments from the earthworks, soils and fuels into the rivers and also surface runoffs. This may ultimately lead to potential degradation of the water quality especially for downstream users and adversely affect the aquatic life.

Mitigation Measure

- Adequate regular checks on the equipment in use to ensure they are well maintained and in good working condition to prevent leaking oils and fuels. Refueling should be done in safe locations where is no likelihood of spillages,
- Access roads should not venture into the sensitive areas such wetlands around the project areas.
- Apply sediment control procedures to prevent sediment returning into the rivers
- Ensuring all construction equipment and machineries are clean and mud free

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 affected by grazing management practice. This be an interdisciplinary approach, which should include range science and related disciplines such soil and watershed science.
- Develop restoration/vegetationtechniques 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 from the project activities and irrigation

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 1 Indicative 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. 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		
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 jokedto 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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