

CHAPTER 9 ENVIRONMENTAL IMPACT SURVEY

CONTENTS

CHAPTER 9	ENVIRONMENTAL IMPACT SURVEY	9-1
9.1	Review and Status of Existing EIA Report.....	9-1
9.1.1	EIA Related National Policies and Legislative Framework	9-1
9.1.2	Review of Existing EIA Study	9-2
9.2	Supplemental EIA by the JICA Study Team.....	9-10
9.2.1	Supplemental EIA Survey	9-10
9.2.2	Application of GIS	9-15
9.3	Natural Environment Impact Assessment.....	9-18
9.3.1	Physical Environment Impacts.....	9-18
9.3.2	Biological Environment Impacts.....	9-39
9.3.3	Impacts in the Downstream of the Dam.....	9-54
9.4	Socio-Economic and Cultural Environmental Impact Assessment	9-55
9.4.1	Objectives.....	9-55
9.4.2	Methodology	9-55
9.4.3	Identification of the Project Affected Areas	9-59
9.4.4	Socio-Economic and Cultural Situation	9-61
9.4.5	Key Socio-Economic and Cultural Effects.....	9-66
9.4.6	The Framework of Resettlement Plan	9-79
9.4.7	Preparation of Social Action Plan	9-82
9.5	Stakeholder Meeting.....	9-86
9.5.1	Overview of Stakeholder Meetings	9-86
9.5.2	First Stakeholder Meeting during Scoping Phase.....	9-87
9.5.3	Second Stakeholder Meeting.....	9-91
9.5.4	Third Stakeholder Meeting.....	9-95
9.6	IEE for Transmission Line – Damauli to Bharatpur	9-98
9.6.1	Objective	9-98
9.6.2	Project Line Route and Affected Areas	9-98
9.6.3	Alignment Alternatives.....	9-99
9.6.4	Physical Environment.....	9-105
9.6.5	Biological Environment	9-105
9.6.6	Socio-economic and Cultural Environment	9-106
9.6.7	Environmental Impacts and Mitigation	9-110
9.6.8	Institutional Requirements and Environmental Monitoring Program	9-111
9.6.9	Findings and Conclusion	9-111
9.7	Environmental Management Framework for the Project	9-112
9.7.1	Overall EMP Summary	9-112

9.7.2	Stakeholders under the Environmental Management Plan.....	9-122
9.7.3	Project's Environmental Management Office	9-123
9.7.4	Administrative and Management Cost for ESMU	9-124
9.7.5	Environmental Monitoring Program	9-124
9.7.6	Records and Corrective Actions	9-131
9.7.7	Environmental Audit	9-131

LIST OF TABLES

Table 9.2.2-1	Outline of GIS Database.....	9-17
Table 9.2.2-2	List of Printed Maps	9-18
Table 9.3.1-1	Land Use Reservoir Area.....	9-18
Table 9.3.1-2	Land Use Project Facility Sites.....	9-19
Table 9.3.1-3	Water Quality Analysis Report of Main Parameters.....	9-20
Table 9.3.1-4	Comparison with Drinking Water Quality Standards	9-20
Table 9.3.1-5	Water Sources Impacted by the Project	9-21
Table 9.3.1-6	Comparison of Unregulated and Regulated Flows in the Seti & Madi River.....	9-30
Table 9.3.1-7	Comparison of the Measures for the Eutrophication in the Reservoir.....	9-33
Table 9.3.1-8	Proposed Bio-engineering Measures for Soil Erosion Control.....	9-34
Table 9.3.1-9	Mitigation Cost for Physical Environment/Construction Phase	9-37
Table 9.3.1-10	Mitigation Costs for the Downstream Effects to Communities.....	9-38
Table 9.3.1-11	Mitigation Costs for Watershed Management	9-39
Table 9.3.1-12	Monitoring Costs for the Physical Environment	9-39
Table 9.3.2-1	Forest Types in the Reservoir Area under Various FSL.....	9-40
Table 9.3.2-2	Forest Types in the Project Facility Sites.....	9-41
Table 9.3.2-3	Plants of Project Sites under Different Conservation Categories	9-43
Table 9.3.2-4	Forest Area Affected at FSL 415 m in the Reservoir Area	9-44
Table 9.3.2-5	Forest Area by Management Types in the Project Facility Sites	9-44
Table 9.3.2-6	Mammals of the Project Area	9-44
Table 9.3.2-7	Fish Species Composition.....	9-47
Table 9.3.2-8	Migratory Life History of the Long Distance Migrant Fishes of the Project Area	9-48
Table 9.3.2-9	Economic Value of the Fish Species of the Project Area.....	9-48
Table 9.3.2-10	Estimate of Forestry Loss due to Reservoir at FSL 415 m and Associated Compensation	9-52
Table 9.3.2-11	Mitigation Costs for Fisheries	9-54
Table 9.3.2-12	Monitoring Costs - Construction & Operation Phases	9-54
Table 9.4.2-1	Sample of Household Survey	9-58
Table 9.4.2-2	Ethnic/Caste Division	9-58
Table 9.4.2-3	Focus Group Discussion	9-59
Table 9.4.3-1	VDCs/Municipality Affected by the Project Components.....	9-60
Table 9.4.4-1	Summary of Socio-Economic Situation in Tanahu District.....	9-62
Table 9.4.4-2	Summary of the Socio-Economic Situation in the Affected VDCs/Municipality	9-63

Table 9.4.4-3	Summary of the Socio-Economic Situation of Affected Persons/Households (N=399)	9-65
Table 9.4.4-4	Summary of Community Resources and Properties	9-66
Table 9.4.5-1	Cultivated Areas in the Reservoir Site as per GIS and Cadastral Maps	9-67
Table 9.4.5-2	Cultivated Areas in the Reservoir Site as per GIS and Cadastral Maps	9-67
Table 9.4.5-3	Annual Production Loss of the Agricultural Land.....	9-68
Table 9.4.5-4	Forest Area by Management Types in the Project Area.....	9-68
Table 9.4.5-5	Number of Land Plots Affected by the Project.....	9-70
Table 9.4.5-6	Number of Affected Land Owners of the Project Area.....	9-70
Table 9.4.5-7	Affected Private Structures	9-71
Table 9.4.5-8	Structure Affected Owners of the Project area.	9-72
Table 9.4.5-9	Residential Structure Affected Owners of the Project Area.....	9-72
Table 9.4.5-10	Residential Structure Affected Owners without Legal Holdings.....	9-73
Table 9.4.5-11	SPAF and PAF by VDC	9-74
Table 9.4.5-12	SPAF and PAF by Cast/Ethnicity.....	9-74
Table 9.4.5-13	Project Affected Main Infrastructures.....	9-75
Table 9.4.5-14	Affected Community Structures	9-76
Table 9.4.6-1	Major Resettlement Effects on APs and Possible Mitigating Measures	9-80
Table 9.4.6-2	Proposed Compensation and Benefits of APs.....	9-81
Table 9.4.6-3	Cost Summary	9-82
Table 9.4.7-1	Socio-economic Effects on Communities and Possible Mitigating Measures	9-83
Table 9.4.7-2	First and Second Priority Needs and Proposed Social Action Programs	9-84
Table 9.4.7-3	Proposed Social Programs	9-85
Table 9.4.7-4	Cost Summary	9-86
Table 9.5.2-1	Suggestions, Feedback and Comments from the Participants	9-89
Table 9.5.2-2	Stakeholder Meetings Covered by Print Media	9-91
Table 9.5.3-1	Participants of 2nd Stakeholders Meeting	9-92
Table 9.5.3-2	Suggestions, Feedback and Comments from the Participants	9-93
Table 9.5.3-3	2nd Stakeholder Meetings Covered by Print Media.....	9-94
Table 9.5.4-1	Participants for the 3rd Stakeholder Meeting	9-96
Table 9.5.4-2	Suggestions, Feedback and Comments from the Participants	9-97
Table 9.5.4-3	3rd Stakeholder Meetings Covered by Print Media.....	9-98
Table 9.6.3-1	Land Use along Transmission Line Alternative Alignment I.....	9-102
Table 9.6.3-2	Land Use along Transmission Line Alternative Alignment II	9-103
Table 9.6.3-3	Land Use along Transmission Line Alternative Alignment III.....	9-104
Table 9.6.6-1	Demographic Characteristics of the Affected Districts	9-106
Table 9.6.6-2	Population Distribution in the Affected VDCs and Municipality	9-106

Table 9.6.6-3	Houses & Other Structures and Features along 220 kV Transmission Line	9-108
Table 9.6.7-1	Environmental Impact and Mitigation Measure Matrix for Significant Adverse Environmental Impacts of the 220 kV Transmission Line Project	9-110
Table 9.7.1-1	Summary of Environmental Impacts and their Corresponding Mitigation/Enhancement Measures and Environmental Management Plan.....	9-113
Table 9.7.2-1	Environmental Management Roles and Responsibilities	9-122
Table 9.7.4-1	Summary of Administrative and Management Costs for ESMU.....	9-124
Table 9.7.5-1	Environmental Monitoring Plan	9-126

LIST OF FIGURES

Fig. 9.3.1-1	Results of Vollenweider Model Analysis	9-26
Fig. 9.3.2-1	Vegetation Study Plots Location.....	9-42
Fig. 9.3.2-2	Number of Plants with Different Use Values Recorded in Project Area	9-43
Fig. 9.4.2-1	Methodologies, Expected Findings and Deliverables.....	9-56
Fig. 9.4.3-1	VDCs/Municipality Affected by the Project (Group 1 and Group 2).....	9-61
Fig. 9.5.2-1	Participants from Affected Municipality/VDCs	9-88
Fig. 9.6.3-1	Alternative Route of Transmission Line.....	9-100

CHAPTER 9 ENVIRONMENTAL IMPACT SURVEY

9.1 Review and Status of Existing EIA Report

9.1.1 EIA Related National Policies and Legislative Framework

Nepal has made significant strides in the environment field by developing national policies and legislative requirements for assessing the environmental impacts of development projects. Under the current legislative framework, particularly as per the Environmental Protection Act (EPA) 1996 and the Environmental Protection Rules (EPR) 1997, the proponent should carry out IEE and EIA of the prescribed projects. This section describes the key national policies and legislative framework related to EIA.

(1) National Conservation Strategy

The National Conservation Strategy was formulated in 1988, which was the first serious attempt to formulate a national environmental policy framework for the country. It was instrumental in paving the way for a series of relevant policy pronouncements in the environmental field. In this strategy, it states that an Assessment and Review Office will be established to be responsible for socio-economic and environmental assessment. It also requires that the proponent of a proposed development project need to prepare and submit the impact statement regarding the potential socio-economic and environmental effects to the Assessment and Review Office.

(2) Nepal Environmental Policy and Action Plan (NEPAP)

Nepal Environmental Policy and Action Plan was formulated in 1993 to further incorporate environmental concern and protection in the development processes. It analyzes the environmental issues in multi-sectoral framework and formulates a strategy for maintaining a balance between economic development and environmental conservation.

(3) National EIA Guidelines

The National EIA Guidelines were developed as an umbrella framework by the National Planning Commission in collaboration with IUCN in 1993. The guidelines contains objective, methods of screening projects requiring the level of environmental assessment, scoping, impact identification and prediction, report review, monitoring and evaluation and impact auditing. The guidelines also include methods for ensuring public participation during the preparation of the EIA report. Within the framework of the National EIA Guidelines, two separate EIA guidelines of Forestry and Industry Sector were prepared and endorsed in 1995.

(4) Environment Protection Act 1996 and Environment Protection Rule 1997

The Environment Protection Act (EPA) 1996 and the Environment Protection Rule (EPR) 1997 were enacted to make the integration of IEE and EIA legally binding to the prescribed projects. Since the existing Acts were too scattered to meet the needs of the overall environmental problems sufficiently, the EPA and EPR have been considered as the long-awaited, and the all-embracing type of umbrella legislation on the environment. A significant contribution by the EPA is the provision of a legal basis for the authorities to fix and enforce guidelines and standards of environmental issues and to impose restrictions on all activities and equipment if they are found to have any significant adverse effect on the environment. The EPA obliges the proponent to prepare IEE or EIA report on the prescribed proposals implementation upon the approval of EIA by concerned agency, i.e. sectoral ministry and MoEST. The Act states the process for the submission and approval of IEE or EIA reports. The EPR outlines provisions to prepare and submit the scoping report, Terms of Reference, and IEE/EIA reports for approval, and public consultation processes.

9.1.2 Review of Existing EIA Study

(1) Current Status of Existing EIA Report

NEA carried out EIA for the Upper Seti Hydropower Project as per the National EIA Guidelines, 1993, EPA, 1997 and EPR, 1997. The status of the existing EIA within Nepal's Regulatory System is summarized as follows:

- The EIA was prepared based on field work in January 2003, with report compilation later that year and then a Public Consultation meeting held in January 2004 and a draft EIA submitted to Department of Electricity b Development (DOED) in July, 2004.
- Comments on the Draft EIA by DOED were received by NEA in October 2005 and NEA have responded to these comments and the Final Draft EIA was submitted in December, 2005
- The Final Draft EIA has been reviewed and approved by DOED and has been forwarded to the Ministry of Water Resources (MOWR) who in turn will approve and submit it to the MOEST for their approval. This is a process with a minimum approval time from MOEST taking 5-6 months but generally extends to more than 1 year.

The general status of the Project and the EIA investigations was confirmed by the Study Team in the field investigation in May/ June 2006. The License to Survey has been officially extended until 3 March 2008 and the License to Survey the Transmission Line was applied for on 6 February, 2006. Thus, further engineering and EIA surveys can now proceed. NEA can alter any surveys and adjust the impacts as long as the Project does not affect and alter the number of Village or District Development Committees mentioned in the License or

there are not any major changes in Project structures. This presents an opportunity to adjust and supplement the EIA if the Full Supply Level (FSL) and project basically remain the same. Additional comments and further updating of the status of the EIA will be included in subsequent Study reports.

The Study Team conformed, in May 2007, the NEA's intention regarding revision of the existing EIA as follows:

- NEA and the ministries concerned recognize that the data quoted in the existing EIA have become out of date and that the supplementary EIA include surveys, impact assessments, and proposals on mitigation measures which the existing EIA did not cover.
- For the above reason, NEA will modify the existing EIA based on the supplementary EIA, after the final report is submitted to NEA. After the modification, NEA will submit the revised EIA to DOED for appraisal, and the EIA will be checked and reviewed by MOWR and MOEST.

(2) Natural Environment

Although the existing NEA EIA did not make these distinctions, from the physical and social environmental point of view, it is useful to conceptualize the reservoir's approximately 27 km reservoir area and downstream area as divided into four separate zones:

- 1) The Project Facility Area, extend from the dam site to the downstream of the confluence with the Madi River, project facilities including dam, powerhouse, access road, batching plant and spoil bank are arranged in the vicinity of the rural lands and communities located on both sides of the Seti and Madi confluence area
- 2) The Lower Reservoir (downstream part of the reservoir), approximately 15 km stretch along the Seti River, that is an uninhabited, forested, narrow gorge, and
- 3) The Upper Reservoir (upstream part of the reservoir), an approximately 12 km Seti River stretch relatively flat and spread out, with fertile alluvial and colluvial deposits (*Tars* in Nepali, meaning highly fertile alluvial areas located at the confluence of tributary rivers and streams and used for rice paddy), scattered settlements and at its uppermost end, the semi-urban Bhimad Bajar community
- 4) The Downstream Zone of the Seti River, the river course in the just downstream of the project area form a narrow gorge

The NEA EIA was reviewed by the Study Team earlier during Phase 1 and generally found compatible with the Nepali standards for the physical and biological environmental impacts and management and monitoring plans. The NEA EIA, however, does not comply with international standards for natural environmental aspects, especially as outlined in the JICA

Guidelines for Environmental and Social Consideration (the JICA Guidelines),¹ due to inadequacies in coverage relating to the following:

- Climate and meteorology
- Geology and erosion risks in the reservoir and in the watershed
- Inadequacies in the baseline data relating to vegetation, forestry, wildlife habitat and resources and fish, to a lesser extent
- Sedimentation in the reservoir and flushing of sediments from the reservoir
- Alteration to flow regime and downstream effects
- Background data and seasonal variations in water quality
- Watershed management and associated conservation measures

The background descriptions, impact assessments and mitigation, management and monitoring measures are lacking to a large degree for all above aspects. It is to be noted that descriptions on the fisheries aspects are adequate but the options for mitigation required reviewing. All of the shortcomings of the original NEA EIA were adequately addressed by the Supplemental EIA

(3) Socio-Economic and Cultural Environment

The results of review of the existing EIA from the socio-economic and cultural environment aspects are presented below.

1) Existing Socio-Economic and Cultural Conditions

Both the socio-economic and cultural environment baseline and the potential socio-economic and cultural impacts were identified based on the secondary data sources, and the primary data collected during the EIA site investigation by NEA. The secondary data included various compiled government statistics and data while the primary data was compiled from field observation, meetings with local stakeholders including residents, and household sample surveys (HH sample surveys) for targeting 113 households residing close to the reservoir, dam and powerhouse site.

The key feature of the district level baseline is that it is dominantly an agrarian district with over 90% of population depending upon agriculture. Besides, it is one of the densely populated (304,496) hilly district of Nepal (197 person/km²). About 68% of the district population is economically active. Literacy rate is 69.27%, which is among the highest in Nepal. Nearly 50% of the land is under forest while 42% is under intensive agriculture.

¹JICA Guidelines, Section 1.3 Impacts to be Assessed: 'Impacts on the natural environment include trans-boundary or global-scale impacts through air, water, soil, waste, accidents, water usage, climate change, ecosystems and biodiversity.'

Out of the 47 VDCs of the Tanahu District 9 VDCs are recognized as directly impacted VDCs namely Pokhari Bhanjyang, Kahun Shivapur, Kotdurbar, Majkot, Jamune, Chhan, Bhimad, Rising Ranipokhar, and Vyas Municipality. These VDCs constitute about 23.29% of the district population indicating that the impacted VDCs are among the most populace VDCs of the District.

Approximately 45 households have been recognized as the potential impacted households who need to be relocated from the current places to new ones. This estimation is based on the case of the proposed Full Supply Level of 425 m, plus 10 m. Socio-economic information on 113 households residing close to the reservoir, dam and powerhouse site is collected using the structured questionnaire under HH sample surveys. The characteristics of these surveyed HH are as follows;

- There are 9 dominant ethnic groups within the area, Magar (37%) are followed by Brahmins (17%), Newars (11%), Damai (7%), Gurung (6%) and Chetri (6%).
- Average HH size is 6.34, with higher male population compared to female.
- The population structure is dominated by 15 to 59 age group (65%) followed by below 15 age group (about 32%). Old and aged above 60 age groups constitute only a small segment of population.
- Most of the people (98%) are living in the area for more than 3 generation.
- Average landholding size is 0.84 ha/HH, with about 30% HH having land hold size below 0.25ha. Chetris HH land holding is highest (2.14 ha) followed by Brahmins (1.25 ha), Magars (0.9 ha), Gurungs (0.7 ha), Kamis (0.5 ha), and Damai (0.5 ha).
- Most of the HH are owner and cultivator. Pure tenant are less than 2%.
- Only 3.41% of the population have livelihood based on wage and labor while others are based on agriculture, services and business.
- Average annual per capita income is NRs. 8,167 which above Nepalese poverty income level and the average per capita expenditure is NRs. 4,028.
- The major cereal crop grown in the area is paddy, wheat, maize and millet and the cash crops are mustard, potato, legume, fruits and vegetables. Three to two crops are grown annually. Normally in irrigated land 3 crops are grown annually while in the upland (tars) only 2 crops are grown. Average cropping intensity is 179%.
- Only 39% of the HH have sufficient agricultural produce and about 15% of HH has their agricultural produce sufficient for only 3 months.
- About 35 part time fisher men are accounted in the area while 250 fishermen exercise occasional fishing practice.

- River Seti water has no consumptive and non-consumptive use in the project area.

2) Socio-Economic and Cultural Environmental Impact Assessment

The section 5.3 in the exiting EIA report discusses the potential socio-economic and cultural environmental impacts of the project for construction and operation phase. These adverse impacts are summarized below.

- The project will have direct and indirect impacts on 41 settlements in 9 VDCs of Tanahu district during the construction and operation phases.
- Loss of 162 ha of arable agricultural land amounting a loss of 768.58 tones/year of agricultural crops equivalent to 16 million Nepali rupees with serious implication on the livelihood conditions of the affected people during the construction and operation phases.
- About 45 households will be impacted directly by the land and property acquisition.
- The number of affected households who will lose their agricultural land is estimated to be 324. These households will be impacted by the loss of livelihood during the construction and operation phase
- Peoples living close to the project site but not affected physically are recognized as indirectly affected households. These peoples are assumed to be impacted in various ways during the construction operation phases.
- Influx of project workers is assumed to impact on the social life, cultural and traditional values of local communities during the construction phase.
- Income from fishery resources of 286 families amounting to 11,440 kg/year equivalent to NRs. 1.14 million has been estimated during the operation phase.
- One temple will be impacted by inundation near Bhimad during the operation phase. Furthermore, 3 cremation sites will be inundated by the reservoir.
- A total of 4 suspension bridges will be inundated by the reservoir formation with implication to the local transportation and communication during the operation phase.
- Influx of construction workers during the construction phase is assumed to have disturbance to the existing law and order situation around construction sites.
- Withdrawal of project activities will impact the booming economic activities of the areas near construction sites during the operation phase.
- Influx of outside workers is assumed to have stress upon the existing water supply, sanitation, and other health service facilities with implications. The lack of proper sanitary measures and increase in waste and water pollution during the construction phase will potentially lead to the outbreak of the epidemics of various diseases.

- The construction activities are assumed to have potentials of occupational health risk as well as risk of accidents.
- The influx of outside workforce at the construction sites is assumed to impact on the community resources particularly the forests and the fishery resources and wild resources of the area by illegal harvesting of these resources.
- White water rafting at the Seti River is assumed to be impacted severely during the operation phase.

The adverse impacts predicted are of very general nature not sufficient to assess the gravity of socio-economic and cultural impacts for the following reasons.

- The existing EIA report does not identify the land and property of severely project affected families who will need to be relocated from the current residential premises to a new location, though 45 households are categorized as such a group.
- In the report, the affected arable land is estimated to be approximately 162 ha. However, it does not provide specific information on land use and land area that will be affected by the project and whose land will be impacted. Furthermore, it does not provide the information on the project facility area including the temporary facilities and access road
- It is assumed in the report that 324 households will be affected by the project. However, this estimate is based on that the total arable land is divided by the land plot size which more than 50% of surveyed households have. This means 162 ha divided by 0.5 ha makes 324 households. The report does not specify
- There is no description of non-title holders who will be affected by the project. It is assumed that such non-title holders, who can be generally characterized as the poor and disadvantages groups, will be included as affected households, and are likely to be affected severely compared to those with legal title holders.

3) Mitigation and Enhancement Measures for Socio-economic and Cultural Environment Impacts

The section 7.3 presents mitigation and enhancement measures concerning socio-economic and cultural impacts, and includes guidelines for land and property acquisitions and mode of compensation. The key proposed mitigation measures are summarized as follows;

- With regard to the mode of compensation, cash compensation is preferred and proposed as it is difficult to make land-for-land compensation due to land scarcity and steep terrain. For cash compensation, the two options namely one-time compensation and long-term compensation are proposed. The former is paid immediately after land

acquisition while long-term compensation is paid in several installments. Concerning the cost, it is estimated that 479 million is for compensation for land acquisition and 40.5 million is for resettlement. For the affected families who lose their land and property, an Acquisition, Compensation and Rehabilitation Plan (ACRP) will be developed. The cost for preparation of ACRP and Environmental Management Action Plan (EMAP) is estimated to NRs 2.5 million.

- For minimization of the impacts on cultural practices from the influx of the outside work force, the existing EIA report recommends a stringent code of ethics is enforced to these workers.
- As mitigation measures to pressure on the existing infrastructure, establishment of adequate facilities such as health clinics, hospitals, schools, water supply, and sanitation facilities both within the outside construction camps is proposed. One temple in Bhimad Bajar which is likely to be inundated needs to be relocated. It is also recommended that new suspension bridges be constructed at appropriate location. The cost for the rehabilitation of infrastructure is estimated to be NRs 10.6 million
- To reduce the impacts on the local economy and enhance the livelihood of the affected families, the report recommends that the employment opportunities be provided to these affected families and the people of the affected communities.
- For occupation health and safety and other accidents related to project construction operation warning measures, use of appropriate safety tools and gears have been proposed.
- Measures for rehabilitation to the affected families and communities include programs for Environmental Awareness for Conservation, Training and Loan Assistance Programs, and Education Programs.
- Under the environmental enhancement measures, Watershed management programs, Programs for Agriculture Improvement, Rural Electrification Programs, Programs for Community Development Initiatives with a host of training packages for farmers and communities are proposed. The cost for these environmental enhancement measures is estimated to be NRs 155.76 million.

Although a range of mitigation and enhancement measures are proposed, the following information is inadequate.

- As recommended in the existing EIA report, the ACRP need to be developed. It implies that the impacts on the affected households/communities are not well identified. In addition, the estimated cost for compensation for land acquisition, relocation and rehabilitation is purely tentative and requires the development of ACRP including further impact assessment and detailed cost estimation.

- Except for the training packages, the amount allocated for environmental mitigation and enhancement measures are lump sum. The more detailed design for mitigation measure is required including where these mitigation measures are to be implemented for whom.
- There are numerous inconsistencies in the data given in the report for example accounted land for shoreline landslide risk is 10m high above FSL level while in some places it is denoted to be 100m length from the reservoir shoreline. So is the case with the involvement of outside workforce in some section it is estimated up to 2,500 and in some section it is 1,000 only.

4) Public Consultation

According to Government legal procedures, public consultation needs to be carried out one during Scoping and other after completion of the Study. Public consultation described in the existing EIA report is illustrated below.

- The scoping consultation is done through publication of a 15 days notice to seek and solicit the public opinion in written form. The notice was published on the Gorkapatra National Daily dated on February 4, 2001. Key concerns are related to erosion and sedimentation, and compensation issues of the affected land and property. Others are mostly related to opportunities for employment and skill development as the enhancement measures.
- The public hearing was held at Damauli on January 25 2004. Beforehand, a public notification was made on the Gorkapatra daily and by posing notices to the affected VDCs. Approximately 200 people participated in this meeting. The major concerns raised include compensation for land acquisition, and process of resettlement. Other concerns are related to implication on fisheries, water quality, down stream environmental water release, employment opportunities, and the enhancement programs.

The existing EIA report does not mention whether or not these concerns raised were incorporated into that report as part of mitigation and enhancement measures.

5) Environmental Management Plan

The **Chapter 9** describes the overall environmental management approach, environmental monitoring and environmental auditing as per Nepalese EIA requirements. The summary is presented below.

- Over all environmental management responsibility is given to the project proponent. The proponent is expected to be responsible for making adequate funding arrangements for the environmental cost and for incorporation of the environmental

clauses in the contract documents prior to floating the tender for contract bidders. Besides, the proponent needs to take initiatives for the formation of price fixation committee as per Nepalese Land Acquisition Act.

- During project implementation, a separate unit such as Upper Seti Environment Unit is required to be formed to administer and implement day-to-day activities according to proposed environmental mitigation measures. Under this Unit, it is proposed that three sections namely project resettlement unit, mitigation measure coordination unit and compensation unit be established.
- Baseline monitoring, compliance monitoring and impact monitoring are proposed with specifics of indicators, monitoring location, frequency of monitoring, and monitoring methods. Key monitoring parameters under baseline are watershed, hydrology, water quality, air quality, fishery, forest, settlement and health and sanitation. The parameters under impact monitoring are the compliance of EIA prescribed provisions, and land and property acquisition procedures. Impact monitoring parameters include watershed, shoreline stability, water quality, air quality, forest cover, wildlife, fishery, compensation to affected communities/households, occupational health, community health, law and order and changes in social values. Most of the indicators of monitoring parameter are qualitative except for a few of the parameters. A total of NRs 14.63 million is estimated for monitoring.
- The proponent is also responsible for the environmental auditing in consultation with other government agencies such as MOEST, MOWR, Ministry of Forest and Soil Conservation. Auditing parameters under physical, biological and socio-economic and cultural environments are same as the monitoring parameters. A total cost of NRs 3.597 million is estimated for a one-time auditing after 2 years of project completion.
- For the overall environmental management of the project, a total of NRs 720.62 million is estimated.

The existing EIA report does not mention the monitoring and auditing role of the concerned agencies. The roles stipulated in the EPR 1997 are as follows;

- The MOWR and the concerned ministries are expected to take a responsible for carrying out monitoring activities while MOES is mainly responsible for undertaking the auditing.

9.2 Supplemental EIA by the JICA Study Team

9.2.1 Supplemental EIA Survey

A detailed plan for surveys has been established as below based on the above review results, discussions with NEA counterparts and general knowledge of Nepal. Subsequent to the **Section 9.3**,

results of the Supplemental EIA Survey conducted by the JICA Study Team are summarized, while detailed results are shown in Appendix of the Final Report as Environmental and Social Considerations Report (ESC Report).

(1) Natural Environmental Studies

1) Examination of the eutrophication potential of the reservoir

While this is not considered a problem at this stage, this aspect needs to be investigated and confirmed through:

- a. Collection of water quality data including those from the existing EIA, NEA Engineering Services and other sources
- b. Take additional samples and analyze for specified parameters in dry season (June) and wet season (October) at four locations; downstream of Damauli, downstream zone affected by releases (dam site to Madi River confluence), proposed dam site, and Bhimad Bajar.

The water quality parameters to be measured in the samples include:

- pH
 - Turbidity
 - Total Dissolved Solids
 - Suspended Solids
 - Settleable Solids
 - Non-settleable Solids
 - Total Alkalinity
 - Total Hardness
 - Dissolved Oxygen
 - Chemical Oxygen Demand
 - Biological Oxygen Demand
 - Total Coliform
 - Measurements for Ca, Mg, NH₃, PO₄, Cl, Na, K & Fe
- c. Evaluation of the possibility of eutrophication of the reservoir using an appropriate eutrophication model (Vollenweider) after predicting conditions in the reservoir in terms of nutrient balance, future fish production and cage-culture, runoff into the reservoir and releases from the reservoir during operational phase, and water exchange rates and retention times

2) Study on aquatic ecology and fishery aspects

The aquatic ecology and fisheries aspects were examined in the existing EIA as a separate sub-study based on one dry season field trip. The study is included as a separate document

entitled *Volume II – Fish and Aquatic Life Study Report (SRCL, 2004)*. This is a comprehensive document compiling the results on sampling of fish, water quality, phyto- and zoo-plankton, mitigation and enhancement measures needed and a list of fishermen. This study also includes projections from cage culture and open-water fisheries and includes programs to remediate adverse effects of the Project.

It is to be noted that there is a Begnas Fisheries Research Station (BFRS) operating in the area. BFRS' activities include:

- A breeding station for including *Tor* species and Chinese carp, but no program for Snow trout, *i.e.*, one of the main species in the reservoir area
- Provision of fingerlings by the BFRS to stocking programs and commercial fishermen with cage culture in lakes near Pokhara, *i.e.*, Phewa Lake, Begnas Lake and Rupa Lake
- Supervision of all commercial operations in Western Region

It is noted that fisheries programs in the areas relating to the Kali Gandaki A and the Marsyangdi HEPs have or are being undertaken and with their association and experience in these projects will provide valuable information for the Study.

It is recommended that surveys be carried out in both the wet season (June/July) and dry season (October), by sampling of fish and aquatic ecology – biological water quality, algae, plankton, benthic organisms, invertebrates and fish, in order to confirm findings of the existing EIA including. This study should cover both the reservoir area and affected areas downstream in the Seti River.

3) Study on vegetation and forestry

The vegetation and forestry was surveyed at 13 sample sites in the existing EIA, and the result indicated that some 155 ha of forested land would be lost. The sampling shows as follows:

- 59 species of plants with 20 species at the power station/dam site, 40 species in the forest of right bank and 59 species in forests of the left bank
- Three species which are listed as endangered species, Khair (*Acacia catechu*), Simal (*Bombax ceiba*) and Sal (*Shorea robusta*), of the 59 species
- 10 species used as food, 9 as fuel wood, 38 as fodder, 15 as timber and 11 as medicinal plants

Six (6) Community Forests are located within the general area of the reservoir so that the area to be affected should be re-confirmed in the Study.

A total of 199.5 ha and approximately 710 households have an interest in these

Community Forests through membership in Community Forest User Groups (CFUGs), and further details are needed including data on status of trees and plantations (e.g., Sisoo plantations East of Bhimad Bajar).

The vegetation and forest types have not been assessed in any of the ancillary areas such as access roads, borrow pits and quarry areas, lay down areas, temporary and permanent camps and spoil disposal areas. A survey in all these works areas needs to assess the vegetation and forest type in the areas.

4) Study on wildlife resources

The documentation of the wildlife aspects in the existing EIA is inadequate, because it was prepared based on literature and discussions with local residents. It is lacking in its descriptions and assessment of impacts of the Project in this regard and needs to be rectified to satisfy international guidelines. For instance, the presence and status of birds (e.g., king fishers and eagles) and aquatic animals (e.g., otters and water monitors) needs to be assessed, because these species are indicated in white-water rafting guides as significant. Also it is probable that the insect communities (e.g., butterflies and crustaceans) in the gorge environments have not been adequately assessed. It is unlikely that mammals such as the ghoral² are present, but again it should be confirmed through sampling and discussions.

5) Assess impacts of proposed alterations to project design and operations

This aspect will be a key feature of the new investigations, and assessment in this aspect will include:

- Study and confirm the validity of compensation flow to downstream sector proposed in the existing EIA, when the power plant is not operating
- Study alterations to downstream regime in terms of seasonal and daily fluctuations in water levels due to projected operation of the power station and recommend mitigation for this section up to Madi River confluence
- Study erosion of the river banks and lowering of the river bed in the downstream reach due to a decrease of a sediment supply from the reservoir
- Study needs for any additional mitigating actions in the Seti River up to the Madi River confluence and propose a program with prioritizing and realistic budgets for the recommended actions: this includes river training and erosion protection works for agricultural areas

² *Ghoral* (Nepali) = A kind of antelope, resembling the Ibex.

- Investigate and evaluate risks of landslides or collapsing of reservoir terraces or cliffs due to fluctuating water levels, particularly in the reservoir's upper reaches and tributaries
- Investigate and evaluate affects in the downstream sectors due to waste disposal practices during dam construction and sediment flushing during the operational phase or dredging/removal of deposits from upper reaches of reservoir

6) Study for watershed management

Watershed management which is important to the Project will include the following subjects:

- Water level fluctuations of some 55 m on an annual basis on the reservoir shoreline
- The presence of highly erodible deposits at the Bhimad Bajar/Chhari Patan/Khaniaaltar Areas in the Upper Reservoir
- Other zones where tributary streams enter the reservoir and are characterized as *Tar*
- Affects on the daily fluctuations in river levels in the downstream area from the dam site, Damauli through to the Banchare/Simaswara area

It is understood that the Danish International Development Agency (DANIDA) has a watershed management program operating in Tanahu District with one project located immediately upstream of the reservoir (Khairantar Area). Also there are a number of watershed management programs associated with Community Forests, of which several are operated by aids and NGOs in the Pokhara area within the Upper Seti watershed.

The headwaters of the Upper Seti are reserved as part of the Annapurna Conservation Area (ACA). This is Nepal's oldest reserve, was declared in 1986 and is administered by the King Mahendra Trust for Nature Conservation (KMTNC), an internationally recognized NGO. There are over 50,000 trekkers per year to the ACA based on fees payment records. The ACA communities and KMTNC have active conservation programs including watershed management.

The studies for the watershed management will be conducted referring to the GIS data, records of agencies and NGOs and appropriate programs devised; focused on the reservoir and downstream and upstream areas of the Seti River. The studies should include:

- Investigate overall features of the Upper Seti watershed using GIS data and those of all known projects including area covered and program sponsors and duration of programs
- Identify ecologically sensitive areas where additional programs are needed and prioritize these based on GIS data and field surveys

- Investigate and document appropriate mitigation and enhancement measures, particularly in immediate proximity of reservoir and downstream of the dam
- Investigate and document appropriate environmental monitoring measures

(2) Socio-economic and Cultural Environmental Impact

As discussed in the previous section, the existing EIA report recognized 45 HH as those who need to be relocated due to the project, and 324 HH as those who are to be affected in terms of their assets such as land and property. The estimated land to be acquired was 917 ha. These estimates were based on the use of 1:25,000 scale maps with a contour interval of 20 m and EIA site investigations using established benchmarks and altimeters in the Upper Reservoir. Furthermore, as the EIA regulatory system in Nepal does not include social environmental considerations to a large degree, the existing EIA report neither discusses a wide variety of these social environmental issues nor develops the framework of RAP, which is clearly required during the feasibility study phase as per JICA Guidelines for Environmental and Social Considerations published in 2004 (hereinafter referred to JICA Guidelines) and other guidelines of key international donor agencies. The report also suggested that the detailed RAP be prepared in the detailed design phase. Therefore, a separate Supplement EIA Study including the detailed socio-economic survey is obviously required to fill in the data gap of the existing EIA report and to accommodate the requirement of JICA Guidelines.

The Supplemental EIA scoping was drafted based on the use of the Leopold Matrix in collaboration with NEA. As per JICA Guidelines, it was finalized through discussions and consultation with local stakeholders in the 1st stakeholder Meetings held in Damauli and Kathmandu on June 2 and 7 2006 respectively. The main items of the Supplemental EIA concerning socio-economic and cultural aspects are illustrated below;

- Socio-economic survey targeting the affected people
- Preparation of the framework of Resettlement Plan (RP)
- Assessment of the impacts on social and cultural aspects
- Assessment of the impacts on vulnerable groups
- Preparation of the Social Action Plan
- Initial Environment Examination of transmission line routes
- Preparation of the framework and revised costs for EMP

9.2.2 Application of GIS

In order to implement the investigations on environmental and social considerations, the topographical maps with appropriate accuracy for the planned reservoir and its vicinity is indispensable. The topographical maps that to be able to be obtaining in the study area is on a scale of 1:25,000 made based on 1:50,000 aerial photos and a contour line interval is 20 m. The EIA of

NEA was conducted with use of these maps.

In this study, two distinct regions of survey operated such as a general mapping region which include the geographic extent of the Seti and Madi River basins and a detailed region affected by dam and power station. All survey data are made, stocked and managed by Geographic information system (GIS). The overall objective of the mapping work is to prepare GIS-based digital maps and data to support this project. The survey areas and survey items, also data accuracies are shown below.

The survey area comprises two (2) distinct mapping regions:

(1) The Seti River Watershed Study Region -A general mapping region-

A general mapping region, which nominally defined as the geographic extent of the Seti and Madi River basins that are within the Tanahu District of the Western Development Region in Nepal. For reference, the Tanahu District covers an area of approximately 1,500 km². In addition, the Seti and Madi River basins include the detailed mapping region, as described below.

The mapping scale for the Seti and Madi River basins is one to twenty five thousand (1:25,000).

(2) River Corridor Detailed Study Region -A detailed mapping region-

A detailed mapping region, which is defined as the area affected by the reservoir, dam and power station is a corridor bounded in the east by the confluence of the Seti and Madi River basins. The corridor generally follows the average centerline of the Seti River. The total length of the corridor is approximately 30 km and the total area to be mapped is approximately 150 km².

The mapping scale for the detailed mapping region is one to five thousand (1:5,000).

ASTER medium resolution satellite imagery (15 m pixel size) used of mapping work for a general region. The greatest feature of ASTER image is which data include a corresponding digital elevation model (DEM). Since the maximum elevation error is less than 15 m (as official announcement value), therefore, ASTER satellite imagery meets the requirement of the creation of 20 m interval contour line which required for the general mapping survey.

QuickBird high resolution satellite imagery used of mapping work for a detailed region. The main usage of the topographical maps in this study is to confirm the number of affected households (the number of residents) and the area of compensation for the land losses caused by the project. It is important for this study to grasp accurate land surface information and accurate topographical data because of compensation cost depends on the full supply water level of the project. Namely, accuracy of the topographical maps to be

prepared based on the 1:50,000 existing aerial photographs and based on ASTER satellite imagery are insufficient in evaluation of environmental and social considerations.

It is desirable that the maps with accurate altitude data are based on actual ground surveys. Considering restrictions of the study such as the survey period, however, it is not practical to prepare maps based on ground surveys or using Air-borne SAR (Synthetic Aperture Rader) data. The study team therefore will use the QuickBird satellite imageries for the base map of the detailed mapping work. QuickBird is advanced earth observatory satellites that have horizontal resolution of 60 cm and enable to create maps with a contour interval of 5 m from the satellite images. This study used the two sets of QuickBird Ortho-ready Standard Imagery which changed the sensor elevation angles.

In addition, this study made contour line data not only image analysis processing work but also the field leveling survey and the compensation of the accuracy of the contour line both 20 m contour line data from ASTER satellite and 5 m contour line data from QuickBird satellite. It shows accuracy evaluation for details of the measurement reference point acquired in this survey.

Meanwhile, the environmental impact assessment of the study includes grasping the present conditions and natures of the watershed from satellite image analyses. The study team proposes to establish a geographical information system (GIS) that includes the above-mentioned maps. The GIS consists of two forms; (1) GIS for the watershed (scale 1:25,000) and (2) GIS for the reservoir and its vicinity (scale 1:5,000). The works are to be conducted with subcontracting to a local consultant. The principal specifications of each GIS data base are as mentioned in **Table 9.2.2-1**.

Table 9.2.2-1 Outline of GIS Database

Item	The Seti River Watershed Study Region	River Corridor Detailed Study Region
Uses of GIS	Assessment for conditions of watershed, Watershed management plan, Environmental management plan	Social impact assessment, Resettlement assessment, Compensation assessment for land losses, Preparation of resettlement plan
Coverage area	1,500 km ²	150 km ²
Map scale	1:25,000	1:5,000
Satellite images	ASTER	QuickBird
Other information	Existing topographical maps (1:25,000, 1:50,000) , Soil maps, Geology maps, Land use maps	Cadastral maps, Aerial photograph, and existing geographical features survey
GIS data from satellite image analyses	Land use, 20 m interval contour lines, Vegetation, NDVI, Land slides/collapses, Glaciers	Land use, 5 m interval contour lines, Houses and architectural structures, Gradients, Gradient directions
GIS data from other information	Administrative boundaries, Roads, Rivers, Lakes, Gradients, Gradient directions, Soil classifications	Cadastrs, Roads, Rivers, Lakes, Houses, Architectural structures

This study made a GIS database with the same coordinate system, and made several types of

thematic maps. The thematic maps prepared in this study were not only GIS digital format but an image file format so that it is possible to print the prepared thematic maps without the GIS software. All maps were prepared by the A1 size that was the standard in an analog map of Nepal.

Table 9.2.2-2 shows the list of printed maps of this study.

Table 9.2.2-2 List of Printed Maps

Target	Names of maps	No of maps	Scale
Watershed Study Region	Topographic Maps (Base Map)	16 map sheets	1:25,000
	Soil Map	16 map sheets	
	Geology Map	14 map sheets	
	Landuse Map	16 map sheets	
	Hazard Map	14 map sheets	
	ASTER CIR Image	1 map sheets	1:100,000
	ASTER Pseudo Natural Color Image	1 map sheets	
River Corridor Detailed Study Region	Topographic Maps (Base Map)	18 map sheets	1:5,000
	Cadastral Map	18 map sheets	
	Landuse Map	18 map sheets	
	Topographic map of Dam Site and Construction Site with design drawing layouts	5 map sheets	

9.3 Natural Environment Impact Assessment

9.3.1 Physical Environment Impacts

9.3.1.1 Baseline Data of Physical Environment

(1) Land Use in the Project Area

The land use conditions in the Project area are as shown in **Tables 9.3.1-1** and **9.3.1-2**.

Table 9.3.1-1 Land Use Reservoir Area

SN	Land Use Type	Land Use in the Reservoir Area (ha)						
		435	425	415	405	395	385	375
1	Cultivation	223.22	108.89	69.36	51.72	37.45	28.77	16.41
2	Built up	2.19	1.34	0.85	0.38	0	0	0
	Total cultivation/built up	225.41	110.23	70.21	52.1	37.45	28.77	16.41
3.1	Grazing Land	125.21	102.56	84.59	70.03	47.87	32.25	17.62
3.2	Shrubs	34.53	28.18	17.94	11.07	4.84	2.64	0.82
	Total grazing/shrub	159.74	130.74	102.53	81.1	52.71	34.89	18.44
3.3	Hil Sal Forest	64.32	43.64	29.46	20.40	11.75	7.29	3.17
3.4	Khair/Sissoo Forest	69.88	60.97	52.62	44.46	36.70	29.12	20.52
3.5	Mixed Open Forest	338.25	304.87	271.81	239.82	206.73	175.79	138.08
	Total	472.45	409.48	353.89	304.68	255.18	212.2	161.77
4	Barren Land	5.05	1.43	0.28	0.01	0.03	0	0
5	Escarpment	13.17	8.70	5.38	2.14	0.07	0	0
6	River	109.74	98.45	91.44	87.49	81.50	75.31	65.39
7	Sand	164.58	128.54	111.74	101.19	92.57	82.85	69.12
	Total	1150.14	887.57	735.41	628.71	519.51	434.02	331.13

Source: GIS Land Use Map, JICA Study Team, 2006

Table 9.3.1-2 Land Use Project Facility Sites

SN	Land Use Types	Land Use in Project facility sites - ha
1.	Cultivation	35.28
2.	Hill Sal Forest	44.46
3.	Khair/Sisoo Forest	0
4.	Mixed Open Forest	24.24
5.	Barren Land	0
6.	Built up Areas	0.245
7.	Escarpment	0
8.	Grazing Land	7.35
9.	River	7.01
10.	Sand	9.28
11.	Shrubs	4.67
	Grand Total	132.54

Source: GIS Land Use Map, JICA Study Team, 2006

Nearly 58% of the land use in the reservoir area under various Full Supply Levels is forest land use (including shrub and grassland). The proportion of forest land use increases with the decrease in the reservoir Full Supply Level, while the proportion of the built-up area decreases. The proportion of agricultural land in the reservoir varies between 20 to 4% at lower full supply levels, with the higher reservoir levels showing a higher proportion of agricultural land being inundated. riverine areas (wet channel and river flood plain) constitute 9 to 19% of the inundation area under various reservoir FSLs, that is the higher the reservoir FSL the lower the riverine area in proportion to the total area inundated.

There are an additional 13.4 ha required for securing the risk zones in erosion prone areas associated with the nominated reservoir of FSL 415 m in places such as near the Wantang Khola, the Pedhi Khola and Tittuwa. This is made up mainly of cultivation (6.5 ha), grazing land (2.2 ha), shrubs (2.3 ha) and Sal forest (2.3 ha); accounting for over 90%.

In the project facility sites, nearly 64% of the area lies in the forest land (including shrub land and grass land). The cultivated land occupies about 46% of the total land required.

(2) Water Quality

Water quality was sampled at four locations in the reservoir area in June and October. Parameters necessary for projecting reservoir eutrophication such as Dissolved Phosphate and Total Phosphate were measured for the first time. It is to be noted in **Table 9.3.1-3** that there is variation from the end of the dry season (June) to wet season (October) with respect to factors such as Turbidity, Total Suspended Solids and Settleble Solid.

Table 9.3.1-3 Water Quality Analysis Report of Main Parameters

S. N.	Parameters	Observed Values			
		Range 04-06-06		Range 09-10-06	
		Low	High	Low	High
1.	Water Temperature	20	24	20	22
2.	pH at 25°C	8.1	8.1	8.1	8.2
3.	Turbidity (NTU)	120	230	19	34
4.	Total Dissolved Solids (mg/l)	131	175	104	162
5.	Total Suspended Solids (mg/l)	206	501	33.6	66.8
6.	Settleble Solids (mg/l)	206	497	33.3	65.9
7.	Non Settleble Solids (mg/l)	<1	3.7	0.34	0.94
8.	Total Hardness as CaCO ₃ (mg/l)	135	149	90	160
9.	Total Alkalinity as CaCO ₃ (mg/l)	133	144	89	160
10.	Total Acidity (mg/l)	2.6	7.7	2.6	2.6
11.	Chloride (mg/l)	1.5	3.0	2.0	3.5
12.	Ammonia (mg/l)	0.10	0.14	<0.05	<0.05
13.	Sulphate (mg/l)	14.8	18.5	9.1	16.9
14.	Dissolved Phosphate (mg/l)	0.02	0.047	0.02	0.03
15.	Total Phosphate (mg/l)	0.21	0.36	0.07	0.13
16.	Calcium (mg/l)	35.3	37.7	22.4	38.1
17.	Magnesium (mg/l)	9.7	14.8	8.3	15.1
18.	Iron (mg/l)	2.31	6.07	0.78	1.0
19.	Sodium (mg/l)	1.93	2.14	2.21	2.99
20.	Potassium (mg/l)	2.02	2.14	2.13	2.73
21.	Dissolved Oxygen at 15°C, (mg/l)	8.6	8.8	7.3	7.8
22.	Chemical Oxygen Demand, (mg/l)	2.0	3.5	1.5	4.5
23.	BOD ₅ , (mg/l)	0.42	0.78	0.75	0.91

Note : Sample – 1 : Upstream Damsite
Sample – 3 : Upstream, Bhimad

Sample – 2 : Downstream, Bhimad
Sample – 4 : Seti-Madi Confluence

From the results of the water quality test, toxic material was not found in the river water. With regards to biological oxygen demand and chemical oxygen demand values the river water is in the state of self cleaning status. The low BOD/COD rating shows that the water is in the state of least contamination by other organic pollutants. The Ammonia values ranges from 0.04 mg/l to maximum of 0.12 mg/l at upstream dam site, which are low.

There are no specific Water Quality Standards for river or other sources of water in Nepal, the only standards being applied to the streams as “receiving waters of industrial releases”. A comparison of the sampled water quality with Standards adopted from the Department of Water Supply and Sewage is presented in **Table 9.3.1-4** which shows that the samples exceeded the criteria for turbidity and Iron.

Table 9.3.1-4 Comparison with Drinking Water Quality Standards

S.N.	Parameters	Desirable Limits	Water Quality Sample	
			Highest	Lowest
1	Turbidity (NTU, Max)	51 (10) ³	230	19
2	Total Dissolved Solids (mg/l, Max)	500 (1500)	175	104
3	pH value	6.5 – 8.5 (5.5-9.0)	8.2	8.1

³ Value for turbidity is 5 in FAR(for mineral water), PFA, BS, WHO

S.N.	Parameters	Desirable Limits	Water Quality Sample	
			Highest	Lowest
4	Total Hardness (as CaCO ₃) (mg/l, Max)	250	160	90
5	Magnesium (as Mg) (mg/l, Max)	30	15.1	8.3
6	Iron (as Fe) (mg/l, Max)	0.3	6.07	0.78
7	Chlorides (as Cl) (mg/l, Max)	250	3.5	1.5
8	Sulphate, (as SO ₄) (mg/l, Max)	150 ⁴	18.5	9.1
9	Ammonia (mg/l, Max)	1.5	0.14	<0.05

Source: Standards adopted from Department of Water Supply & Sewerage

Presently the local populations in the reservoir surrounding areas make limited use of the Seti River waters for domestic uses, preferring to use the tributary streams in the dry season and local runoff in the wet season. This is shown in **Table 9.3.1-5**. As the reservoir impacts only marginally on these sources and they will be changed for the Resettlement Plan as its impact will be minimal. Also in the downstream zones there will be no impacts as similar use is made of the Seti River; not used for domestic sources but used for bathing, washing and stock watering only.

Table 9.3.1-5 Water Sources Impacted by the Project

Group No.	Source Type	Source Name	Location	Beneficiary Household
Chhang 4 Chokre	Pond/Pokhari	Chokre Pokhari	Just below Chokre village	39
Chhang 5 Furbari Ghaeri	Pond/Pokhari	Chokre	Chokre	20
	Pipe water	Pipale	Pipale	15
Chhang 7 Jhakash Furbari	Pipe water	Chitung Khola	Jhakash-Fulbari	23
Bhimad-1, Khanaltar	-	-	-	-
Rani Pokhari-9 Rising Patan	Spring /Mulpani	Kumalpani	Rising Patan	50
	Spring /Mulpani	Amalapani	Rising Patan	50
	Spring /Mulpani	Dulegaunda	Rising Patan	40
	Spring /Mulpani	Dhunge Pandhero	Rising Patan	200
	Spring /Mulpani	Tarebhir	Rising Patan	70
Rani Pokari-9 Rishing Patan-Kharakhare	Stream	Bokse Chhahra	Sanutari	16
Kotdarbar-1 Median Swarna	Spring /Mulpani	Risini Khola	Ward-3	35
Kahun Sivapur-3 Bakle	Kuwa	Bakle Kuwa	Bansbot	4
	Kuwa	Sarki Kuwa	Kahun	50
	Pipe Water	Kheradi	Kahun Basti	20
	Kuwa	Gidha	Ranibari Gidha	5
Kahun Sivapur-1 Beltar	-	-	-	-
Vyas 7 Tallo Patan	-	-	-	-

⁴ Value for Sulphate BS:200, FAR(for mineral water) and PFA:250

Group No.	Source Type	Source Name	Location	Beneficiary Household
Vyas-7 Beni Patan	Spring /Mulpani	Linde Dhara	Near School	25
	Water Tank	Dharakholsi and Asagurikholsi	Asaguri	45
	Pipe Water	Dharakholsi	Asaguri Puchhar	1
Totals Sources – All Non Stī River Sources		13 VDCs & 19 Sources	-	708 HHs

9.3.1.2 Impact on Physical Environment

(1) Construction Phase

1) Land Use and Topography

Most sever impact in the reservoir type project inundation of the land. Avoiding land use changes completely is not possible given the project requirements. However, selection of lower reservoir Full Supply Level could minimize existing land use changes drastically.

Construction activities of various types in the dam site and project facility sites involving excavations, drilling, blasting and material removals are potential to generate new sets of land instabilities, particularly at Betini, tailrace area and dam site. As most of these areas will be occupied by the project, the immediate consequences to the communities are very low.

2) Air Quality

Dust is likely to be generated from excavation, filling, stockpiling and construction vehicle movements associated with the construction of the various surface and sub-surface structures and transportation of the spoil materials to the spoil bank.

3) Noise Quality

Noise will be generated from cut-and-cover activities, excavation, back filling and construction of above ground structures and transportation of the construction vehicle. Vibration will be generated from and drill & blast activities in the dam, tunnel and powerhouse. It is not expected to effect communities living away from source. However, impacts to wild life are expected.

4) Water Quality

Poor sanitation facilities to construction workforce at the construction camps and construction areas may lead the use of the adjacent river bed areas for open defecation dislodging of solid waste and other sanitation uses. Such uses of the river area, especially in the dry season, may substantially degrade the water quality in the Seti River due to discharges of organic load. The implications will be on the increment in the BOD load, increase in total suspended solids, total dissolved solids, total phosphorous and Ammonia

and decrease in the dissolved oxygen.

Excavation works are expected to increase the turbidity and total suspended solids in the flowing water. Besides, accidental oil spills of the operating equipment will be released to the flowing water. And also, discharge of concrete plants, aggregate washing plants etc. also provide huge amount of fine sediment to the receiving water bodies making the water bodies unsuitable for aquatic fauna and flora.

Though the construction activities may be short lived has potential to cause short period degradation of water quality.

(2) Operation Phase

1) Land Use and Topography

Reservoir Area

In the upper reservoir area, the soil slides associated with the terrace materials are prevalent, while in the lower reservoir area, soil slides associated with colluvial material are dominant. However, the landslides in the lower reservoir area are small scale and observed above the full supply level. Thus, the risk of the slope instability due to the reservoir operation should be considered in the upper reservoir area.

The failure at the terrace breaks are mostly associated with the toe cutting by the stream, caving and overhanging. Toe cutting of the terrace breaks is remarkable at Bhimad Bajar, Sanutar, Jhakas, Wanten Khola and Pedhi Khola. In the colluvial materials below Tittuwa, It is reported that slow creeping phenomenon down the valley slope is observed in the colluvial material below Tittuwa, which is required to confirm.

Full Supply Level (FSL)

The originally proposed Full Supply Level (FSL) was at 425 m, annual flushing was not proposed in the original feasibility study by NEA. Considering the new full supply level and flushing operation, the backwater effects of the reservoir have been confirmed by the JICA Team. Investigations have confirmed that:

- The annual flushing of the reservoir at FSL 415 m will effectively control any sedimentation.
- In the case that proposed Full Supply Level is 415 m, the sedimentation will not happen around the Bhimad Bajar.
- The backwater effect after the sedimentation is minor.

Impact in the Downstream of the Dam

The Project is planned to deliver the water diverted at the dam to the underground powerhouse through the 1-km long of headrace tunnel for generation and release the

water used for the generation from a tailrace outlet to the Seti River. The tailrace outlet is located at approximately 5.5 km downstream of the dam and 3.3 km downstream of the confluence with the Madi River. Selection of this option means that high sediment deposit at the sediment flush operation and river scouring at the normal operation will be experienced in the Seti River section immediately below the dam.

The agricultural land on the left bank appears to be high enough that it would not be affected. The agricultural land on the right bank will be acquired for the construction. The permanent river protection work will not be required in this section.

However, it is difficult to estimate the erosion and sediment due to the difficulty of the analysis considering the annual flushing of the reservoir and sediments flow from the Madi River. Therefore, it is proposed that the monitoring of sedimentation patterns should be undertaken in this zone for at least 10 km below the outlet.

2) Water Quality

Thermal Stratification of the Reservoir

Since the density of the water is maximized at 3.98°C, circulation pattern in the reservoir is different due to the climate condition. According to the meteorological record from 1987 to 2004, the temperature in the project area is ranged from 3 to 38°C. The water temperature could be kept above 4°C through a year. In this case, summer stratification forms in the summer season and circulation in the whole layer is caused by natural convection effect from the post monsoon season to winter season. Thermal stratification in such process forms simple structure in the natural lakes and marshes. However, the formation of the thermal stratification in the reservoir is more complicate due to factor of the inflow and outflow of the reservoir in addition to the climate condition.

The possibility and features of the thermal stratification in the reservoir can be classified approximately as shown in the table below based on the “Run-over rate” defined by the following equation.

$$[\alpha : \text{Run - over rate}(1/\text{year})] = \frac{[Q_0 : \text{Annual Inflow Volume} (\text{m}^3 / \text{year})]}{[V_0 : \text{Gross Reservoir Volume} (\text{m}^3)]}$$

$$[\alpha_8 : \text{Run - over rate in August} (1/\text{year})] = \frac{[Q_0 : \text{Inflow Volume in August} (\text{m}^3 / \text{year})]}{[V_0 : \text{Gross Reservoir Volume} (\text{m}^3)]}$$

Run-over rate (1/year)	α	α_8
Enough possibility to cause the thermal stratification	< 10	< 1
Some possibility to cause the thermal stratification	10~30	1~5
Little possibility to cause thermal stratification	30 <	5 <

Run-over rate (1/year)	α
To form the stable thermal stratification (Stratification Type)	< 10
To temporarily form the thermal stratification temporarily, which will disappear by the turbulence of the flood and wind (Medium Type)	10~20
To hardly form the thermal stratification (Mixing type)	20 <

Since Run-over rate is calculated at $\alpha=12$, $\alpha_8=3$ for reservoir of the Upper Seti Project, the possibility and the features of the thermal stratification is categorized into "Some possibility to cause the thermal stratification" and "Medium Type". Though it has possibility to form the weak thermal stratification, the stratification could be disturbed by the flood in the monsoon season from June to October.

Furthermore, before heat receiving period, for which the thermal stratification is developed, reservoir water is completely evacuated and recreate the natural river flow condition by the sediment flush operation. Consequently, cold water cannot be retained in the reservoir and it is expected that the sever thermocline could not form in the reservoir.

Eutrophication of the Reservoir

Eutrophication can be defined as excessive organic production within a reservoir due to nutrient input. Increasing the inflow of nutrient, in particular phosphorus or nitrogen, by the human activity such as sewage and agriculture is considered as one of the cause of the algae bloom.

An occurrence of the above phenomena relates with various factors, not only the nutrient concentration flowing into the reservoir but also hydraulic condition such as retention period of the reservoir water, meteorological conditions and so on. Even though the concentration of nutrition in the water becomes higher, the problem of eutrophication could not appear in the area where the retention time is short like river since the nutrient is flow down before increasing phytoplankton.

To confirm the possibility of the eutrophication, *Vollenweider Model (1976)* is applied for the analysis, which is commonly used for initial estimation of the eutrophication in the world.

$$L(P) = [\bar{P}] \lambda \cdot (V_p + H \cdot \alpha)$$

$L(P)$: Load of total phosphorus (g/m² / year)

$[\bar{P}] \lambda$: Annual average concentration of total phosphorus (mg/l)

V_p : Setting velocity of the phodphorus (10m/year)

H : Average water depth (40.65m)

α : Run - over rate (12 times/year)

The average concentration of the total phosphorus on the sampling data is 0.186 mg/l. The total phosphorous level is much greater than 0.03 mg/l. **Fig. 9.3.1-1** presents the results of analysis for the average of total phosphorus on the sample date. Although the data used in

this study is limited to water quality analysis in June and October, the average phosphorous concentration values of sampling data reveal that the reservoir will be eutrophic even in the present day loadings of phosphorous from the Seti watershed.

The Pokhara, Lekha Nath Municipalities of Kaski district are expanding at fast pace and are expected to expand in the years to come. Considering the future land use potentials of the watershed i.e. urbanization in the Seti watershed and use trends of agrochemicals in the agricultural lands, the phosphorous loading in the Seti River from the urban and agricultural area is expected to increase.

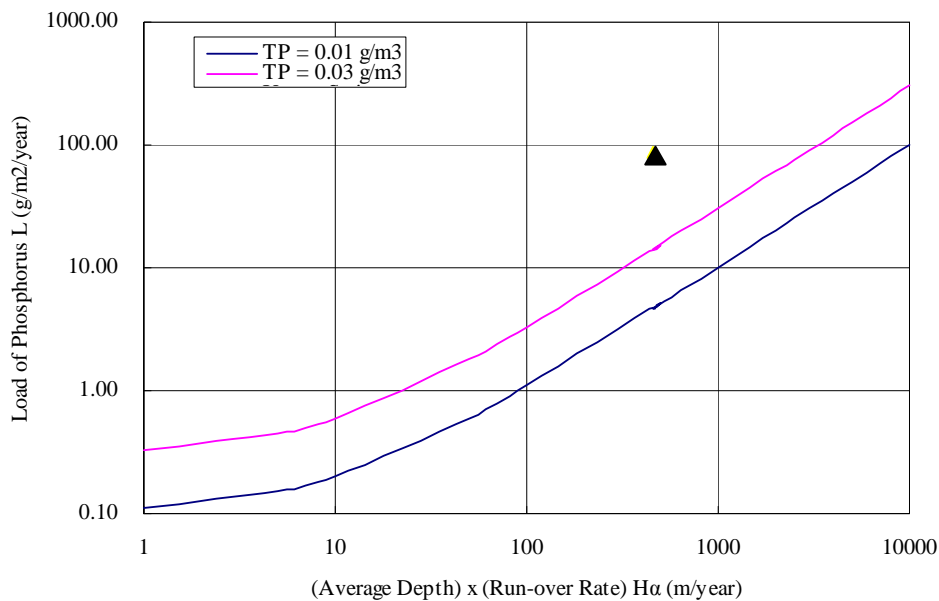


Fig. 9.3.1-1 Results of Vollenweider Model Analysis

Sediment Flushing Operation

In the case of the Dashidaira Dam in Japan, highly deteriorated water by sediment flushing operation of the reservoir has worsen the downstream water quality and caused significant damage to the downstream aquatic ecology since the sediment deposit with organic matter such as fallen leaves accumulated and deteriorated for six years in the reservoir was flushed in the winter period with low discharge in the river. Based on the lesson, method of the sediment flushing operation was changed into once a year in flooding season between June and August with high volume of water flow and high turbidity under natural condition, since it was concluded that frequent sediment flushing operation was better not to cause the downstream water pollution. Also, there are many international cases which conduct the sediment flushing operation every year with adequate water quality monitoring.

In addition, the sediment flushing operation is required every year from viewpoint of maintenance of the reservoir function, which means the sediment flushing operation with

every several years makes life of the reservoir shorten compared to that with every year since it hasten increase of sediment deposit volume in the reservoir according to the study.

For the above reasons, the sediment flushing operation for the project should be conducted once a year between June and July by emptying the reservoir in the beginning of the rainy season, and then flushing the sediment from flushing gate, installed in the dam body, with flooding flow in the rainy season.

In addition, the following should be implemented to prevent water quality deterioration as possible.

- 1) Before starting full operation of the sediment flushing, the flushing gate should be opened partially to lead fresh water with high oxygen content from the surface into the bottom of the reservoir to make better water quality in the lower layer of reservoir.
- 2) In addition to the regular sediment flushing operation, the sediment flushing operation without lowering water level of the reservoir should be conducted by using surplus water in the flood season between August and September, to prevent sediment deposit in the reservoir and downstream riverbed degradation as well as to improve water quality in the bottom of the reservoir.

By implementing the above operation, significant downstream water deterioration will be prevented according to the past cases. In addition, it is expected that environmental impact will be alleviated further since the flushed water will be merged with flow of the Madi River, which has similar watershed area, in the immediate downstream of the dam.

Further examination should be conducted in the detailed design stage. During the sediment flushing operation, downstream water quality monitoring should be conducted with establishing criteria to stop the sediment flushing operation in terms of the river water environment conservation. In the case where the monitored water quality data exceeds the criteria, the sediment flushing operation should be stopped immediately. After the sediment flushing operation, degree of the impact to the downstream environment should be verified through the water quality, bottom sediment, and biological surveys to have feedback to improve method of the sediment flushing operation with minimum environmental impact.

9.3.1.3 Mitigation Measures for Physical Environment Impact

(1) Construction Phase

1) Land Use

Avoiding land use changes completely is not possible on the condition of the storage type hydropower project. However, selection of lower reservoir Full Supply Level could minimize existing land use changes. The higher is the reservoir Full Supply Level, larger

is the area of land use changes. The project design engineers are advised to select the optimum reservoir Full Supply Level based on the trade of between the incurred losses and the project benefits to avoid land use changes not more than the required. (Refer to **Chapter 10** “Optimization of the Development Plan”).

The impact on the land use in the Project Facility Area can be mitigated by selecting the layout of the project facilities such as the alignment of the access road. To minimize the impact, the JICA Study Team examined the layout of the project facilities, especially the construction facilities, based on the GIS Map and discussed it with NEA at site. The layout of the construction facilities are determined considering the following aspects to minimize the impacts on the communities of Beni Patan and Shivapur, which included:

- Locating the access road route under the Vyas-Shivapur footbridge rather than through the village, with associated benefits of traffic separation
- Shifting the spoil bank to the river side to reduce the affected area
- Locating the permanent NEA camp at the southern end of the flat area and closer to the power station – it is not recommended to build a bridge across the Seti River at this location
- Shifting the main access road to uphill from the present road so that Project traffic is separated from schools and shops along the existing road in Beni Patan.

2) Air Quality

Various dust suppression measures are proposed to minimize environmental impacts in the construction phase.

- On-site vehicle speed restrictions and vehicle washing before leaving the site;
- Frequent watering of the road in the dry season ensuring that the road surface does not generate dust; and
- Frequent watering of the dusty barren areas or spoil disposal areas.

3) Water Quality

Following mitigation measures to protect water quality in and around the project facility sites will be implemented.

- Establishment of good water supply and sanitation facilities in the construction work camps, at actual construction sites;
- Establishment of effective solid waste collection facilities in the construction work camps;

- Discharge of batching plant, aggregate washing plant, and tunnel seepage waters only after appropriate treatment (sedimentation facility) to the natural water bodies;
- Public awareness program to the construction workforce and the construction on good health and sanitation practices; and
- Disposal of construction related spoils only into defined and well protected spoil disposal sites approved by concerned authorities.

4) Noise Quality

A package of following mitigation measures will be implemented to control construction noise impacts.

- Care in the placement and orientation of noisy plants away from sensitive receivers;
- Use and correct fitting of silencers, mufflers and acoustic shields;
- Regular maintenance of plant and equipment; and
- Awareness programs and information shearing with the communities on the noise related issues

5) Construction Spoils

Spoil bank will be constructed along with the right bank of the Seti River. To control potential erosion of the deposited spoil following measures will be implemented.

- Construction of a dry stone gabion structure at the toe of the spoil bank
- Construction of a water collection system for the spoil bank to avoid free flow of the run off from the mountain slope over the spoil material;
- Proper grading of the spoil surface with adequate drainage provisions after the closure of spoil disposal at the site; and
- Afforestation and bioengineering of the spoil area after proper grading and drainage management.

(2) Operation Phase

1) Reservoir Shoreline Failure

It is likely that the reservoir Full Supply Level of 415 m and at higher elevation would aggravate the local landslides present throughout the upper reservoir area. It is proposed that the area requiring protection would be delineated during the detailed design. In the meantime it is estimated that the following actions should be undertaken:

- Completion of protection embankment works with concrete blocks cover in the vicinity of Bhimad Bajar

- Land acquisition program and stabilization of erosion prone in the risk zone area from Full Supply Level to 10m high above
- Selective planting of ground cover and trees at the base of areas susceptible to erosion in tributary stream leading into the Seti River
- Land acquisition program and stabilization of erosion prone areas with suitable tree species in the vicinity of the Wantang Khola, the Pedhi Khola and Tittuwa

Due to the lack of the detail geological data in the reservoir area, it is difficult to estimate the risk of the slope failure and the measures for them. The situation of landslides and their treatment needs a comprehensive study by the qualified expertise in soil and watershed management techniques in the next stage.

2) Environmental Flow

The NEA EIA recommended an annual environmental flow of 2.4m³/s, which determined from the 10% of the minimum monthly average flow with reference to the method applied in the Kaligandaki A Project. Regarding the environmental flow, new water policy was issued in Nepal in 2005. However, it is not formulated in the appropriate laws and regulations. According to the New Policy, the required environmental flow should be defined as 10% of the minimum monthly average flow in respective month. A comparison between require environmental flow based on the NEA EIA method and that proposed by the new Water Policy case is given in **Table 9.3.1-6**.

Table 9.3.1-6 Comparison of Unregulated and Regulated Flows in the Seti & Madi River

Month	Unregulated Monthly Average Flows (m ³ /s)			NEA Riparian Releases Monthly Averages (m ³ /s)		Water Resource Policy Monthly Averages (m ³ /s)
	Madi River 1978-1999	Seti River 1966-1999	Total	Environmental Flow in NEA-EIA	Total Residual Flow in D/S of Confluence	Total Residual flow in the Downstream of Confluence
January	23.00	27.02	50.02	2.4	11.48	1.96
February	19.47	23.69	43.16	2.4	10.69	1.85
March	20.88	23.99	44.87	2.4	12.19	2.10
April	23.80	27.41	51.21	2.4	12.86	2.23
May	37.96	41.02	73.98	2.4	24.42	5.21
June	101.72	113.52	215.24	2.4	54.04	12.07
July	261.83	286.84	548.67	2.4	165.30	34.38
August	276.22	320.62	596.84	2.4	168.93	36.20
September	190.37	224.32	414.69	2.4	123.26	26.43
October	86.57	112.40	198.97	2.4	33.78	7.05
November	43.49	51.98	95.47	2.4	17.56	3.30
December	29.28	34.22	63.50	2.4	13.52	2.41

This shows that the Madi Khola effectively mitigates the mainstream Seti River flows in a reduced total quantity but in overall seasonal patterns. Judging from the following aspects, it is considered that the magnitude of this mitigation is approximately the same for both

the Existing NEA EIA and the Water Policy criteria for environmental releases.

- The length of the dewatering area is only 2 km between dam site and the confluence with the Madi River.
- The Project lay down in the Seti River watershed and is a high dam project which severely affected the aquatic and fishery resources. There is no need to reproduce wet season pulse type flows to induce fish to migration up the Seti River because the river is blocked by the high dam.
- No religious and consumptive use in the community is made of the Seti River flows.
- The expected annual complete flushing of the reservoir over a one month period which will result in extensive sedimentation in that the section of the Seti River between the dam and the confluence with the Madi River
- The mitigating effects of joining the Madi River downstream which has a flow regime equivalent to 75% of the Seti River flows.

In the Japanese Guidelines, the environmental flow is required in the case that dewatering section is more than 10km. Required discharge is defined as 0.1 to 0.3 m³/s per 100 km² of the catchment area. The catchment area of the Seti River is 1,502 km² in the upstream of the dam. According to the Japanese Guideline, the required environmental flow is estimated as 1.5 m³/s to 4.5 m³/s. The environmental flow proposed by NEA is likely to be reasonable range in comparison with the Japanese Guideline.

However, impacts on the river's aquatic ecology and fish resources are unavoidable in the section of the Seti River immediately downstream of the dam and must be mitigated to the fullest extent possible. These mitigation measures are outlined in **Section 9.3.2** "Biological Environment".

3) Measures for Eutrophication

As a result of water quality test, the concentration of the nutrient input from the upstream of the reservoir is high and there is high possibility of the reservoir eutrophication in future. Reduction of nutrient input from the upstream area is the most effective measures for the eutrophication. However, implementation of such measures will be difficult from the view point of the limitation of the scope of Project and related agencies. Thus, the measures for the eutrophication in the reservoir are examined in this section. Though the further detail investigation is required to establish the concrete measures, the following alternatives are considered as the conceivable measures in the reservoir at this moment.

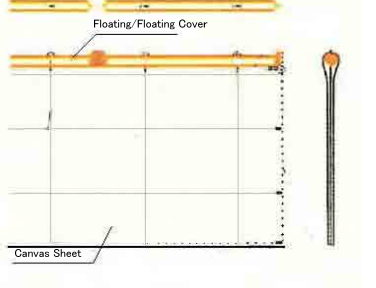
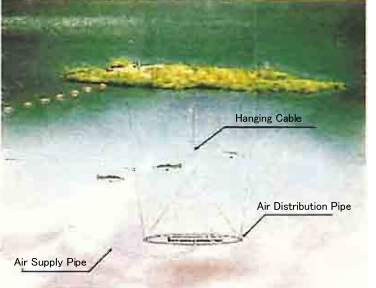


- Installation of the Fraction Fence
- Installation of the Aerator

- Installation of Vegetated Floating Inland
- Input Minerals

Table 9.3.1-7 shows the comparison study for the above alternatives. As a result of comparison study, it is proposed that the installation of the fraction fence is most attractive measures from the view point of the low cost and easy maintenance. This method has been introduced in the some dams in Japan and the effectiveness is confirmed. The fraction fence is composed of the impervious sheet to connect with float. Its purpose is to lead the inflow of nutrient to the deep layer of the reservoir by changing the flow downward by fence. Consequently, it is expected to decrease the breeding of the phytoplankton by controlling the photosynthesis. Especially, since the transparency of Seti River is low, fraction fence is expected to work effectively. Furthermore, it is expected to evacuate the nutrient salt with the daily generating operation by leading the water flow to the medium layer providing intake of waterway.

Fraction fence is the effective measures for the river flow containing the nutrient salt for the phytoplankton. On the other hand, it should be considered to elute from the bottom of the reservoir. To avoid the accumulation of the nutrient salt in the reservoir, sediment flush operation should be carried out once a year. The nutrient salt setting in the reservoir will be evacuated with sediment by the operation.

Table 9.3.1-7 Comparison of the Measures for the Eutrophication in the Reservoir

	Fraction Fence	Aeration	Vegetated Floating Inland	Input Minerals
Image				
Purpose	Restrict the photosynthesis of phytoplankton by nutrient salt flowing downward	Make circulation flow in the reservoir by supplying the air bubble. In addition to prevention of algae bloom, it is expected that DO in the reservoir will be improved.	Plants absorb the nutrient salt from the reservoir water. Furthermore, algae bloom is controlled since the floating inland shade the sun light on the surface of the reservoir.	Change the reservoir water into weak alkali condition by input the mineral. In the alkali condition, microbes actively resolve the organic material.
Specification	Float: Foam Polystyrene covered with rubber sheet Curtain: High strength polyester	Deep aeration system Shallow aeration system Total aeration system	Inside: Palm fiber Outside: Synthetic resin foundation with protection net	Main Ingredient: Magnesium Hydroxide
Features	<ul style="list-style-type: none"> The effects appear soon To removal easily No maintenance Durability 5 to 8 years 	<ul style="list-style-type: none"> To improve DO Large system is required. 	<ul style="list-style-type: none"> More than 10 % of reservoir surface should be covered. No maintenance Impossible to provide in the fast flow area 	<ul style="list-style-type: none"> Deodorizing effect is expected. To prevent elution of the phosphorus from the bottom of the reservoir In the case that the reservoir volume and river discharge is large, large quantity of the minerals is required
Initial Cost	Low	Medium	High	High
Running Cost	No	Operation and maintenance costs are required.	No	Depend on the reservoir water condition
Total Estimation	Recommendable	Difficult	Impossible	Difficult

9.3.1.4 Framework of Watershed Management Plan

(1) Watershed Management

To minimize the risks of sedimentation and its implication on the reservoir dead and live storage capacity, watershed management programs targeting on the reduction of erosion rates in the Seti watershed upstream reservoir dam is necessary.

The sediment source study in the Seti watershed of upstream dam indicates high sediment source areas in the northern part of the Seti watershed, more than 40 - 50 km away from the reservoir. Because this area is located far from the reservoir, only fine sediment loads conveyed by the flow in the river network. to the reservoir. There is little possibility that glacial lake outburst flood may carry a lot of sediment to the reservoir at once because these lakes are small and located far from the reservoir.

It is considered that the sediment sources most affected for the reservoir are loose alluvial deposit area (*Tar* in Nepal) with ramifications of gullies extended along the Seti River and its tributaries in the downstream of Pokhara. There are also landslides along some tributaries of the Seti River.

Consequently, it is proposed to provide small-scale civil engineering and bio-engineering measures of slope protection in the areas upstream from Bhimad to Pokhara. The bio-engineering measures for slope protection are listed in **Table 9.3.1-8**.

Table 9.3.1-8 Proposed Bio-engineering Measures for Soil Erosion Control

System	Applications and Site Requirements	Time to Maturity
Grass planting	Wet condition, cut slope, Slope <45°	2 seasons
Grass seeding	Consolidated debris slopes, Slope <45°	3 seasons
Palisades	Small size and narrow galley, Slope <30°-45°, dry, erodible and consolidated debris	2 seasons
Brush layering	Wet condition, Rocky Slope, Slope <30°-45°	One season if planted early and watered
Fascines	Small Stream, Gully, Slope <45°	3 seasons
Shrub planting	Any slopes, Slope < 45°.	At least 4 seasons
Tree planting	Any debris slopes, Gully, Grazing land, Bad lands in the community or public area, Landslide area, Slope <45°	At least 5 seasons
Bamboo planting	Steep bank slope Gully, Base of slope, Slope <30°-45°	At least 5 seasons

For the control of active gullies and streams bringing a lot of bed load, it is recommended to construct check dams. Gabion check dams will be suitable for small gullies and streams, whereas stone masonry check dams should be constructed in large streams and gullies.

As most of the bed load is generated from landslides and bank failures, special attention should be paid to protect them. The banks of the Seti River are extremely vulnerable. Though it is difficult to control such a process, some river training works together with surface and subsurface water management could be effective.

Debris flows and landslides are the other major source of sediment. The construction of retaining walls, surface and subsurface drains, and galleries will be proposed as landslides control works

If the landslide movement is related to a short-term rainfall, surface water should be drained out immediately. Shallow subsurface drainage is often used along with open surface drainage. The horizontal drainage boring is effective for decreasing the ground water level, if it applied in suitable location.

The river bed erosion in the downstream of tailrace outlet does not have significant impact on the socio-economy of the area since the river course forms narrow steep gorge.

(2) Conservation of Water Quality

To prevent degradation of the reservoir water quality such as eutrophication, the basin management for the inflow of the pollution load is important as well as the measures in the reservoir. However, it will be difficult to carry out the basin management for the river water quality in this project because it requires large budget and extends to the manifold executing and the administrative agency. Thus, the basin management plan for the conservation of the



Dumping Disposal Waste in the Phewa Lake

water quality should be prepared by the related central government agencies cooperating with NEA, local government and related communities in future. It should be comprehensively studied considering the characteristic of the basin and merit and demerit of the measures explained below.

1) Sewerage system

It is recommended that the river basin around the urban area such as Pokhara City having about 200,000 of population should be provided the appropriate sewerage system in future.

Implementation of the sewerage system is expected to securely improve the water quality by dealing with the sewage in the urban area. On the other hand, it will take long time to implementation due to the construction of a sewage disposal plant and a sewer.

2) Community Wastewater Treatment Plant

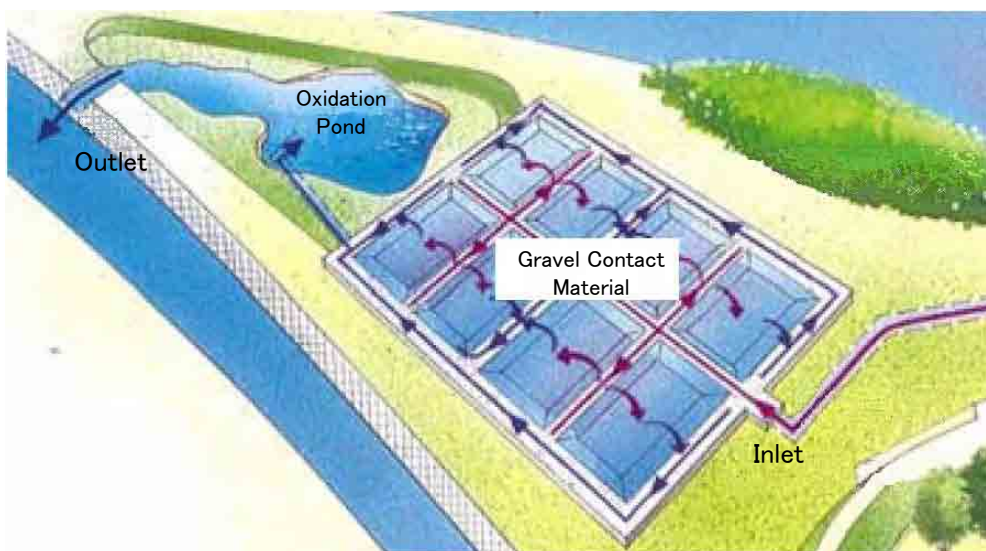
Installation of the community wastewater treatment plant is considered as the measures for the domestic sewage in the area where it is not expected to develop the sewerage

system in the near future.

The community wastewater treatment plant is efficient to improve the water quality in the area where houses are sparse. Installed period of the plant per one unit is generally short. It is noted that the treatment plant should be maintained appropriately by user.

3) River Flow Purification Measures

It is expected that the water quality can be improved by the river flow purification measures in the remarkably polluted river, where the appropriate sewerage system and the community wastewater treatment will not be provided in the near future. “Gravel contact oxidation method”, “Vegetation method” and “Use of rapids and deep pool method” are considered as the viable measures. In the case that the particular polluted river is identified in the basin, it is expected that the water quality can be improved by the above measures in a relatively short time. However, when water quality is improved with the progress of the sewerage system, the efficiency of river flow purification facilities becomes lower since the inflow of the pollution load decreases.



Sketch of the Gravel Contact Oxidation Method

4) Effort of the Community and Related Agency in the River Basin

From the point of view mentioned below, it is important to promote the active effort to the conservation for the water quality by the enhancement of the awareness on the water quality in the communities and related agencies

- Prevention of the dumping the disposal waste in the river by enhancement of the community people
- The measures for first flush by cleaning of the ditch etc.
- Appropriate management for the domestic sewage treatment apparatus

- Reinforcement and extension of the solid waste management conducted in the Pokhara city



Waste Transporting Vehicle in Pokhara City



Pokhara Sanitary Landfill Site at the Seti and Phurse River Confluence

5) Measures for the Area Source Such as the Agricultural Land and Stockbreeding

Area source such as the agricultural land, forest and stockbreeding should be investigated. If necessary, the appropriate measures for the eliminating the pollution load should be considered.

9.3.1.5 Mitigation Costs

(1) Construction Phase

Most of the mitigation measures proposed for implementation rely on best practice management and do not require additional costs and may be considered as Contractors' costs. The main items which may require additional mitigation costs and have to be specified in the Contracts for civil construction costs are presented in **Table 9.3.1-9**. Costs for the bio-engineering works in the spoil bank site are included in the Biological Environmental Section.

Table 9.3.1-9 Mitigation Cost for Physical Environment/Construction Phase

Environmental Impact	Mitigation Measures	NRs. million
Air Quality	Suppression of fugitive dusts by water sprinkling (2 tankers /day/245 days a year/5 year	4.9
	Dust masks to workers , twice a year (lump sum)/5 year	0.7
Water quality	Sanitation (toilet provisions) at all work and campsites (lump sum, about 100 toilets)	4.5
	Camp Solid waste collection management system and disposal facilities	2.8
	Sedimentation tank for batching discharges, tunnel discharges and aggregate crushing discharges and spoil disposal area	10.0
Land Instabilities and erosion	Bio-engineering of the cut batter slopes of the access roads (lump sum)	2.0

Environmental Impact	Mitigation Measures	NRs. million
Construction Spoil Drainage	Dry gabion wall approximately 1,300 m (1.5m high and 1 m wide)	5.0
	Run off catch drainage of mountain slope (approximately 900 m)	3.2
Accidental costs	Vibration effects to houses, natural springs, and other unforeseen impacts	10.0
Total		43.1

(2) Operation Phase

The mitigation costs for reservoir shoreline failure, as mentioned in the impact section, are very difficult to assess, because of the nature of the risk. The worst erosion prone areas (Bhimad Bajar) should be provides embankments with concrete block cover to protect the private land, houses and property from the flood water. The slope failure protection is designed in the Project Design as explained in **Chapter 11** and these costs are included in the civil work.

The 10-m height from the reservoir shoreline, as was done in the existing NEA EIA, is considered as the risk zone and the bioengineering protection will be provided in this area. In addition to the above, the steep slope area in the vicinity of the Wantang Khola, the Pedi Khola and Tittuwa is considered as the risk zone. These areas will be also compensated and protected by the bio-engineering works. These compensation costs for land acquisition are estimated in the social environment part and the costs for the bio-engineering works are included in the biological environmental cost.

Table 9.3.1-10 presents the costs to protect the downstream communities and the costs for the prevention of accidents due to sudden surge of water twice a day in the Seti River immediately downstream and with flushing flows in the sector downstream of the dam. The actual locations of these sirens are yet to be established but their need is obvious.

Table 9.3.1-10 Mitigation Costs for the Downstream Effects to Communities

Environmental Impact	Mitigation Measure	Million NRs.
Downstream impacts to community activities	Siren network along the Seti downstream tailrace (lump sum)	3.5
	Awareness training on the safety measures to downstream areas (lump sum)	0.3
Total		3.8

(3) Cost for Watershed Management

Precise costing of the mitigation (Watershed Management Plan) proposed is very difficult at this stage. Further on site field studies are required for such costing. However, cost for watershed management is tentatively proposed on broad headings. Mitigation costs for the watershed management are summarized in the table below.

Table 9.3.1-11 Mitigation Costs for Watershed Management

SN	Measures	Million NRs.
1	Studies and planning	1.5
2	Bio-engineering Measures for Soil Erosion Control	25
3	Afforestation Programs in the watershed	15
4	River training works	25
5	Landslide Stabilization measures	10
6	Check dams in the tributary streams (draining to reservoir)	35
Total		111.5

9.3.1.6 Monitoring Cost for Physical Environment Impact

The monitoring costs related to the physical environment are summarized in **Table 9.3.1-12**.

Table 9.3.1-12 Monitoring Costs for the Physical Environment

SN	Particulars	Million NRs.
Construction Phase		
1.	Monitoring (air, water, noise, spoil management land erosion etc)	5.32
2.	Measures for downstream effect	3.8
Operation Phase		
3.	Monitoring of water quality for 20 years	3
4.	Monitoring of river bed sedimentation and erosion for 20 years	2
Grand Total		14.12

Note: Environmental impacts in the downstream area have uncertain, wide, and long term aspects. In addition, there is no experience and relevant monitoring data for similar project in Nepal. In these senses, the monitoring period for 20 years was proposed, though there is no designated monitoring period as per any norm in Nepal.

9.3.2 Biological Environment Impacts

9.3.2.1 Baseline Data of Biological Environment

(1) Forest and Vegetation

All together twenty seven plots (25m×25m) were inventoried in the Project area and represent eleven from planted forest (Plot 1 to 11) and rest from natural forests (Plot 12 to 27). **Fig. 9.3.2-1** presents the location of the study plots.

Eleven plots in planted forest include all the plantation sites of Damauli, Huksetar, Patan, Geruwar, Risingpatan and Bhimad. Sisoo and Khayar are the major planted species. Wood volume is highest in the bamboo plantation of Plot No. 1, located on the right bank of Seti River near its confluence with the Madi River; and the Plot No. 3 located near the bridge to Jhaputar at Damauli, with both areas since discarded from potential facility sites location.

For the study, the surveyed forests can be classified into three types as follows.

Hill Sal forest

Shorea robusta (Hill Sal) is dominant species, which is normally observed above EL.400m. The associates of this forest are *Schima wallichii* (Chilaune), *Lagerstroemia*

parviflora (Botdhyero), *Bauhinia vahlii* (Bhorla) and *Desmodium oojeinense* (Sadan) etc.

Mixed Open Forest

This forest type is spread along the river belt. Representative species are different depending upon the aspect of the hill. *Terminalia alata* (Saj), *Mallotus philippensis* (Sindhure), *Albizia chinensis*, *Albizia lebbeck*, *Sapium insigne* (Khirro), *Bamboo spp.*, *Lagerstroemia parviflora* (Botdhyero), *Bauhinia vahlii* (Bhorla) and *Desmodium oojeinense* (Sadan) are commonly found in this forest area. Other associates are *Murraya koenigii*, *Leea macrophylla* and *Dioscorea bulbifera*.

Khair/Sisoo Forest

Acacia catechu (Khair) is the representative species of this forest area. It is mostly found just at the side of the rich alluvial deposits of along the Seti River. The associate species of this forest is *Bombax ceiba* (Simal), *Dalbergia sisoo* (Sisoo), *Sapium insigne* (Khirro), *Murraya koenigii* and so on. The Khair forest is threatened due to fewer seedlings in the area as well as high interest in the usage. *Dalbergia sisoo* (Sisoo) is mostly planted associated with wild Khair.

Due to difficulty of access and complex geography, the forests on the steep slope along the Seti River are hardly disturbed and maintain the rich biodiversity especially in the lower reservoir area. Floristic exploration in the Project area reveals 209 wild flowering plant species. Present survey enumerated herbs in highest number (69 spp.) followed by tree (62 spp.), shrubs (53 spp.) and climbers (25 spp.).

The relative distribution of the classified composition of the forest types is described and their distribution presented in **Table 9.3.2-1** and for the Project's works area in **Table 9.3.2-2**.

Table 9.3.2-1 Forest Types in the Reservoir Area under Various FSL

SN	Types of Forests	Reservoir Area (ha)						
		435	425	415	405	395	385	375
1	Hardwood Sal Forest (Hill Sal Forest)	64.32	43.64	29.46	20.40	11.75	7.29	3.17
2	Hardwood Mixed Forest (Mixed Open Forest)	338.25	304.87	271.81	239.82	206.73	175.79	138.08
3	Kahir /Sisoo Forest	69.88	60.97	52.62	44.46	36.70	29.12	20.53
	Total	472.45	409.48	353.89	304.68	255.18	212.2	161.78

Source: Field Survey of Supplemental EIA Survey, JICA Study Team, 2006

Table 9.3.2-2 Forest Types in the Project Facility Sites

SN	Types of Forests	Area in ha
1	Hardwood Sal Forest (Hill Sal Forest)	44.46
2	Hardwood Mixed Forest (Mixed Open Forest)	24.24
3	Khair/Sisoo Forest	0
Total		68.7

Source: Field Survey of Supplemental EIA Survey, JICA Study Team, 2006

These comparisons clearly shows that the Project's impacts most severely on the Hardwood Mixed (Open) Forest with an approximate total of 296.05 ha affected with a Reservoir Full Supply Level of 415m and the works areas compared with totals of 51.5 ha of Hill Sal Forest and 58.2 ha of Khair/Sisoo Forest at the same Full Supply Level, that is the sum of the tables.

Out of total record of 209 wild plants in the project area 3 plants fall under Nepal Government conservation categories, six (including four orchids) under CITES conservation categories and six plant species are under IUCN conservation categories. Plants found inside project area which fall into different conservation categories are shown in **Table 9.3.2-3**.

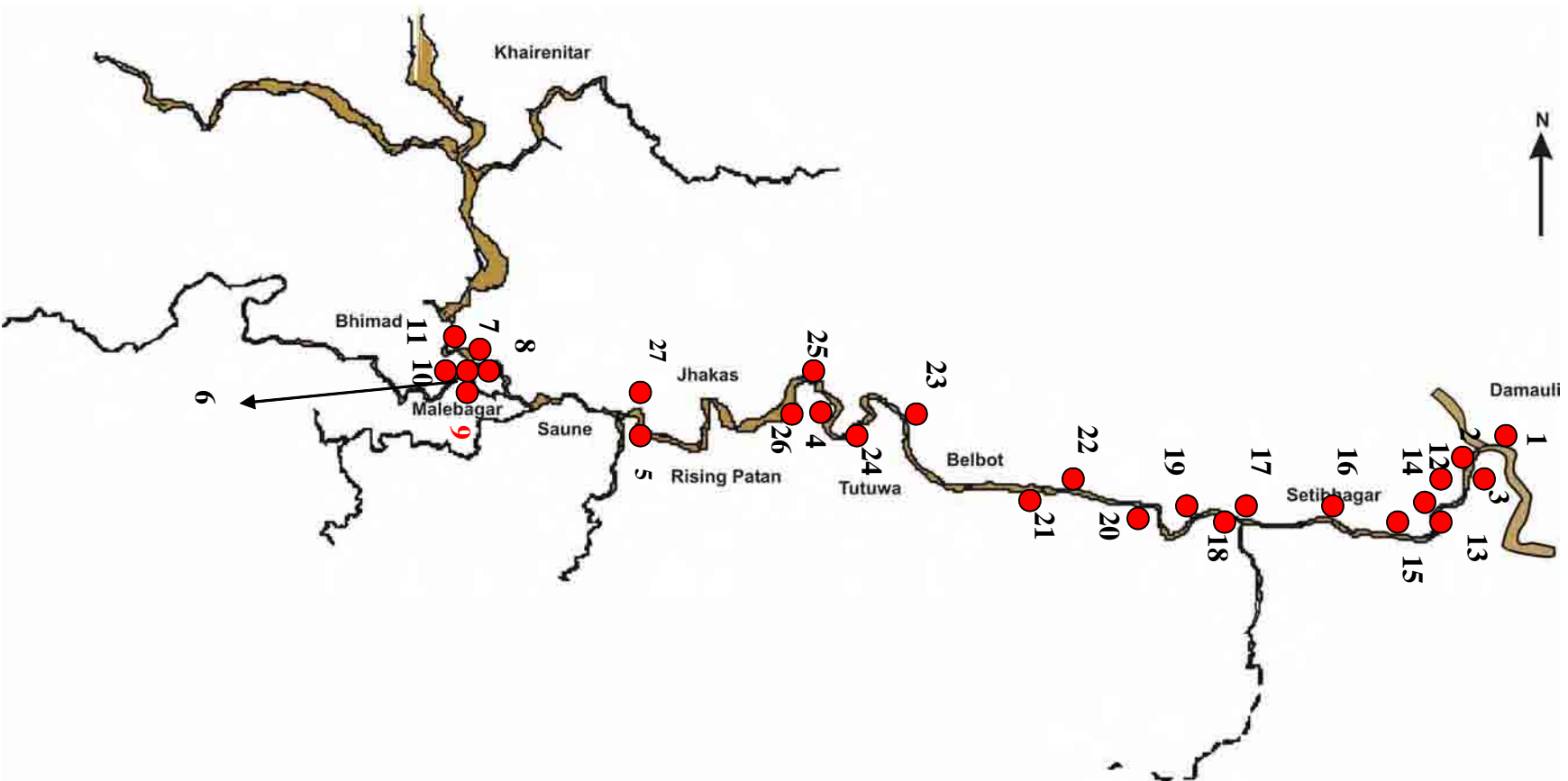


Fig. 9.3.2-1 Vegetation Study Plots Location

Table 9.3.2-3 Plants of Project Sites under Different Conservation Categories

SN	Species	Conservation categories		
		GON	CITES	IUCN
1	<i>Acacia catechu (L.f.) Willd.</i>	+		Threatened
2	<i>Alstonia scholaris (L.) R. Br.</i>			Rare
3	<i>Coelogyne sp.</i>		Appendix II	
4	<i>Dendrobium sp.</i>		Appendix II	
5	<i>Dioscorea deltoidea Wall. Ex Grises</i>		Appendix II	Threatened
6	<i>Habenaria sp.</i>		Appendix II	
7	<i>Oroxylum indicum (L.) Kurz.</i>			Vulnerable
8	<i>Pandanus nepalensis St. John</i>			(Locally) Threatened
9	<i>Rauwolfia serpentina (L.) Benth.</i>	+	Appendix II	Endangered
10	<i>Shorea robusta Gaertn.</i>	+		
11	<i>Vanda teres Lindl.</i>		Appendix II	

The plants of the Project area are used by local people for various purposes as shown in the graph presented in **Fig. 9.3.2-2**.

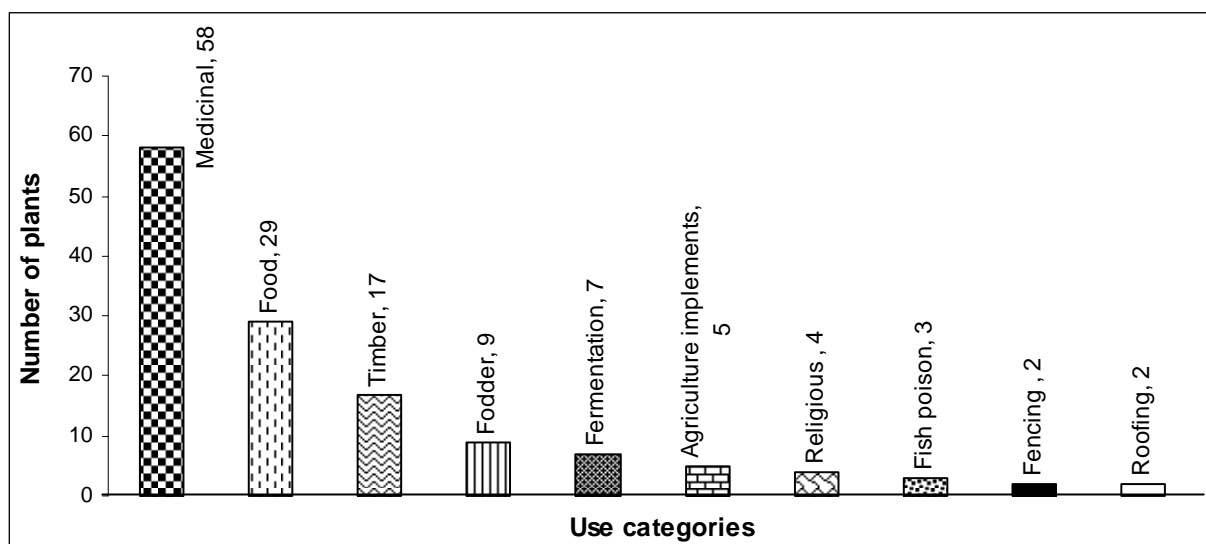


Fig. 9.3.2-2 Number of Plants with Different Use Values Recorded in Project Area

The distribution and responsibility for Forest Management are illustrated in **Table 9.3.2-4** and **-5** and there is an increasing trend towards additional areas of Community Forests, with nine affected with a total area of 88.8 ha and about 5.3 ha of Private Forest affected at Full Supply Level of 415 m. Also it is to be noted that most of the reservoir and the area affected by the works area and access roads to the Project are National Forest (75%) and this will require negotiation with the Ministry of Agriculture and Forests.

Table 9.3.2-4 Forest Area Affected at FSL 415 m in the Reservoir Area

SN	Management Types	Areas -ha
1	National Forest (Protection Forest)	259.83
2	Community Forest	88.77
3	Private Forest	5.29
Total		353.89

Source: Field Survey of Supplemental EIA Survey, JICA Study Team, 2006

Table 9.3.2-5 Forest Area by Management Types in the Project Facility Sites

SN	Management Types	Areas -ha
1	National Forest (Protection Forest)	51.91
2	Community Forest	16.79
3	Private Forest	0.0
Total		68.7

Source: Field Survey of Supplemental EIA Survey, JICA Study Team, 2006

(2) Wildlife

1) Inventory Survey

a) Mammal

This is an area in which the existing EIA was lacking and efforts were made to fill the information gaps. Consequently, more comprehensive species lists have been compiled for mammals, reptiles and amphibians, birds and butterflies. A number of protected species according to CITES, IUCN and Government of Nepal classifications are present in the Project areas affected. This includes the Bengal Tiger, Sloth Bear, Himalayan Black Bear, Common Otters and a number of smaller cats, as shown in **Table 9.3.2-6**. There is some doubt as to the presence of species such as tigers as they were seen in the upland hill area above projected reservoir levels. Several other species are also listed as “Rare” or “Threatened” in IUCN documents. Further study will be necessary to grasp the detailed distribution of these mammals in the project site.

Table 9.3.2-6 Mammals of the Project Area

SN.	Common Names	Scientific Names	Local Name	Conservation Status		
				CITES Annex	IUCN	GON
1	Rhesus monkey	<i>Macaca mulatta</i>	Bandar	2	LR/nt	
2	Assamese monkey	<i>Macaca assamensis</i>	Asami Bandar	2	VU	P
3	Jungle cat	<i>Felis chaus</i>	Ban Biralo	2	LR/lc	
4	Common leopard	<i>Panthera pardus</i>	Chituwa	1	LR/lc	
5	Golden Jackal	<i>Canies aureus</i>	Syal	3		
6	Clouded leopard	<i>Neofelis nebulosa</i>	Dhwanse Chituwa	1	VU	P
7	Rabbit	<i>Lepus nigricollis.</i>	Kharayo			
8	Porcupine	<i>Hystrix indica</i>	Dumsi			
9	Barking deer	<i>Muntiacus muntjak</i>	Ratuwa Mirga			
10	Sloth bear	<i>Melursus ursinus</i>	Kathe Bhalu	1	VU	

SN.	Common Names	Scientific Names	Local Name	Conservation Status		
				CITES Annex	IUCN	GON
11	Royal Bengal tiger	<i>Panthera tigris</i>	Bagh	1	EN	P
12	Mongoose	<i>Herpestes edwardsid</i>	Nyauri Musa			
13	Yellow throated martin	<i>Martes flavigula</i>	Malsapro	3		
14	Common rat	<i>Rattus rattus</i>	Musa			
15	Squirrel	<i>Funambulus sp.</i>	Lokharke			
16	Bats	NA	Chamera			
17	Common Otter	<i>Lutra lutra</i>	Ontt	1	VU	
18	Langur Monkey	<i>Semnopithecus entellus</i> <i>Syn. Presbytis entellus</i>	Langur (Kalo bander)	1	LR/nt	
19	Bengal Fox	<i>Vulpes bengalensis</i>	Fauro	3	DD	
20	Wild boar	<i>Sus scrofa</i>	Bandel			
21	Himalayan black bear	<i>Selenaractos thibetanus</i>	Kalo bhalu	1	VU	
22	Wolf	<i>Canis lupus*</i>	Byanso	I	Lr/ic	
23	Palm civet cat	<i>Pagume larvata</i>	Bharse			
25	Red fox*	<i>Vulpes vulpes</i>	Rato Fyauro	3	LR/ic	
26	Flying squirrel*	<i>Petaurista sp.</i>	Udne lokharke			
27	Leopard cat*	<i>Felis bengalensis</i>	Chari bagh	1	LR/ic	P

Note: EN = Endangered, VU = Vulnerable, LR/lc = Lower Risk/ least concern, LR/nt= Lower Risk/near threatened, P = Protected by law

Most species confirmed by several Discussion Groups * Reported but presence is doubtful

NA = Name not available

b) Reptiles and Amphibians

A total of 17 reptiles and amphibian species are reported in the Project area. In the lower reservoir area, all of the recorded species are found. While, in the upper reservoir and the Project facility Site, only House Lizard, Garden Lizard, Frog, Toad, Green or Bamboo Pit Viper, and Rat Snake are found. Out of 17 reported species, Golden Monitor Lizard and Rat Snake is respectively categorized in “Lower Risk/Near Threatened” and “Lower Risk/Least Concern) in IUCN Red List. These two species are legally protected in Nepal. In addition, two species are listed in the CITES Annex I and three species in the CITES Annex III.

c) Birds

62 bird species belonging to 14 orders and 34 families are recoded in the Project area. Large number of birds and many species are found in the lower reservoir area. Out of recorded species, Vulture (*Gyps sp.*) is categorized into “Globally Threatened” and Spot Billed Ducks (*Anas poecilorhyncha*) and in Appendix I and Eurasian Golden Oriole (*Oriolus oriolus*) in Appedix II of CITES.

d) Butterfly and Moth

Total of 44 species of butterflies and two species of moths were found in the site. No recorded specie is listed in the CITES and IUCN Red List.

2) Process Involved and Potential Impact

Potential Impacts in the construction and operation phase are as follows:

- Impact especially on the mammals and the reptiles due to topographical change associated with the construction of the project facilities
- Impact due to the loss of forest
- Impact on the riverine habitat of wildlife located under the FSL 415 m
- Impact on the activity of the wildlife due to blasting, noise and lighting in the night-time.
- Impact due to the population inflow.
- Increase of poaching due to the completion of the access road

(3) Fish and Aquatic life

1) Inventory Survey

The Fish and Aquatic life was documented adequately in the NEA EIA but further field work and investigations have revealed more species, different impacts and degrees. Therefore, expanded assessment of losses, mitigation measures recommended and monitoring costs are examined in the Supplemental EIA.

The Seti River still maintains its aquatic habitats for the reported 36 fish species in the river system of the project area. The high flows and the cleaning effects of high monsoon floods are instrumental in maintaining the river aquatic ecology as well as the fish diversity in the project area.

A variety of different habitats are found in the Seti-Madi River complex. The Madi River has a wide river bed about 500 m upstream the confluence between the Seti and Madi River. The river is often braided with divided wet channels separated by sandbars. The river flood plain is covered with gravels and small sized boulders. Vegetation is sparse on the flood plains. The river substratum is mostly gravelly. Algal growth is seen at the surface of the gravel substratum near the shore line. Around the flood plane provides a good habitat for fish spawning and feeding

A list of species caught during the July and October sampling periods in the Seti River with indications of the number individuals caught are given in **Table 9.3.2-7**. It is reported that some 23 species are resident in the Seti River.

Table 9.3.2-7 Fish Species Composition

S.No.	Scientific Name	English Name	Local Name	No. Fish Caught in July	No. Fish Caught in October	Total	%
1.	<i>Anguilla bengalensis</i>	Torrent catfish	Raj Bam				
2.	<i>Amblyceps mangois</i>	Fresh water Eel	Bidur	1		1	0.56
3.	<i>Barilius barila</i>	Minor carp	Faketa	22	8	28	15.00
4.	<i>Barilius bendilisis</i>	Minor carp	Faketa		13	13	7.30
5.	<i>Barilius barna</i>	Minor carp	Pate Faketa				
6.	<i>Bagarius bagarius</i>	Gaint Catfish	Gouch				
7.	<i>Botia almorhae</i>	Loach	Baghi	1	2	3	1.68
8.	<i>Chagunius chagunio</i>	Carp	Gadeni	5	5	10	5.61
9.	<i>Channa stritus</i>	Murrels	Hile				
10.	<i>Channa punctatus</i>	Murrels	Hile	1		1	0.56
11.	<i>Channa gachua</i>	Murrels	Hile		2	2	1.12
12.	<i>Crossocheilus latius</i>	Stone roller	Lohare				
13.	<i>Garra annandalei</i>	Stone roller	Lohari, Buduna	3		3	1.68
14.	<i>Garra goytila</i>	Stone roller	Buduna	2	11	13	7.30
15.	<i>Glyptothorax trilineatus</i>	Catfish	Kavre	1		1	0.56
16.	<i>Glyptothorax telchitta</i>	Catfish	Kotle	14		14	7.86
17.	<i>Glyptothorax cavia</i>	Catfish	Kataga	1		1	0.56
18.	<i>Glyptosternum blythii</i>	Catfish	Tilkabre				
19.	<i>Labeo dero</i>	Minor carp	Gardi	9	13	22	12.35
20.	<i>Labeo angra</i>	Minor carp	Gardi, Thed/Handey	2	3	5	2.80
21.	<i>Mastacembelus armatus</i>	Spiny eel	Bam	4	1	5	2.80
22.	<i>Mystus aor</i>	-	Tanger	1			0.56
23.	<i>Neolissocheilus hexagonolepis</i>	Copper Mahseer	Katle	13	11	23	12.92
24.	<i>Noemacheilus rupicola</i>	Stone loach	Gadela	8		8	4.49
25.	<i>Noemacheilus rupicola var inglish</i>	Stone loach	Gadela		2	2	1.12
26.	<i>Noemacheilus botia</i>	Stone loach	Gadela				
27.	<i>Noemacheilus bevani</i>	Stone loach	Gadela				
28.	<i>Pseudocheneis sulcautus</i>	Catfish	Katanga, Kabre	2		2	1.12
29.	<i>Puntius conchoniis</i>	Barbs	Karange	1	3	4	2.24
30.	<i>Clupisoma garua</i>	-	Jalkapoor	1	2	3	1.68
31.	<i>Semiplotus semiplotus</i>	-	Khurpe				
32.	<i>Schizothorax plagiostomus</i>	Snow trout	Buche Asala				
33.	<i>Schizothoraichthys progastus</i>	Snow trout	Chuhhe Asala				
34.	<i>Schizothorax richarsonii</i>	Snow trout	Asala		1	1	0.56
35.	<i>Tor Putitora (Ham)</i>	Golden Mahseer	Pahelo Sahar	10	1	11	6.17
36.	<i>Tor Tor (Ham)</i>	Mahseer	Sahar	1*			
	Total			100	78	178	100

Source : Field Survey October 2006, Supplemental EIA Survey, 2006, JICA Study Team

* observed only

The blockage of fish species by the proposed dam is a major impact of the Project and is reflected in the chart of long distance migrating species which are of economic importance to local fishermen. Similar migration patterns are given also for the middle distance migrants.

Table 9.3.2-8 Migratory Life History of the Long Distance Migrant Fishes of the Project Area

Scientific Name	Migratory Pattern (Months)											
	J	F	M	A	M	J	J	A	S	O	N	D
<i>Tor Pittora</i> (Golden Mahseer) <i>Tor Tor</i> (Mahseer)					↑	↑	↑	↑	↑	↓	↓	↓
<i>Mystus aor</i> (Tangra)					↑	↑	↑	↑	↑	↓	↓	↓
<i>Clupisoma garua</i> (Jalkapoor)					↑	↑	↑	↑	↓		↓	↓
<i>Anguilla bengalensis</i> (Fresh water Eel)	↑	↑	↑	↑	↓	↓	↓					
<i>Bagarius bagarius</i> (Jalkapoor)				↑	↑	↑	↑	↑	↓	↓	↓	↓

Out of the total of 36 species caught, none are officially Red Listed by IUCN but one species is listed as “Endangered” 3 as “Vulnerable” and 5 as “Rare” under a classification system devised, but not yet accepted, by Shresta in 1995.

Even though not important from a viewpoint of the conservation, some fish species are valuable for the economic activity of the local fisherman. Fishing activity and economic importance of fish species are given in **Table 9.3.2-9**.

Table 9.3.2-9 Economic Value of the Fish Species of the Project Area

S.N	Scientific Name	English Name	Local Name	Economic important
1.	<i>Anguilla bengalensis</i>	Torrent catfish	Raj Bam	Oily fish 1,L, 3
2.	<i>Amblyceps mangois</i>	Fresh water Eel	Bidur	1,L
3.	<i>Barilius barila</i>	Minor carp	Faketa	1,M
4.	<i>Barilius bendilisis</i>	Minor carp	Faketa	1,M
5.	<i>Barilius barna</i>	Minor carp	Pate Faketa	1,M
6.	<i>Bagarius bagarius</i>	Gaint Catfish	Gouch	1,L
7.	<i>Botia almorhae</i>	Loach	Baghi	1,L
8.	<i>Chagunius chagunio</i>	Carp	Gadeni	1,M, 2 ,3
9.	<i>Channa stritus</i>	Murrels	Hile	1,L
10.	<i>Channa punctatus</i>	Murrels	Hile	1,L
11.	<i>Channa gachua</i>	Murrels	Hile	1,L
12.	<i>Crossocheilus latius</i>	Stone roller	Lohare	1,M
13.	<i>Garra anmandalei</i>	Stone roller	Lohari, Buduna	1,M
14.	<i>Garra goytla</i>	Stone roller	Buduna	1,M
15.	<i>Glyptothorax trilineatus</i>	Catfish	Kavre	1,M
16.	<i>Glyptothorax telchitta</i>	Catfish	Kotle	1,M
17.	<i>Glyptothorax cavia</i>	Catfish	Kataga	1,M
18.	<i>Glyptosternum blythii</i>	Catfish	Tilkabre	1,L
19.	<i>Labeo dero</i>	Minor carp	Gardi	1,H
20.	<i>Labeo angra</i>	Minor carp	Gardi, Thed/Handey	1,M
21.	<i>Mastacembelus armathus</i>	Spiny eel	Bam	1,M
22.	<i>Mystus aor</i>	-	Tanger	1,H
23.	<i>Neolissocheilus hexagonolepis</i>	Copper Mahseer	Katle	1,H
24.	<i>Noemacheilus rupicola</i>	Stone loach	Gadela	1,L
25.	<i>Noemacheilus rupicola var inglish</i>	Stone loach	Gadela	1,L
26.	<i>Noemacheilus botia</i>	Stone loach	Gadela	1,L

S.N	Scientific Name	English Name	Local Name	Economic important
27.	<i>Noemacheilus bevani</i>	Stone loach	Gadela	1,L
28.	<i>Pseudocheneis sulcautus</i>	Catfish	Katanga, Kabre	1,M
29.	<i>Puntius conchoni</i>	Barbs	Karange	1,M
30.	<i>Clupisoma garua</i>	-	Jalkapoor	1,H
31.	<i>Semiplotus semiplotus</i>	-	Khurpe	1,H
32.	<i>Schizothorax plagiostomus</i>	Snow trout	Buche Asala	1,H
33.	<i>Schizothorax richarsonii</i>	Snow trout	Asala	1,H
34.	<i>Schizothoracichthys progastus</i>	Snow trout	Chuhhe Asala	1,H
35.	<i>Tor Putitora (Ham)</i>	Golden Mahseer	Pahelo Sahar	1,H, 2, 3
36.	<i>Tor Tor (Ham)</i>	Mahseer	Sahar	1,H, 2, 3

Note: I = Food Value: L = Low food value H = High food value M = Medium food value

2 = Medicine

3 = Aquarium

The aquatic invertebrates including phytoplankton, zooplankton and aquatic insects are also described in the Supplemental EIA with species representations of 70, 19 and 26, respectively. There is none of which are known to be or classified as rare or endangered species.

2) Process Involved and Potential Impact

The processes involved which will affect the fish and aquatic life are described as they occur in the construction and operational phases of the Project and the potential impacts are described under the following headings:

Process involved:

- Construction impacts and effects such as river diversion and spoil disposal
- Barrier impacts especially on the fish resources of Seti River and its catchment, which is by far the most serious and irreversible impact of the Project

Impacts:

- Downstream dewatering impacts including long term impacts on the Seti River focused on section between dam and power station outlet and of changes in regime along Seti River to its junction with the Trisuli River
- Reservoir fluctuating levels and its impacts on species survival and use of the reservoir for fishing and similar uses in downstream sectors
- Alterations to fish trapping and capturing methods applicable to reservoir fisheries
- Potential effects on fish of gases generated seasonally in the reservoir
- Potential effects of sediment releases associated with flushing discharged from the reservoir.

(4) Biodiversity in the study area and its conservation

Nepal government has enforced regulations on the collection, trade and export of selective plants under Forest Act 1993. Similarly, the World Conservation Union (IUCN) has developed conservation status of globally important plants. Based on thorough study on their habitat and population dynamics, 60 Nepalese plants are listed under IUCN threat categories. Furthermore, Nepal is a member of Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) since 1993. CITES list includes 15 plants under its different categories.

Although 11 species included in the conservation lists of IUCN, CITES and Government of Nepal were found in the study area, similar habitat conditions for them widely extend in the vicinity of the study area such as Madi river and Trisuli river watersheds and other regions in the country, which means those 11 species are supposed to inhabit in those area. Therefore, it is considered that the extinction of those species hardly occurs as an impact of dam and reservoir construction. To confirm this, further field survey will be needed in the next stage to identify the exact locations of listed species' habitats and the environmental monitoring should be conducted during the project implementation.

9.3.2.2 Mitigation Measures and Mitigation Costs for Biological Environment

(1) Forest and Vegetation

As mentioned above, several types of forest vegetations in the study area distribute not only in the study area but also widely in the vicinity of the area, which means the possibility of tree species extinction as an environmental impact by the dam and reservoir construction is little. Therefore, the mitigation measures for the affected forests and vegetation are focused only on the compensational planting and payment of indemnity for lost firewood and fodder resources.

The estimating of forest values for compensation payment was discussed with NEA in some detail. It was agreed that the forestry compensation estimate should be based on the policy paper titled as "*Guideline for utilization of forest land and other land use*" issued in 2006 by the Forest Department to regulate the ratio of lost:planted tree is 1:25. According to this, the total estimated number of trees affected is about 160,000 the replacement trees are required equals almost 4 million trees with Full Supply Level of 415 m. This quantity will be revised when the District Department undertakes a more detailed survey of the actual areas affected and the types and volumes of trees to be compensated.

The replacement plantation aims to restore the forest originally grown in its location and to maintain its economic value as well as biodiversity in the area. Accordingly, mixed planting of several indigenous species is applied as a technical norm for the plantation. For example the indigenous trees such as *Terminalia alata* (Saj) and fast growing species e.g. *Albizia*

cinensis shall be planted to restore the mixed open forest. For Hill Sal forest, *Schima wallichii* (Chilaune), *Bauhinia vahlii* (Bhorla) and *Desmodium oojeinense* (Sadan) shall be planted. For Khair/Sisoo forest, *Dalbergia sisoo* (Sisoo), *Acacia catechu* (Khair), *Bombax ceiba* (Simal), *Sapium insigne* (Khirro) shall be planted for compensational plantation. The amount of trees planted, areas of plantation required, its costs, etc. are shown in **Table 9.3.2-10**.

It is indicated that the actual volumes of trees will be compensated for the Private Forest, as the owners of such areas is permitted to log all the trees for timber, poles or fuel wood. In addition, the compensation is estimated based on the fuel wood volumes and grazing lands for the Community Forest, which is more special case, as these are multiple use areas administered by local Forest User Groups (FUG). Most of the community forests are located in the Seti River at lower elevations which would be affected also by the project. It is indicated that at least seven (7) Community Forests are affected to varying degrees with a total of over 400 ha and involving some 900 members of FUGs at Full Supply Level of 415 m. Compensation for the fuel woods and fodders shall be done based on the norms regulated by the Department of Forestry as shown in **Table 9.3.2-10**.

Table 9.3.2-10 Estimate of Forestry Loss due to Reservoir at FSL 415 m and Associated Compensation

	Commercial Trees & Other Assets	Replacement at 25:1 Trees MOAF	Project Area Losses-ha (Area required for plantation 1:25, ha)	Reservoir Compensation NRs '000	Estimated Cost Based on:
1. National Forest					
Timber – Tree Numbers	126,287	3,157,175	311.5 (717.5)	198,900	- NRs 280,000 / ha of Replacement Trees as per average of NESS Supplementary EIA & Sindhuli Roads Construction Project (SRCP) Agreement with Department of Forestry (DoF)
Fuel Wood – m ³	-	-		-	
Fodder Resources -LU	-	-		-	
2. Community Forest					
Timber –Tree Numbers	33,025	825,625	105.6 (187.6)	52,014	- NRs 5,500/ m ³ of timber (DoF Reg'n)
Timber Volume m ³	712			19,580	
Fuel Wood - m ³	469	-		6,214	- NRs 2,650 per Livestock Unit (LU)(DoF Reg'n)
Fodder Resources - LU	2,441	-		6,103	
3. Private Forest					
Timber – Tree Numbers	2,655	-	5.29		- NRs 500 per Livestock Unit (LU)
Timber – Volume – m ³	623	-	-	3,427	
Fuel Wood – m ³	-	-	-	-	- There is a need to consider Fuelwood & Fodder Resources in Community Forests
				-	
4. Grass & Shrubland - LU	652	-	102.5	1,630	
5. Totals of All Lands					
Timber – Tree Numbers	161,967	3,982,800		250,914	- Production loss for 5 years will be compensated.
Timber – Volume –m ³	1,335	-		23,007	
Fuel Wood – m ³	469	-		6,214	
Fodder Resources - LU	3,093	-		7,733	
Total Forest Land Losses				287,868	
6. TOTAL FOREST LANDS			422.39 (905.1)		

(2) Wildlife

The mitigations measures to reduce the impacts on the wildlife are proposed as follows.

- To select the appropriate layout to minimize the cutting of trees especially from the dam site to the lower reservoir area
- To provide alternative energy sources such as kerosene for the daily uses in the camp site
- To restrict hunting and trapping
- To save endangered animals by a rescue operation using boats during the filling of the reservoir and relocating them to compatible ecosystem in nearby forests.

(3) Fish and Aquatic Life

With respect to proposed mitigation actions, following alternatives are considered;

- 1) Fish Trapping and Trucking Alternatives
- 2) Fish Lock or Ladder Alternatives
- 3) Fish Hatchery Backed with Open Water Stocking of Suitable Fish Species, as is being done at NEA's Kaligandaki HEP.

The effectiveness of the applied measures may be varied in terms of success depending upon the local field conditions, expertise applied and behavior of the existing aquatic fish species. Any provision of a) fish rapping and hauling or b) fish rock and fish ladder structure at diversion structure will not completely compensate for the impacts of such high dam. It is proposed that c) fish hatchery is the most viable method. However, the implementation of the fish hatchery program needs the further detail study.

Three (3) locations on the Seti River (downstream of Damauli), on the Phedi Khola (a reservoir tributary) and on the Madi Khola (just upstream of the quarry site) are examined for the fish hatchery facilities. The costs of a hatchery program for 5 years varied at these sites between USD 1.59 and 1.73 million. Furthermore, based on discussions with NEA, it was examined that an extension of the fish hatchery at Kaligandaki A Project, where 8-9 migrant species are produced. The cost of an equivalent 5 year program was the preferred alternative at a cost of USD 1.02 million. From the results of the above comparison, the extension of the fish hatchery at Kaligandaki A Project is proposed as the attractive alternatives for the Project.

Table 9.3.2-11 Mitigation Costs for Fisheries

SN	Particulars	Unit cost (NRs.)	Total Cost (NRs. million)
1.	Financial and Technical Assistance to Kaligandaki A hatchery for added production & facility development and research for Upstream & Downstream Stocking in Seti River system	As Per Estimate	73.6
2.	Annual release of purchased exotic carps to Seti reservoir	2/fishfry	1.9
3.	NEA Extension program for fisheries and mitigation to local fishermen	Lump sum	1.0
4.	Total Estimated Cost (NRs million)		76.5
5.	Total Estimated Cost (USD)		1.02 million

Note: Cost breakdowns are based on local market price

Though the cost for the hatchery development and research (item 1 in the table above) is presented as a part of operation phase, the costs on this item should be disbursed at the start of the construction works and preparation of hatchery facilities and supplying of fish fry should be ready for the dam closure period.

(4) Proposed Monitoring Cost

The various programs for monitoring during the construction and initial operational phases of the Project are preliminarily estimated as shown in **Table 9.3.2-12**.

Table 9.3.2-12 Monitoring Costs - Construction & Operation Phases

Monitoring Items	million NRs
Aquatic ecology survey in the 7 Baseline stations twice a year for 5 years during construction phase @ 0.1 million/monitoring season Sub-Total for 5 years	1.0
Aquatic ecology survey in the 7 Baseline stations after two years of project operation for 10 years @ 0.15 million/monitoring Sub-Total Monitoring Cost for 10 years	3.0
Total Cost for Monitoring (NRs million)	4.0
Total Cost for Monitoring (USD)	USD 53,400

Note: Cost breakdowns are based on local market price

9.3.3 Impacts in the Downstream of the Dam

As the impacts of dam construction the changes of water level and quality, the sedimentation caused by sand flash operation and the erosion of the river bed are expected. Their scales and consequences and further impacts on the fauna and flora as well as the impacts on the human activities relying on resources of the river in the downstream (such as fishing and rafting) have not been clarified so far. Therefore in further stage of the project, topographic survey in the downstream rivers and detailed hydraulic examination such as increase speed of downstream water level in water discharge for power generation should be conducted.

During the operation period, it is necessary to monitor the fall of water level, the changes of water quality and the erosion and sedimentation pattern caused by the sand flash operation. As the measures to mitigate the impact on the communities in the downstream, it is proposed to install a

siren system in the section between dam site and tailrace.

Furthermore, the monitoring system by the international cooperation among the countries located in the downstream areas of Seti river needs to be set up to grasp the environmental impacts generated by the reservoir construction as well as the complex and accumulated impacts induced by other causes which are not known clearly so far. Such monitoring needs to be continued in the long term in wider downstream areas which include several rivers extending in other countries bordering on Nepal.

9.4 Socio-Economic and Cultural Environmental Impact Assessment

9.4.1 Objectives

Based on socio-economic and cultural perspectives, Supplemental EIA Survey has the following four major objectives:

- Review the general socio-economic and cultural situation of the project district, affected VDCs and communities,
- Study the socio-economic and cultural impact, due to the project activities at district-, VDC- and community-levels,
- Develop a framework of Resettlement Plan and Social Action Plan and
- Prepare a framework for Environmental Management Plan

9.4.2 Methodology

The methodologies for accomplishing the above objectives are mainly based on Literature Search, Field Survey, Household Survey, and Focus Group Discussion (**Fig. 9.4.2-1**).

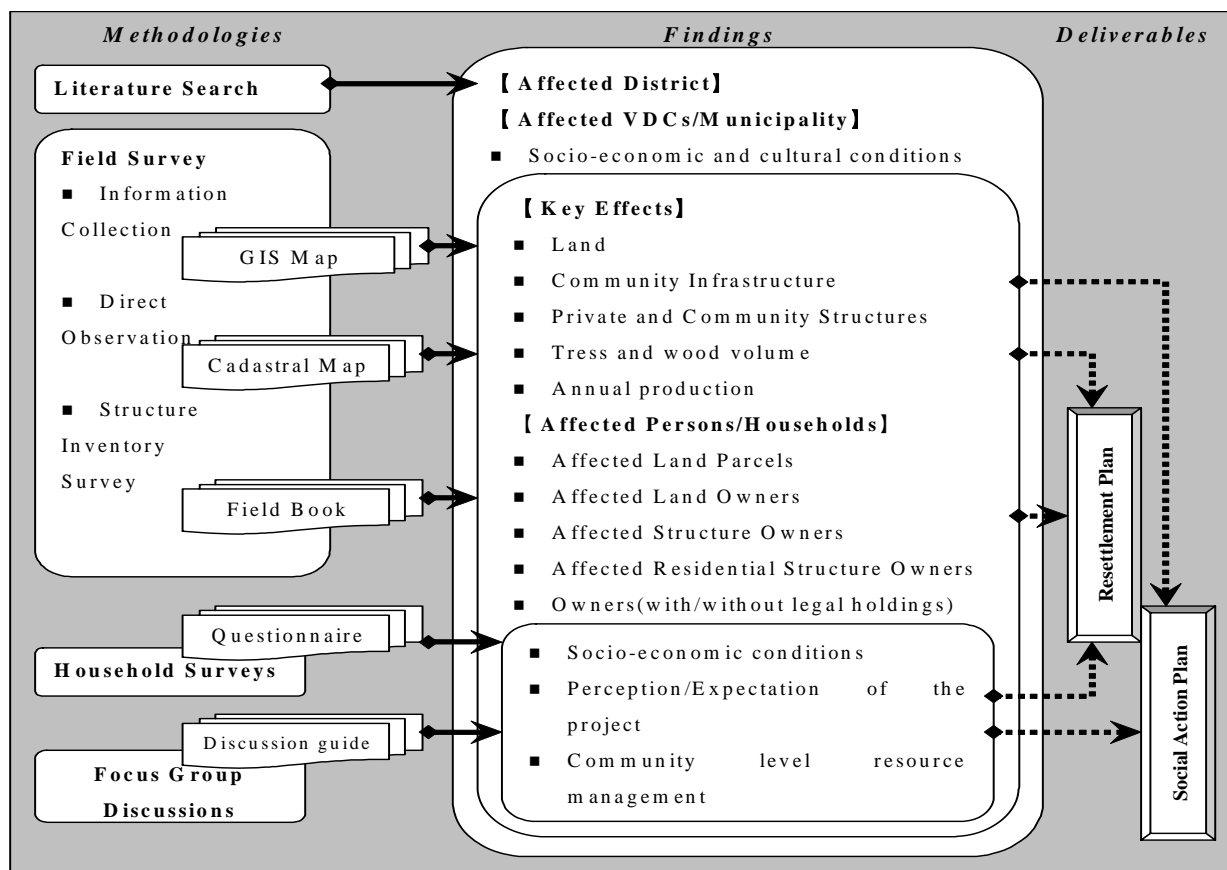


Fig. 9.4.2-1 Methodologies, Expected Findings and Deliverables

(1) Literature Search

Prior to the Field Survey, a literature search was conducted, including the 2001 census survey (CBS, 2001), District Profile of the Tanahu District (DDC, 2001), Poverty Mapping Report, Tanahu (DDC, 2001) and other secondary data available in order to grasp the current socio-economic and cultural conditions in the Tanahu District and affected VDCs. One of the limitations of the literature search was that certain statistical data tended to differ from one source to another at times. Another limitation was the fact that some statistics data of the Vyas municipality were not available while those of affected VDCs were.

(2) Field Survey

To complement the results of the literature search, the Study Team and the local consultant team visited the government and other relevant offices of the Tanahu District, where they collected secondary information.

The cadastral maps, which are the official land use maps, showing the land and land plot numbers, were obtained from the district Survey Office via GIS consultants. These cadastral maps were prepared some 30-35 years ago, and the divisions of land plots have been updated every 5 years. They do not include information on forests, barren areas, river corridors, shrub-land and grasslands and do not, in fact, precisely represent the current

reality in a timely manner. Thus, the obtained cadastral maps have been superimposed onto the GIS mapping in order to specify the affected areas, including land parcels. Furthermore, the Field Book, namely the listed land plots of cadastral maps, was used to research the ownership of respective land plots and the land areas. Via the use of these GIS maps, cadastral maps and the Field Book, an inventory structure survey was carried out to collect detailed information on the affected structures, including the number of structures, the materials used, and ownership of each structure. Its results were also used to estimate the loss of affected structures. As well as the comparison among the cadastral and GIS maps, direct field observation was very useful as a basis to identify and estimate the number of residential structure affected owners without legal holdings and affected cultivated land without legal registration.

There were also some limitations to the Field Survey. Due to the high number of absentees during the survey, not all the land parcels could be verified. Furthermore, a number of land areas under cultivation were observed, although not legally defined as land parcels. Another limitation was the fact that the cadastral maps for Jamune VDC were not provided, which meant there was no information on the land plots affected and affected land owners in Jamune, although information on the affected structures, including residential structures, was collected and confirmed via the inventory structure survey. Wantang Khola, Phedi Khola and Tittuwa were not covered by the inventory structure, survey since these areas were identified as Risk Zones upon completion of the field survey. The GIS Map was only used to estimate the number of affected structures and their owners because the few areas of the project facility sites were also not covered by the inventory structure survey, due to the redesign of the project facility sites upon completion of the field survey. It is proposed that these limitations be taken into consideration during the Detailed Design Phase.

(3) Household Surveys

To identify the socio-economic situation and the perceptions towards the project among those affected, the local consultant team, comprising sociologists and engineers, carefully designed a structured questionnaire in collaboration with the Study Team. Altogether 399 households of the VDCs and municipality of Tanahu District affected by the project, more specifically, those living below 425 m of the reservoir FSL, were randomly selected and interviewed using the structured questionnaire (**Table 9.4.2-1**). The ethnic group and caste of these households are described in the table, while those without legal holdings were also included as targets of the Household (HH) Survey. It should be noted that most of the households in Jamune VDC who were most likely to be affected by the project were not covered by this Survey because they were not present during the HH Survey. However, overall the sample represents about 50 percent of households who have land or assets in the

area below 425 m of the reservoir FSL⁵ and who are likely to be affected by the project activities.

Table 9.4.2-1 Sample of Household Survey

Bhimad	Chhang	Majkot	Rising Ranipokhari	Kotdurbar	Kahun Shivapur	Vyas (Damauli)	Total
4	85	47	137	17	21	88	399

Note: The sample households were selected from those who have land or assets in the area below 425m of FSL reservoir and presented during the period of the survey. In other words, some unidentified owners of land or assets in the Field Book and the absentees during the survey were excluded. Thus, the number of sample households varied from one VDC to another.

Source: Supplemental EIA Survey, JICA Study Team, 2006

Table 9.4.2-2 Ethnic/Caste Division

Ethnicity/Caste	Caste Name	Frequency	Percent	
Brahmin/Chhetri/Thakuri	Brahmin	63	15.79	19.0
	Chhetri	13	3.26	
Adibasi/Janjati ⁶	Magar	204	51.13	69.7
	Gurung	34	8.52	
	Newar (Shrestha)	23	5.76	
	Majhi, Bote	17	4.26	
Dalit ⁷	Sarki	9	2.26	8.0
	Kami	17	4.26	
	Damai	6	1.50	
Other	Sanyasi	13	3.26	3.3
	Grand Total	399	100	100

Source: Supplemental EIA Survey, JICA Study Team, 2006

(4) Focus Group Discussion

Focus Group Discussions were held to identify the status of the utilization of natural resources and the level of empowerment among women within the project area at the community level in 13 different localities, as indicated in **Table 9.4.2-3**. The findings of the Focus Group Discussions have been also used as a basis for formulating the Social Action Plan.

⁵ The number of affected land owners of the project area was estimated to be 838 (See Table 9.4.5-6).

⁶ About 60 indigenous tribes of Nepal are defined as Adibasi/Janjati by the Nepal Government.

⁷ Mainly three castes, such as Shoe Maker (Sarki), iron-workers (Kami) and tailors (Damai) are included in the Dalit caste.

Table 9.4.2-3 Focus Group Discussion

SN	Areas	VDC, Group Discussion Place	Ward No.	Covered Village	No. of Participants		Ethnic and Caste Group
					M	F	
1	Inside Reservoir Area	Chhang, Chokre	4	Chokre, Piple	6	0	Magar, Newar
2		Chhang, Fulbari	5	Ghaderibesi, Chokre	2	5	Magar, Gurung
3		Chhang, Jhakash-Fulbari	7	Jhakash,-Fulbari	0	13	Gurung, Newar,
4		Bhimad, Khanaltar	1	Khanaltar, Bhimad Birta	0	5	Brahmin
5		Rising Ranipokhari, Rising Patan	9	Rising Patan, Wantang, Saune	7	7	Brahmin Chhetri
6		Rising Ranipokhari, Khakahre	9	Bhainsikile, Amdanda, Bandarkuna	5	16	Magar, Dalit, Newar, Gurung
7		Kotdurbar, Maidan Swanra	1	Ward No.1 & 2	0	32	Magar
8		Khaun Shivapur, Bakle	3	Bakle, Kahun Shivapur, Ranidanda, Tallo Setang	0	15	Magar
9	Outside Reservoir Area/Soil	Kahun Shivapur, Beltar	1	Mathillo Jhapu, Tallo Jhapu, Dharapani, Bharkeni Beltar	0	21	Magar, Dalit
10	Dumping Site	Vyas Municipality, Tallo Patan	7	Tallo Patan (Close to Batching Yard)	9	5	Brahmin, Chhetri
11		Vyas Municipality, Beni Patan	7	Beni Patan (Batching Yard Site)	15	0	Gurung, Brahmin, Magar, Newar.
12		Vyas Municipality, Beteni	7	Beteni	0	11	Magar
13		Vyas Municipality, Bairenitar	7	Botegaun, Kumaltari, Atrauli Birenitar	14	2	Bote, Darai

Source: Supplemental EIA Survey, JICA Study Team, 2006

9.4.3 Identification of the Project Affected Areas

The affected areas are categorized into the following three groups:

- **Group 1:** It comprises areas affected by the project components, such as the reservoir, dam, and powerhouse, tailrace, and switches yards and involves effects related to land and property acquisition besides the loss of natural resources and community properties.

Group 1 can be further categorized into the following two impact areas in the Supplemental EIA Survey:

i) Reservoir area — Full Supply Level 415 m

It refers to an inundated reservoir area. Based on the results of the optimization study, an elevation of 415 m was selected as the optimal Full Supply Level (See the details in **Chapter 10**).

ii) Risk zones

Based on the discussion with NEA, the Study Team regarded i) Wantang Khola, ii) Phedi Khola and iii) Tittuwa as Risk Zones. In these areas, the deposit materials have vertically

formed overhanging cliffs, and been constantly eroded. Since the terrace breaks in some places, and will be in danger of slope failure due to the implementation of the project, a 50 m horizontal distance from the edge of the cliff was delineated as a Risk Zone. Furthermore, a 10 m vertical distance has been added to the FSL as Risk Zone for safety purposes, which was the same method as that used by the NEA. Land, structures and loss of agricultural production within such Risk zones will be compensated.


Bhimad Bajar, however, was not included in this category since it is least likely that the project with FSL 415 m will directly affect this area. However, Bhimad Bajar will be also in danger of slop failure because of erosion caused by the flood or heavy rain, meaning appropriate measures need to be taken (See the details in the Natural Environmental Impact Section and Environmental and Social Consideration Report).

- **Group 2:** It comprises project facility structures required for the construction of the project, such as access roads, camps, batching yards and spoil disposal yards etc. Like the project components, it involves effects related to land and property acquisition, besides the loss of natural resources and community properties.
- **Group 3:** It comprises downstream effects and although not involving the loss of land and property, it will impair the utility aspects of the natural resources, due to twice daily changes in river flows.

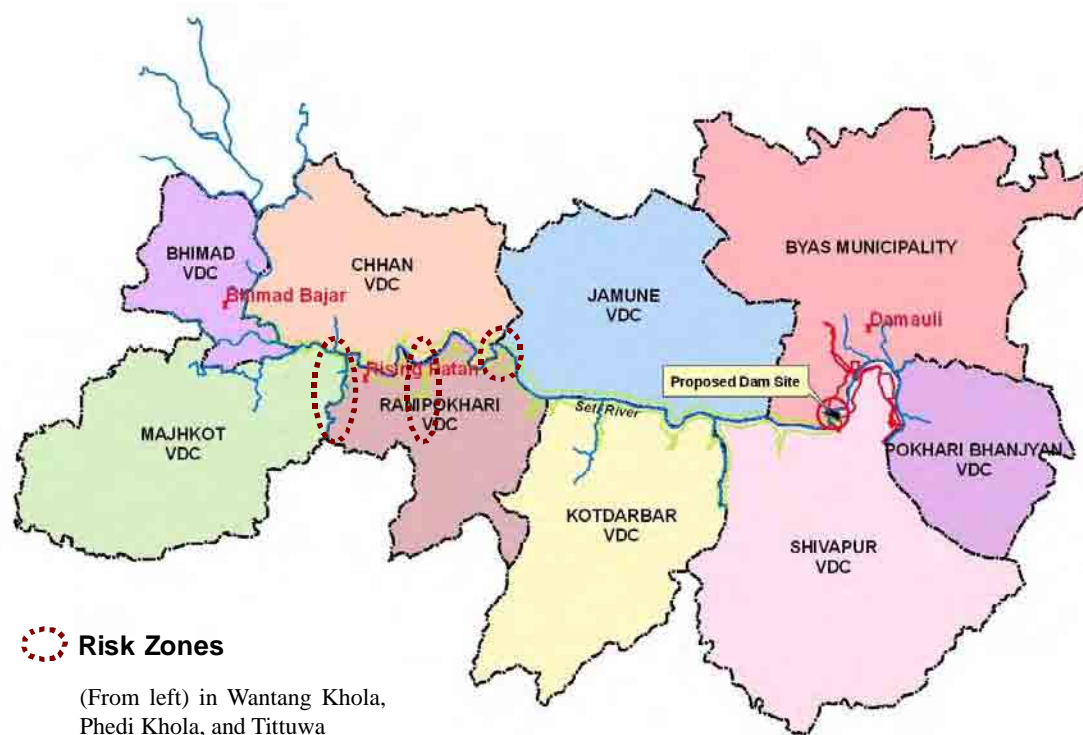
Table 9.4.3-1 and Fig. 9.4.3-1 indicate the VDCs and Municipality affected by the project for each category.

Table 9.4.3-1 VDCs/Municipality Affected by the Project Components

Group 1	Reservoir Areas (FSL 415m)	Bhimad, Chhang, Majkot, Rising Ranipokhari, Kotdurbar, Jamune, Kahun Shivapur VDCs, Vyas Municipality
	Risk Zones	i)Wantang Khola (Majkot-Rising Ranipokhari), ii)Phedi Khola (Rising Ranipokhari), iii) Tittuwa (Rising Ranipokhari) and iv) a 10 m vertical distance from FSL 415 m (Bhimad, Chhang, Majkot, Rising Ranipokhari, Kotdurbar, Jamune, Kahun Shivapur VDCs, Vyas Municipality)
Group 2	Project Facility Sites	Kahun Shivapur VDC, Vyas Municipality
Group 3	Downstream Areas	Kahun Shivapur, Pokhari Bhanjyang, Keshavtar, Dharampani, Baidi, Chhipchiipe, Devghat, Deurali VDCs

Note:  is hereinafter referred to "Affected VDCs and Municipality" in this report and Environmental and Social Consideration Report.

Source: Supplemental EIA Survey, JICA Study Team, 2006



Note: Pokhari Bhanjyan VDC regarded as one of the affected VDCs by NEA in existing EIA was categorized into Group 3 in this report and Environmental and Social Consideration Report.
Source: GIS Map, JICA Study Team, 2006

Fig. 9.4.3-1 VDCs/Municipality Affected by the Project (Group 1 and Group 2)

“The affected VDCs/Municipality” refers to seven VDCs and one municipality, namely Bhimad, Chhang, Majkot, Rising Ranipokhari, Koldurbar, Jamune, Kahun, Shivapur VDCs and the Vyas Municipality in this report and Environmental and Social Consideration Report, since these areas will be more seriously affected by the project than the other VDCs categorized into the abovementioned Group 3.

9.4.4 Socio-Economic and Cultural Situation

(1) Socio-economic Situation in the Tanahu District

The Upper Seti Hydroelectric Project lies in the Tanahu District of the Western Development Region. The Tanahu District has an area of 1,546 km² and a population of 315,237 according to the 2001 Census. The population density of the district is regarded as one of the highest among the hills district (204 persons/ km²). Magar and Gurung are dominant ethnic groups in Tanahu District. Close to 70% of the population above 6 years in Tanahu District are literate, which is higher compared to the national average literacy (60.2%). The majority of the people (67%) are engaged in agriculture to produce all types of cereals such as paddy, maize, wheat, millet, and cash crops. The socio-economic situation in Tanahu District based on Literature Search is summarized in **Table 9.4.4-1** (See the details in Supplemental EIA).

Table 9.4.4-1 Summary of Socio-Economic Situation in Tanahu District

1	District population and House holds (2001)	315237 (Male: 146788, Female 168,449), 62898 households
2	Average Family Size (2001)	5.01
3	Population Density (2001)	202 persons/km ²
4	Ethnic/Caste Composition	Magar (27%), Gurung (13%), Newar (8%), Dalits (14%), Chhetri/Thakuri (14%), Brahmin (13%), Kumal (2.4%), Dairai (1.2%), Brahm (0.4%), Dura (0.3%), Jirel(0.1%)
5	Languages	Nepali (63%), Magar (16%), Gurung (10%), Newari (5%), Rai/Rirat (2%).
6	Religion	Hindu (91%), Buddhist (7%), Muslim (1.7%) and Christian (0.2%)
7	Literacy rate (above 6 years)	70% (Male: 79%, Female 56%)
8	Gross Enrollment Ratio (2004/05)	Primary (Male: 120.4, Female: 118.50) Lower Secondary (Male: 95.2, Female 80.8), Secondary (Male: 61.8, Female 51.6)
9	Net Enrollment Ratio (2004/05)	Primary (Male: 91.0, Female: 90.4) Lower Secondary (Male: 54.9, Female 45.9), Secondary (Male: 32.5, Female 29.2)
10	Top 10 Diseases	1. Skin diseases, 2. ARI, 3. PUO, 4. Diarrhea, 5. Intestinal Worm, 6. Gastritis, 7. Injury/Fracture, 8. COPD, 9. Ear Infection, 10. Abdominal Pain
11	Drinking Water Sources	Pipe (74%), Well (20%), Rain Water (4%), Other (2%)
12	Electricity	Approximately one third of the population
13	Economically active (10 years and above)	Male: 70,171(29.9%), Female: 80,006(34%), Total: 150,177 (63.9%)
14	Occupation among economically active populations	1. Farm Workers (67.1%), Elementary occupations (9.48%), Craft Trade Workers (8.76%), Service Workers (8.12%), Professionals (2.55%), Clerks (1.6%), Technicians (1.42%), Plant machine Operators (0.74%), Legislator/Officials (0.23%), Not stated (0.09%)
15	Landless	Approximately 1% (499 households)
16	Average land holding size	0.54 ha
17	Average number of parcels	2.9
18	Average per capita income (2004)	218US \$ (NRs 16,071)

Source: 1-7, 10, 13- 14 Population Census, 2001, CBS
 8-9 Annual Report, District Health Profile, Tanahu, 2004/2005
 11-12 District Development Committee, 2006
 15-17 Agricultural Census, 2001, CBS
 18 Nepal Human Development Report, 2004, UNDP

(2) Socio-economic Situation in Affected VDCs/Municipality

As previously mentioned, the project will affect seven VDCs and one municipality, namely Bhimad, Chhang, Majkot, Rising Ranipokhari, Kotdurbar, Jamune, Kahun Shivapur, and Vyas Municipality of the Tanahu district. The literature survey was basically conducted targeting these seven affected VDCs and municipality. Since Pokhari Bhanjyang was previously included as one of the affected VDCs in the existing EIA report, prepared by the NEA and located in the vicinity of the proposed project facility sites, it was also included in this survey. According to the 2001 Census, the total number of households and population were respectively estimated at 16,512 and 80,884, although the population density varied significantly between these VDCs and the municipality. Vyas municipality, the district

headquarters, has the highest population density (409 person/km²) while Kahun Shivapur VDC has the lowest (92 person/km²). The major settlements and market centers are Vyas Municipality and Bhimad Bajar in Bhimad VDC. Magar, one of the indigenous ethnic groups, is the dominant population in these areas, which represents 36 % of the total population followed by Brahmin (14%) and Dalit (12%). The average literacy rate of these affected VDCs and the municipality is estimated to be 61%. However, the literacy rate, as well as other education and health indicators, varies significantly among the affected VDCs and municipality. 68% of the population 10 years and over is economically active. Agriculture, combined with livestock, remains the main occupation for the majority of the population in the affected VDCs. **Table 9.4.4-2** summarizes the socio-economic situation of these affected VDCs and municipality, based on the available statistics (See the details in the Environmental and Social Consideration Report).

Table 9.4.4-2 Summary of the Socio-Economic Situation in the Affected VDCs/Municipality

1	Population and House holds (2001)	80884(Male: 38037, Female 42847), 16152 households (Bhimad 1382, Chhang 1318, Majhkot 1378, Ranipokhari 740, Kotdurbar 975, Jumune 1929 Kahun Shivapur 1087, Pokhari Bhanjyang 832, Vyas 6511)
2	Average Family Size (2001)	5.0
3	Population Density (2001)	215 persons/km ²
4	Ethnic/Caste Composition	Magar (36%), Brahmin (14%), Dalit (12%), Newar (9%), Chhetri (8%), Gurung (5%), Darai (3.7%), Thakuri (2.8%) Muslim (0.7%), Others (7.1%)
5	Religion	Hindu (91%), Buddhist (8%), Muslim (0.7%) and Christian (0.1%)
6	Average Literacy rate (above 6 years)*	Male 37.1%, Female 24.08%
7	Average Net Enrollment Ratio at primary level (2006)	Male: 95.0, Female: 81, Total: 88
8	Health Related Institution and Facilities	1 hospital, 1 Primary Health Center, 1 Health Post, 6 Sub-Health Posts
9	Average people lacking a hospital within 3km*	35.81%
10	Average Accessibility of Water Supply*	52.15%(79.46%<1Hrs,3.64%1<3Hrs,1.94%3<5Hrs,14.96%>5Hrs)
11	Average % Without Access to Safe Drinking Water*	47.82%
12	Average % Without Access to Latrine*	77.12%
13	Average Accessibility of Electricity*	13.3% (Bhimad 41.7, Chhang 13.4, Majhkot 7.2, Ranipokhari 0.5, Kotdurbar 0.4, Jumune 37.5 Kahun Shivapur 0, Pokhari Bhanjyang 6)
14	Average % of Economically Active Population (10 years of age and over)	67.8%
15	Average % of income from Agriculture and Livestock	14.3 %
16	Below Poverty Line (<NRs3000/household/year to meet 2256 Kcal)*	77.95%

17	Above Poverty Line (<NRs3000/household/ year to meet 2256 Kcal)*	22.05%
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Note: * Vyas Municipality is not included due to the lack of data.

Source: 1-5 Population Census, 2001, CBS

6-7 DEO Tanahu, 2006

8 DHO, Tanahu, 2006

9-12, 14-15 Poverty Mapping Report, 2001

13 Periodic District Plan (2001/02-2006/07)

(3) Socio-economic Situation of Affected Persons/Households

The Household Survey was undertaken, targeting 399 randomly selected households living below 425 m of the reservoir FSL in the affected VDC and municipality to grasp the socio-economic and cultural circumstances of the affected persons and households. The households in Jamune VDC were not covered by this Survey, since those living below 425 m were not present during the Household Survey. The total population of these survey households is estimated at 2,839, with an average family size of 7.1, which is higher than that of the project affected VDCs (5.0) and the district average family size (5.01). Magar are the most dominant ethnic groups, accounting for 51 % of the total households surveyed. Other major ethnic groups include Brahmin (15.79%), Gurung (8.52%), and Dalit (8%) composed of Sarki, Kami, and Damai. Half of the surveyed households have been residing in the area since more than two generations ago, while close to 80% of the population sample surveyed were reported to be literate, with a literacy rate higher than the average literacy rate of the affected VDCs (61%) and district (71%). More than 60% of the sample households have access to electricity services, and 85% of them are served with a piped water supply. The main occupation of the majority of household members is agriculture (56%), followed by service (15%) and business (13%). The level of quality of life varies among the surveyed households, but tends to be higher among Brahmin and Chhetri than Dalit and Sanyashi.

The majority of interviewed households (90.2%) showed positive attitudes towards the project. Regarding the mode of compensation, 78% of the surveyed households were willing to receive cash compensation while 14% preferred land for land compensation. If they were required to resettle due to the implementation of the project, 61% of the interviewed households stated their preference to move to the nearby areas by themselves, while 35 % preferred to move outside the project areas by themselves. Only 4% replied that they would like to accept project rehabilitation measures in nearby areas. The summary of the Socio-Economic Situation is presented in **Table 9.4.4-3** (See the details in Environmental and Social Consideration Report).

Table 9.4.4-3 Summary of the Socio-Economic Situation of Affected Persons/Households (N=399)

1	Population and House holds	2839 (Male: 1485, Female 1344), 399 households (Male: 322, Female 77)
2	Average Family Size	7.1 (Male Headed 7.3, Female Headed 6.3)
3	Ethnic/Caste Composition	Magar (51%), Gurung (8.52%), Dalit (8.0%),
4	Period of Settlement	2 generations before (46.9%), 1 generation before (29.6%), Recent-Within past 30 years (29.6%)
5	Religion	Hindu (86.2%), Buddhist (13.5%), Christian (0.3%)
6	Literacy Rate	79.2 % (Male 86.6%, Female 70.9%)
7	Electricity services	64 %
8	Drinking Water Sources	Pipe (84.5%), MUL (1%), Stream/River (0.5%) Rain Water (4%), Well/Pond (14.0%)
9	Having Toilet	62.9%
10	Major Occupation of HH	Agriculture (56.4%), Service (14.7%), Study (16.0%), Business/Wage/Others (13.0%)
11	HH Owing Different Type of Land	Khet Land (55.1%), Bari Land (92.2%), Kharbari (8.5%), Private Forest (2.5%), Orchard (2.0%)
12	Average Land holding Size	0.685 (ha/household)
13	Reporting Various Sources of Income	Agriculture (94.5%), Livestock (56.4%), Wage earning (32.1%), Salary/Pension (32.8%), Remittance (32.1%), Loan (38.1%), Business (8.8%), Interest/Sell (1.0%)
14	Perception about the Project	Like (90.2%), Do not like (9.8%)
15	Desired Compensation	Cash for house/land (77.7%), Land for land (13.5%), House for house (0.5%), Land for house/land (3.5%), Other (2.5%), Not stated (2.3%)
16	Type of Resettlement Plan Preferred	Self rehabilitation nearby (60.8%), Project rehabilitation nearby (3.8%), Self-rehabilitation outside project area (35.4%)

Source: Supplemental EIA Survey, JICA Study Team, 2006

(4) Community Resources and Properties, and Potential Effects

Focus Group Discussions were held in 13 different communities within the affected VDCs and municipality. These discussions revealed that forest resources and water resources were vital for the daily lives of these community people and these resources are very often managed by the community people themselves as common resources and properties. **Table 9.4.4-4** summarized the results of the focus group discussion (See the details in Environmental and Social Consideration Report).

Table 9.4.4-4 Summary of Community Resources and Properties

1	Forest Resource Use	<p>Sources of fodder are mainly government forest, secondly community forest, while private forest and cultivated land are both scarce.</p> <p>Those beneficiary households, who have a food shortage of more than 6 months from their own products, are not using biogas and fully dependent upon fuel wood. A very small number of households, residing in relatively remote villages, planted or kept a small number of trees within their premises, but otherwise the majority of households were reportedly dependent on the forest.</p> <p>Within the project area, open space for livestock grazing has been observed to be insufficient for the number of livestock held in the area and the forest has been reportedly more actively used for the grazing of cattle and small ruminants. For about two or three months the practice of fallow grazing after crop harvesting was reported.</p> <p>Natural roofing materials are still used by the general population, particularly economically weak households, although the total consumption may be in decline due to the changing customs.</p>
2	Water Resource Use	<p>The sources of drinking water differ from one community to another. They include ponds, pipe water, water tanks, springs and streams. In most of the venues for the focus group discussions, irrigation water from the stream was available.</p>
3	Cemetery and Cremation Ground	<p>Most communities have their own cremation grounds near the river, which lack tangible structures. In several cases, it emerged that different ethnic groups use the same venue.</p>
4	Temple or Religiously/culturally Significant Spots	<p>Some communities have a temple or other religious sites for gathering. Some of them may be used by only specific ethnic groups while others are open to all ethnic and caste groups.</p>
5	User's Group	<p>There are various types of user groups in the communities. 8 community forest users' groups, 13 water users' groups, 2 irrigation water users' groups, 3 livestock raising group, 7cereal farms groups, 13 women groups, and 7 saving credit groups have been identified by community people who participating in this focus group discussion.</p>

Source: Supplemental EIA Survey, JICA Study Team, 2006

9.4.5 Key Socio-Economic and Cultural Effects

The implementation of the project will bring about adverse socio-economic and cultural effects during both the construction and operational phases. These impacts can be categorized into four issues, namely i) the loss of land and property, ii) direct impacts on households, iii) socio-economic and cultural impacts during construction, and iv) socio-economic and cultural impacts during operation.

This section describes these key socio-economic and cultural effects in the reservoir area, risk zones and project facility sites, which have been assessed by the Supplemental EIA Survey.

(1) Loss of Land and Property

1) Affects on Cultivation Lands

The cultivated lands areas are under the ownership of the local people. As indicated in

Table 9.4.5-1, the Project will affect 151.22 ha of the cultivated areas.

In the reservoir areas, the affected cultivated land areas were measured by using the GIS and cadastral maps as per the records of the District Survey Office (**Table 9.4.5-2**). Most agricultural land is located in Rising Patan in Rising Ranipokhari VDC, Samune and Chhore Patan in Majhkot and Bhimad Bajar and its vicinity in Bhimad VDC. A comparative analysis of the cultivated land area by using GIS and the cadastral map reveals that the GIS land use under cultivation is higher than the cadastral map. This can imply that in the reservoir area, there are many land plots which are under cultivation use, but not legally registered in the Land Revenue Office or in the District Survey Office.



Table 9.4.5-1 Cultivated Areas in the Reservoir Site as per GIS and Cadastral Maps

Type of Land Use	Reservoir FSL415+10m	Risk Zones (Wantang Khola, Phedi Khola, and Tittuwa)	Project Facility Sites	Grand Total
Cultivated areas (ha)	108.89	6.51	35.82	151.22

Source: GIS Map, JICA Study Team, 2006

Table 9.4.5-2 Cultivated Areas in the Reservoir Site as per GIS and Cadastral Maps

Affected VDC Reservoir FSL 415+10m	Cultivated land (ha)		Estimated cultivated land without legal registration
	GIS Map	Cadastral Map	
Bhimad	4.18	1.39	2.79
Chhang	26.61	22.09	4.52
Majhkot	12.76	15.28	-2.52
Rising Ranipokhari	28.37	38.75	-10.38
Kotdurbar	14.74	6.00	8.74
Jamune	11.46	0	11.46
Kanhun Shivapur	10.76	10.11	0.65
Total	108.89	93.62	15.26

Note: The Geruwatar area is currently under grassland, but is registered as agricultural land. The GIS map has recorded this area as grassland. It is because of this that the actual cultivated land in Rising Ranipokhari VDC is less than the cultivated land indicated in cadastral maps.

Source: GIS Map, JICA Study Team, 2006, and Cadastral maps. District Survey Office

2) Affects on Agricultural Products

The annual production loss from the agricultural areas occupied by the project is presented in **Table 9.4.5-3**. It is estimated that 660 metric tons of annual production will be lost due to the implementation of the project. If we assume that the average crop yields for paddy are 3.15 metric tons per ha, the annual loss of paddy production resulting from the project is approximately 285 million tones, accounting for 43% of the total annual production loss. Since the vast majority of the local people in affected areas are engaged

in agriculture, the project will have adverse impacts on their livelihood.

Table 9.4.5-3 Annual Production Loss of the Agricultural Land

Loss Type		Production losses in metric tons (1000 kg)				
		Reservoir FSL415+10m	Risk Zones (Wantang Khola, Phedi Khola, and Tittuwa)	Project Facility Sites	Grand Total	Percent
Irrigated land	Paddy	205.8	12.30	67.7	285.8	43.25
	Wheat	24.83	1.48	8.17	34.48	5.22
	Maize	43.12	2.58	14.18	59.88	9.06
	Early paddy	52.66	3.15	17.32	73.13	11.07
Upland	Maize	108.89	6.51	35.82	151.22	22.89
	Millet	20.91	1.25	6.88	29.04	4.39
	Pulses	19.60	1.17	6.45	27.22	4.12
Grand Total		475.81	28.45	156.52	660.78	100

Cropping intensity and production per ha of land in irrigated khet land			Cropping intensity and production per ha of land in upland (bari land)		
Crop Type	Cropping % in the land	Production/ha (MT)	Crop Type	Cropping % in the land	Production/ha (MT)
Paddy	100	3.15	Maize	100	2.5
Wheat	20	1.9	Millet	40	1.2
Maize	33	2	Pulses	50	0.9
Early paddy	26	3.1			

Note: Estimated upland and irrigated land in the reservoir/project facility site area = 60 percent irrigation khet land, and 40 percent upland (bari land) based on the Tanahu district average. Since the compensation for loss of agricultural products is officially estimated based on the unit yield of district average data, it was used here.

Source: Supplemental EIA Survey, JICA Study Team, 2006

3) Effects on Forest Land

Most of the forest land affected is under the jurisdiction of the Department of Forest and also comes under the government managed forest category. Part of the government managed forest has been handed over to the community forest for management and sustainable use, while patches of private forests are also found within the affected project area managed by individual households. The status of the affected forest area in the project area is presented in **Table 9.4.5-4**.

Table 9.4.5-4 Forest Area by Management Types in the Project Area

	Reservoir FSL415m	Project Facility Sites	Grand Total
National Forest (Protection Forest)	259.84	51.91	311.75
Community Forest	88.77	16.79	105.56
Private Forest	5.29	0	5.29
Total (ha)	353.89	68.7	422.59

Source: Supplemental EIA Survey, JICA Study Team, 2006, and GIS Map, JICA Study Team, 2006

The National Forest under government managed category comprises the largest area

followed by the Community Forest (CF). Private Forest is limited to within 6 ha. There are 7 CFs to be affected by the reservoir inundation with FSL 415 m. In particular, in the case of three CFs such as Salbas CF in Kahun Shivapur VDC Ward No.1, Shidhabatasan CF in Jamune VDC Ward No.6 and Ghunmanune Danda CF in Rising Ranipokhari VDC Ward No.9, a large portion of community forest, i.e. 20% to 45% of the total areas, will be inundated. In the project facility sites, along the right bank of Seti River, lies Beltar – Bachangauda Community Forest along the eastern limits of the proposed spoil dump area in Beltar and at the eastern end of Huksetar. Total area of the forest is 5.1 ha. One hundred and twenty household are involved in the forest management with a total population of 616. Since most local people are highly dependent on forest resources, such as fodder and fuel wood, in their daily lives, the inundation of forests in the project area will bring about negative impacts on these people (See also Biological environmental impact in this report and Environmental and Social Consideration Report).

(2) Direct Impacts on the Households

All the people or households whose land or property is acquired by the project, either temporarily or permanently, are generally defined as project affected persons/households. These affected persons/households are those who will lease their land temporarily in negotiation with the contractor, and those who will be permanently displaced by the dismantling and construction of the project structures, project facilities, and reservoir inundation. The extent of the impact severity will vary from household to household, and is also dependent on the loss of land and property, their current social and economic conditions, and the likely conditions after the acquisition of land and property. This section describes the various impacts to the households.

1) Affected Land Parcels of the Project

The cadastral maps were the basic input for the identification of the land parcel in the project affected area. The Household Survey of the affected people could not verify all the land parcels due to the higher number of absentees during the survey. Besides, there are a number of land areas under cultivation, but not legally defined as land parcels and the limited field survey was unable to define these lands in the land parcel category. Cadastral maps of the area limit mapping only to the agricultural areas of the survey period, i.e. about 35 years back with only few modifications. The forest, barren areas, river corridors, shrub land and grasslands are not shown in the cadastral maps. **Table 9.4.5-5** presents the accounted land parcels in the project affected area as per the cadastral maps.

Table 9.4.5-5 Number of Land Plots Affected by the Project

Affected VDCs/Municipality (FSL 415+10 m)	Number of land plots
Bhimad	21
Chhang Bazaar	116
Majkot	134
Rising Ranipokhari	252
Kotdurbar	68
Kahun Shivapur	52
<i>Total land plots affected (Reservoir)</i>	643
Kahun Shivapur VDC	
Access road	24
Spoil disposal (Beltar)	317
Base camp (Huksetar)	55
Vyas Municipality	
Access road (Benipatan and Betini)	130
<i>Total land plots affected (project facility sites)</i>	526
Grand Total Land plots affected Project	1169

Source: Cadastral maps of the affected area in Supplemental EIA Survey, JICA Study Team, 2006

2) Affected Land Owner Families of the Project

Table 9.4.5-6 presents the numbers of land owners actually verified and those estimated from the database of field book of the District Survey Office. The total number of private land owners is estimated to be 838.

Table 9.4.5-6 Number of Affected Land Owners of the Project Area

Particulars	Reservoir area FSL 415+10 m	Project Facility Sites
Owners identified plots	471	662
Owner unidentified plots	113	55
Government plots	59	9
Estimated private owners of unidentified plots	70	34
Private owners of identified plots	275	405
Total arable land unregistered (ha)	16.6	
Estimated private owners of the unregistered plots	54	
Total owners	839	
Total Private Owners	838	
Government Owner	1	

Note: Estimation of owners of unidentified plots and areas is based on the total identified owners Vs identified plots areas for 435 m levels.

Source: Supplemental EIA Survey, JICA Study Team, 2006

Legally, there are no tenant families in the project area. However, the number of landowners and tenants will be further validated during the final check survey to be conducted by the developer.

3) Effects on Private Built Structures

The project is envisaged to affect two types of built structures, namely privately owned and community owned structures respectively. The former include houses, cowsheds, toilets and other facilities. As indicated in **Table 9.4.5-7**, 313 private structures will be

affected by the Project. Close to 55% of the total affected private structures are located in the project facility sites, in which the congested communities have been developed due to good access to Damauli.

Table 9.4.5-7 Affected Private Structures

	Affected VDCs/Municipality	Number of Affected Private Structures
Reservoir Area (FSL 425+ 10 m)	Bhimad,	0
	Chhang	31
	Majkot,	4
	Rising Ranipokhari	82
	Kotdurbar	5
	Jamune	18
	Kahun Shivapur	0
	Vyas Municipality	0
	<i>Total</i>	140
Project Facility Sites	Kahun Shivapur-Beltar (for <i>Spoil disposal</i>)	64
	Kahun Shivapur-Huksetar (for base camp)	41
	Vyas Municipality- Lower terrace (for access road Benipatan-Dam right bank of Seti)	68
	<i>Total</i>	173
Grand Total		313

Source: Supplemental EIA, Survey, JICA Study Team 2006

4) Affected Structure Owners of the Project

Generally, one owner has several structures and the number of owners having affected structures is presented in **Table 9.4.5-8** For the reservoir area and project facility sites, the name of each owner having these affected structures was identified. In the case of the Risk Zones, i.e. Wantang Khola, Phedi Khola and Tittuwa, it was estimated to be 20 people based on the GIS Map since these areas were not covered by the inventory structure survey.

Table 9.4.5-8 Structure Affected Owners of the Project area.

Affected VDCs/Municipality	Reservoir Area 415+ 10m	Risk Zone* (Wantang Khola, Phedi Khola, and Tittuwa)	Project Facility Sites		Grand Total
Bhimad,	0	0			0
Majkot,	3	0			3
Chhang	8	0			8
Rising Ranipokhari	11	20			31
Jamune	12	0			12
Kotdurbar	5	0			5
Kahun Shivapur	0	0	Spoil disposal (Beltar)	22	22
			Base camp (Huksetar)	8	8
Vyas Municipality	0	0	Access road	21	21
Total	39	20		51	110

Note: For the Risk Zones, it was assumed that all structures belong to different 20 people due to the lack of an inventory structure survey.

Source: Supplemental EIA Survey, JICA Study Team, 2006 and *GIS Map, JICA Study Team, 2006

5) Residential Structure Affected Owners

The entire owners having affected structures are not residing in these structures. **Table 9.4.5-9** presents the number of affected owners of residential structures, who need to be relocated from the present residential premises to a new location. In other words, these people will be immediately and severely affected by the implementation of the project.

Table 9.4.5-9 Residential Structure Affected Owners of the Project Area

Affected VDCs/Municipality	Reservoir Area 415+ 10 m	Risk Zone* (Wantang Khola, Phedi Khola, and Tittuwa)	Project Facility Sites		Grand Total
Bhimad,	0	0			0
Majkot,	0	0			0
Chhang	7	0			7
Rising Ranipokhari	4	20			24
Jamune	9	0			9
Kotdurbar	0	0			0
Kahun Shivapur	0	0	Spoil disposal (Beltar)	18	18
			Base camp (Huksetar)	7	7
Vyas Municipality	0	0	Access road	21	21
Total	20	20		46	86

Note: For the Risk Zones, it was assumed that all structures might be residential structures due to the lack of an inventory structure survey.

Source: Supplemental EIA Survey, JICA Study Team, 2006 and *GIS Map, JICA Study Team, 2006

6) Residential Structure Affected Owners without Legal Holdings

Some of the residential structure owners to be affected by the project have no legal holdings of the land plots and their residential structure is located in government land. In some places, the local school authority of the area has given these land plots to people on token money for school funds with the assurance that the plots will be registered in their name. Such residential structure owners are found at Wantang Khola of Rising Ranipokhari VDC and Beltar of Kahun Shivapur VDC. There are also a number of such

land owners in Bhimad, Chhang, Rising Ranipokhari, and Jamune VDC.

Apart from this, there are people having residential structures in others land but without any legal document. **Table 9.4.5-10** presents the numbers of such residential structures in the reservoir area and project facility sites.

Table 9.4.5-10 Residential Structure Affected Owners without Legal Holdings

Particulars	Number
<i>Reservoir Area FSL 415+10 m</i>	
Residential Structures in government land without legal holdings	29
<i>Project Facility Sites</i>	
Residential Structure in others land	1
Grand Total	30

Source: Supplemental EIA Survey, JICA Study Team, 2006

7) Seriously Project Affected Families and Project Affected Families

As previously mentioned, the effect of the project, due to the acquisition of land and other assets, is not the same for all those affected. Some people may lose a significant amount of land or residential house while others may be marginally affected, due to the loss of small portion of land or income. Those who need to lose their houses and relocate may not be seriously affected in terms of economic point of view if they have sufficient amount of land or other assets in non-affected areas. It is very difficult to identify a definitive conclusion on the severity of impacts objectively to each of project affected people, since no reliable database exists concerning the social and economic conditions of the households in VDC and district levels. There have been no standard criteria of Seriously Project Affected Families (SPAF) and Project Affected Families (PAF) in Nepal. Every project has developed and used different criteria of SPAF and PAF⁸.

Although 339 households were randomly selected from the potentially affected households as a sample, it is useful here to comprehend the picture of the most disadvantaged groups among these affected households, who need to be given special consideration during the detailed design phase and implementation of rehabilitation programs under the Social Action Plan.

Thus, a distinction has been made between SPAF and PAF, taking consideration of two poverty related criteria and putting the sample households. The criteria for SPAF are given below;

- Marginal households having < 5 ropani (0.25ha) of land or

⁸ Kaligandaki A project has employed categorization of the project affected households on the basis of the loss of land. Any households losing more than 50% of the total land irrespective of the landholding size and other off-farm income were identified as SPAF and the rest as PAF. This evaluation was based on the answers of the respondents in the household survey.

- Households having a per capita/annum income of NRs 8,902 below the poverty line (defined by the Nepal Living Standard Survey 2003/04 for Rural Western Hill)

Based on the land holding criteria, a total of 263 households (66% of the total) are identified as SPAF, while under the per capita poverty line income criteria, only 30 households (7.5%) are identified as SPAF (Table 9.4.5-11).

Table 9.4.5-11 SPAF and PAF by VDC

Affected VDCs/ Municipality	By Land Ceiling <5 Ropani						By < NRs 8902 Per Capita Annual Income						% of Total (N=399)
	SPAF		PAF		Total		SPAF		PAF		Total		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Bhimad	1	25.0	3	75.0	4	100	0	0	4	100	4	100	1.0
Chhang	24	51.1	23	48.9	47	100	3	6.4	44	93.6	47	100	11.8
Majhkot	8	38.1	13	61.9	21	100	3	14.3	18	85.7	21	100	5.3
Rishing Rani Pokhari	51	58	37	42	88	100	2	2	86	98	88	100	22.1
Kotdurbar	7	41.2	10	58.8	17	100	4	23.5	13	76.5	17	100	4.3
Kahun Shivapur	108	78.8	29	21.2	137	100	11	8.0	126	92.0	137	100	34.3
Vyas	64	75.3	21	24.7	85	100	7	8.2	78	91.8	85	100	21.3
Grand Total	263	65.9	136	34.1	399	100	30	7.5	369	92.5	399	100	100

Source: Supplemental EIA Survey, JICA Study Team, 2006

The SPAF are found mostly among the Dalit (78%) compared to other four categories of caste/ethnic households under the land holding criteria, while under the per capita income criteria, highest number of Adibashi/ Janjati (9%) are categorized as SPAF (Table 9.4.5-12).

Table 9.4.5-12 SPAF and PAF by Cast/Ethnicity

Caste/ Ethnicity	By Land Ceiling <5 Ropani						By < NRs 8902 Per Capita Annual Income						% of Total (399)
	SPAF		PAF		Total		SPAF		PAF		Total		
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Brahmin/Chhetri / Thakuri	39	51.3	37	48.7	76	100	5	6.6	71	93.4	76	100	19.0
Adibasi/ Janajati	190	68.3	88	31.7	278	100	24	8.6	254	91.4	278	100	69.7
Dalit	25	78.1	7	21.9	32	100	1	3.1	31	96.9	32	100	8.0
Other (Sanyasi)	9	69.2	4	30.8	13	100	0	0	13	100	13	100	3.3
Grand Total	263	65.9	136	34.1	399	100	30	7.5	369	92.5	399	100	100

Source: Supplemental EIA Survey, JICA Study Team, 2006

(3) Socio-Economic and Cultural Impact during the Construction Phase

The acquisition of land and property and displacement and/or relocation of people are some of the direct and significant impacts caused by the project. There are other socio-economic and cultural impacts, i.e. both adverse and beneficial, which are assumed to occur during the construction phase of the project.

1) Affects on Infrastructures

The reservoir inundation affects a variety of infrastructure facilities of the communities. **Table 9.4.5-13** summarizes the main infrastructures to be affected by the project. They include motorable roads, suspension bridges, foot trails, irrigation canals, and electricity distribution. Motorable roads are one of the important transportation means of moving goods and people from the bazaar areas, such as Damauli and Bhimad Bajar, to rural villages. There are 6 suspension bridges to be inundated by the Project, which will seriously affect the daily lives of the local people living on either bank of the Seti River, since these suspension bridges represent the lifeline of their transportation and communication. The foot trails are also a very important transportation mode for the local people living on either bank of the Seti River, since they can serve to connect one community to another, and the scattered communities and the district headquarter Damauli as well as Bhimad Bajar. One irrigation canal located in Rising Ranipokhari will be submerged by the Project, while two stretches of electricity distribution lines will also be affected. Other infrastructures to be affected by the project are 3 pipe water systems, 2 ponds, and 11 natural springs (See the details in **Environmental and Social Consideration Report**).

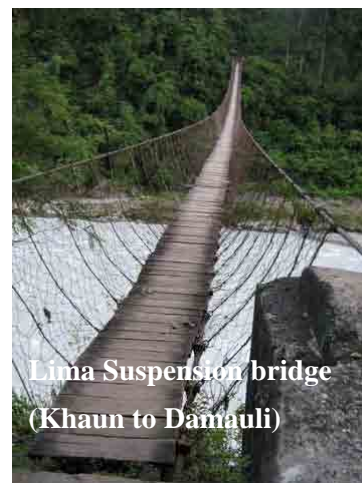


Table 9.4.5-13 Project Affected Main Infrastructures

Type of Infrastructure	Affected Main Infrastructures		
	Name of Structure	Length (m)	Reservoir FSL 415 m
Motorable road gravel	300	2 motorable roads	Majkot, Rising Ranipokhari
Bridge, Causeway, Culvert and Suspension bridge	740	6 suspension bridges	Rising, Ranipokhari, Jamune, Kotdurbar, Kahun Shibapur, Jamune
Foot Trails	31,945	20 foot trails	Chhang, Rising, Ranipokhari, Jamune, Kotdurbar, Vyas Municipality, Kahun Shivapur
Irrigation Canals	3,000	1 irrigaction canal	Rising Ranipokhari
Electricity Distribution	2,100	2 electricity dsitribution	Majkot, Rising Ranipokhari

Source: Supplemental EIA Survey, JICA Study Team, 2006

2) Effects on Community Built Structures

The implementation of the project will adversely affect several community structures. These structures include 1 cremation structure (ghat) used by Gurung in local communities in Bhimad, 1 temple called Mahadev Temple located in Chhang VDC, and 5 resting places. In particular, such temple and cremation structures are essential for the

religious and cultural practices of the local people, who require appropriate compensation for the loss of these structures.

Table 9.4.5-14 Affected Community Structures

	Affected VDCs/Municipality	Affected Community Structures	
	Reservoir FSL 415+ 10 m	Number	Type of Structures
Reservoir Area	Bhimad,	2	Ghat 1, Resting place 1
	Chhang	1	Temple 1
	Majkot	0	
	Rising Ranipokhari	2	Resting places 2
	Kotdurbar	2	Resting places 2
	Jamune	0	
	Kahun Shivapur	0	
	Vyas Municipality	0	
	<i>Total</i>	7	
Project Facility Sites	Kahun Shivapur-Beltar (for Spoil disposal)	0	
	Kahun Shivapur-Huksetar (for base camp)		
	Vyas Municipality- Lower terrace (for access road Benipatan-Dam right bank of Seti)		
	<i>Total</i>		0
Grand Total		7	

Source: Supplemental EIA Survey, JICA Study Team, 2006



3) Risk of Erosion and Slope Failure

The risk of erosion and land failure in the long run along the shore line exists throughout the reservoir due to geologic materials, which will increase after the implementation of the project. That is why it is necessary to delineate a 10 m vertical height from the FSL as Risk Zones and implement necessary measures, such as planting work for the purpose of slope stability. Meanwhile, the extent of the risk of land failure in areas such as Wantang Khola, Phedi Khola and Tittuwa is much higher than in other areas, while the application of bioengineering or civil works for these Risk Zones is very costly. Even with the application of these measures, it is difficult to control such failures in the long run.

4) Water supply, Sanitation and Health

The construction of activities and the likely increase in population of the area during the construction phase may exert increased pressure on the existing water supply system and cause shortages of drinking water, which may also generate conflicts and dissatisfaction between local and new users. Furthermore, the influx of a large number of workers during the construction will potentially cause existing sanitation conditions to further deteriorate. The lack of proper sanitary measures and increase in water pollution and solid waste can trigger the outbreak of epidemics such as typhoid, cholera, and diarrhea, while other communicable diseases, like STDs and HIV, cannot be ruled out when many people flock together and live in a limited area at the construction sites. Since the people have very little generic knowledge of these sexually transmitted diseases, appropriate measures such as awareness and education programs must be taken.

5) Accidents and Occupational Health

Work related injuries and accidents are likely to occur during the construction phase, not only for those who are engaged in construction work but also the local community people, and there are accidental risks, since they live close to the construction sites.

6) Vulnerable Groups

Experiences in other project areas have shown that women and children are vulnerable groups and female trafficking, and sexual and labor exploitation can happen during the construction phase. Although child labor is prohibited under the Nepalese law, children are engaged in stone quarries and other menial jobs.



Besides women and children, elderly people can be regarded as one of the vulnerable groups, who may be in more danger of accidental risks and health hazards. In some cases, it will be more difficult for these elderly people to be relocated away from the current sites elsewhere, since they have had a strong and long term relationship with the community people and an attachment to their own structures and the community itself.

7) Effects on the livelihood of fishermen

The project is less likely to adversely affect any specific fishing communities, like the Kaligandaki A Project. Furthermore, there are currently no full time fisherman in the Seti and Madi Rivers. The Bote community (ferry rider community) used to be engaged in ferry operations across the Seti and Madi Rivers and practice fishing as their main livelihood. In accordance with the replacement of boats by suspension bridges, the

traditional ferry operations came to a halt. They are now engaged in agro-economic activities; only occasionally fishing in their free time. Other ethnic groups, such as the Magar, Gurung and Kumal, are engaged in part-time fishing for recreation. Accordingly, it cannot be said that the project will directly and significantly affect specific fishermen groups or fishermen communities. However, it can be assumed that the water diversion of the Seti River will bring about some effects on the fisheries resources in the project area, to a greater or lesser degree, and may also influence their fishing activities to some extent.

8) Beneficial Impacts

Once the construction of the project starts, significant and visible impacts will be realized in the local economy of the project area. It can be assumed that economic activities will boom in settlements close to the project facility sites. Various employment opportunities will also increase due to the implementation of the project.

(4) Socio-Economic and Cultural Impact during the Operational Phase

1) Downstream Effects

There may be accidental risks to the lives of people and cattle, particularly in downstream areas, due to the surges of water in the Seti River twice daily during the peak power demand periods. The sudden release of water will also affect the white water rafting tour operators. On the other hand, serious downstream effects on agricultural activities in the areas will be less likely, since the local people in downstream areas do not take water from the Seti River for the purpose of irrigation but rather from small streams (See the details in **Physical Environmental Impacts**).

Safety Issue

Regarding the downstream safety issue, it is not examined in detail from environmental viewpoints in this stage of the project since topographic survey and hydraulics of the downstream river course have not been conducted. So far, any economic activities by villagers such as irrigation has not been found in the immediate area of tailrace as long as preliminary examination by using the topographic map at 1:25,000 scale and field reconnaissance, since the area is composed of deep gorge. Therefore, a siren system will be proposed to install in the section between dam site and tailrace. The siren system will be installed, at least, at 2 sites in the vicinity of confluence of the Madi River. The sound of siren reaches area within 500 m radius from the siren. In further stage of the project, topographic survey in the downstream river course and detailed hydraulic examination such as increase speed of downstream water level in water discharge for power generation should be conducted.

Impact to White Water Rafting

Regarding the potential impact to the white water rafting, two types of the impacts are considered; (1) In non-power generation period, rafting activity would be disturbed in the downstream river course since shortage of water level and flow speed at certain section of the river course may occur due to regulation of water discharge from the dam (On the other hand, there is no any impact in the downstream area of the dam since there is no rafting activity at present.), and (2) In power generation period, danger on rafting activity in the river and camp site for rafting tour at river reservation (or river side area) would be considered due to immediate increase of downstream water level by discharging from tailrace outlet. Same situation of the latter can be considered in the sediment flushing operation. However, since downstream conditions and present rafting activity are not known in detail as well as the safety issue, type and degree of the impact for the rafting activity can not clearly be identified in the study. In addition, possibility to implement the rafting activity in the non-power generation period should be examined and discussed between NEA and rafting operators in the further stage of the project.

2) Withdrawal of Economic Activities

The first and foremost impact during the operational phase is the withdrawal of economic activities that flourished during the construction phase, since the majority of the construction related workforce will leave the project areas. However, it is likely that some economic activities will continue in these areas because of the relatively good location close to urban areas such as Damauli and Bhimad Bajar. With this in mind, the impact of the withdrawal of economic activities during the operational phase can be assumed to be low to moderate.

9.4.6 The Framework of Resettlement Plan

(1) Resettlement Effects and Possible Mitigation Measures

The Supplemental EIA Survey reveals that the project will cause a range of resettlement effects in the affected VDCs and Vyas Municipality. Some families residing within the reservoir and project facility sites will need to be relocated because of land acquisition. Productive assets, including land, housing structures, income sources, and livelihood can be also lost. In order to avoid or minimize these resettlement effects, the framework of the Resettlement Plan (RP) was prepared in the course of the Study.

Table 9.4.6-1 summarizes the resettlement effects on affected persons/households and potential mitigation measures. These measures were developed based on the review of the prevailing legal registration related to resettlement and similar Hydroelectric Development Projects in Nepal, such as Kaligandaki A and Middle Marsyangdi. Furthermore, the results of discussion with NEA and other stakeholders have been incorporated into these measures.

Table 9.4.6-1 Major Resettlement Effects on APs and Possible Mitigating Measures

Effects	Possible Mitigation Measures
Loss of land due to permanent acquisition for project components project facility sites	<ul style="list-style-type: none"> ▪ Landowners of the permanently acquired lands of project components and project facility sites will be compensated in cash for the replacement cost. The Compensation Fixation Committee, in consultation with local government and APs, shall decide on the replacement costs of the land.
Loss of land due to permanent acquisition in erosion-prone areas, i.e., Risk Zones	<ul style="list-style-type: none"> ▪ Landowners of the risk zone, which is a 10 m vertical distance from the FSL and three Risk Zones, namely Wantang Khola, Phedi Khola, and Tittuwa, will be compensated in cash at the replacement cost as per NEA's practices. The Compensation Fixation Committee, in consultation with local government and APs, shall decide on the replacement costs of the land.
Damage to crops/plants/trees during construction/operation	<ul style="list-style-type: none"> ▪ Any loss of crops shall be paid to landowners of the permanently acquired area, based on the evaluation norms of the District Agricultural Office ▪ Any loss of forest resources, particularly Government Forest and Private Forest, shall be compensated for as per the prevailing forest policy. Meanwhile, it is proposed that the Community Forest be compensated according to the production loss of forest resources such as timber, fuel wood (See the Biological Environment Section).
Dismantling of the house and other structures and Utilities	<ul style="list-style-type: none"> ▪ House and other structures and utilities in the project affected areas shall be compensated at replacement costs, based on the evaluation norms of the District Development Committee. Depreciation shall not be accounted for.
Need to transport the salvaged materials of house structure and utilities	<ul style="list-style-type: none"> ▪ All the APs whose house structure is occupied permanently will be given a transportation allowance of NRs. 18,000 to transport the salvaged materials to the new place. The rate of transportation allowance was set based on that taken by the Middle Marsyangdi Hydro Electric Project in consideration with price boost.
Disturbance to APs who are relocated	<ul style="list-style-type: none"> ▪ A grant of disturbance compensation shall be payable to APs, who lose their residential houses, to tide them over during reconstruction of their houses and/or adjusting to their new environment. The amount shall be no more than 180 days multiplied by the daily minimum wage in the project-affected area. ▪ House rental allowance to APs for a period of 180 days @ NRs. 200/day ▪ A grant of disturbance compensation shall be payable to APs, who lose their residential house structure due to shoreline erosion, to tide them over during reconstruction of their houses and/or adjusting to their new environment. This shall be payable in cash to a sum not exceeding 180 days, multiplied by the daily minimum wage in the project-affected area (district rate).
Adverse economic impacts upon APs who are relocated due to loss of residential structures	<ul style="list-style-type: none"> ▪ A gift land plot in the adjacent area or cash compensation equivalent to the cost of the above land size will be given to APs whose residential houses are affected by the project. Concerning the relocation destination, there are no appropriate large areas within or near the sites affected by the project. Furthermore, the relocation of APs, who used to live in different areas, into one area is envisaged as having the potential to spark social conflict. Besides, a majority of the people would prefer cash compensation and wish to relocate themselves in areas of their choice. Accordingly, a gift plot equivalent to one Ropani land (508 m²) is proposed for households who will lose their residential plots, irrespective of the size of the residential land plot.

(2) Compensation and Benefits of Affected Persons/Households

It is proposed that the following compensation and benefit should be provided to the identified affected households and affected persons. The rehabilitation program including restoration of all types of livelihoods for APs is included in the Social Action Plan. The

summary of the proposed compensation and benefits is shown in **Table 9.4.6-2** (See the details in Entitle Matrix in **Environmental and Social Consideration Report**).

Table 9.4.6-2 Proposed Compensation and Benefits of APs

Affected Households/Persons /Community	Compensation and Benefits
Land owner/ legal title holder and occupier of the land during the cut off date.	<ol style="list-style-type: none"> 1. 100% payment on market-based rates of the permanent land occupancy for the project components and project facility sites 2. 100% payments of the agricultural production for one year of the agricultural lands
Structure owner other than residential (registered or unregistered or in others land) at the time of the cut off date.	<ol style="list-style-type: none"> 1. Replacement cost of structure/associated utilities 2. Transportation allowance
Residential structure owner (registered or unregistered or living with a structures in others land) at the time of the cut off date.	<ol style="list-style-type: none"> 1. Replacement cost of house structure/associated utilities without deducting depreciation 2. Disturbance compensation allowance for 180 days for one person at the minimum district wage rate for one person of the house 3. Transportation allowance (lump sum) NRs. 18,000 4. House rental allowance for 180 days @ of NRs. 200 per day 5. Gift land plot or equivalent cost of the gift land plot (508m²) in the adjoining area of the residential structure
Community structure	<ol style="list-style-type: none"> 1. Replacement cost of structures and facilities without depreciation 2. Transportation allowance (lump sum) NRs. 18,000

(3) Cost Estimates for Compensation and Benefits of Affected Persons/Households

The cost estimates for the proposed compensation and benefits of affected persons/households are summarized below⁹.

⁹ Cost estimation for land use restriction is included in the Physical Environmental Costs.

Table 9.4.6-3 Cost Summary

Reservoir FSL (m) + Risk Zones	415 + 10 m
Cost Estimation for the Private Land*	999.51
Cost Estimation for the Structures**	33.972
Cost Estimates for Agriculture Production Equivalent to One Year Production***	0.647
Other Rehabilitation Compensation to Relocatee****	44.95
Transportation Allowance to affected Structure Owners Other than the Affected Residential Structure Owners*****	0.56
Monitoring for 10 years*****	1.80
Grand Total	1,081.4

Note

- * Land areas identified by the GIS map were accounted for in the cost estimation. The land cost obtained from focus group discussion i.e. NRs.250,000/Ropani (0.051ha) for reservoir area and NRs 600,000/Ropani (0.051ha) for project facility sites was used.
- ** Structures cost, including private and community structures and utilities, has been estimated on a per district basis and based on Government of Nepal norms.
- *** An estimated 40% for up and 60% for rain-fed irrigated land in the project area. The cropping intensity and production per ha are based on the Tanahu district average.
- **** Other rehabilitation includes disturbance compensation, house rental compensation, transportation allowance, and a gift house plot.
- ***** This transportation allowance is provided to private and community structure owners, who need not be relocated but can move the salvaged structural materials from the current site to elsewhere. It is estimated at NRs 18,000 (lump sum) per owner.
- ***** This cost for 10 years or 5 times monitoring is estimated.

9.4.7 Preparation of Social Action Plan

(1) Socio-economic Effects on Communities and Possible Mitigation Measures

The Resettlement Plan addresses what types of APs will be eligible for what types of compensation and benefits in order to mitigate, particularly, economic impacts on APs. However, it does not respond to the socio-economic effects on the communities such as loss of community resources and properties. To reverse these impoverishment risks caused by the project, the Social Action Plan (SAP), a package of social programs, has been prepared based on the results of Supplemental EIA Survey under the Study. **Table 9.4.7-1** summarizes the socio-economic effects on communities and possible mitigating measures.

Table 9.4.7-1 Socio-economic Effects on Communities and Possible Mitigating Measures

Effects	Possible Mitigation Measures
Loss of Infrastructures (motor roads, foot trails, suspension, irrigation canals, electricity distribution lines etc.)	The infrastructures affected by the project during the construction and operation phases shall be reinstalled by the project as a separate package of Social Action Program (Restoration of Project Impacted Infrastructure).
Loss of Community Structures (Temples, Pati and built cremation grounds etc.)	<p>Community structures and utilities in the project affected areas shall be compensated for replacement costs, based on the evaluation norms of the District Development Committee. Depreciation shall not be accounted for.</p> <p>The loss of community structures and utilities due to shoreline erosion during operation shall be paid to the respective owners as above. The loss of community structures shall be compensated for the respective communities at replacement costs, based on the evaluation norms of the District Development Committee. Depreciation shall not be accounted for.</p> <p>A transportation allowance of NRs. 18000 shall be provided to the communities to transport the salvaged materials to the new place</p>
Loss of forest resources	Any loss of forest resources, particularly Government Forest and Private Forest shall be compensated as per prevailing forest policy. Meanwhile, it is proposed that the Community Forest be compensated according to the production loss of forest resources, such as timber, fuel wood (See the Biological Environment Section).
Deterioration of health and education conditions in affected communities due to the inflow of a large number of workers	Efforts to maintain the community health and education shall be carried out under separate packages of the Social Action Program (Community/Public Health & Education Enhancement).
Deterioration of occupational health of workers during the construction and the operation phases	Project contractors in the construction phase and project operators in the operation phase will be made responsible for the occupational health of workers.
Adverse impacts on vulnerable groups due to the inflow of a large number of workers	Efforts to assist vulnerable groups will be carried out under separate packages of the Social Action Program (Women Development Program etc).

(2) Proposed Social Programs

The formulation of Social Programs is based on the assessment of socio-economic effects on the affected persons and community through the Field Survey, the Household Survey and Focus Group Discussion in the project-affected VDCs and municipality under the Supplemental EIA Survey. During the Focus Group Discussion, undertaken in 13 different places of the project-affected VDCs and municipality, the communities were asked to list three urgent development needs in the context of the local area and categorize those needs into first and second priorities. Prioritization of the development needs differed from community to community. Their perceived development needs, when compiled and assessed for all communities of the project areas, are summarized in **Table 9.4.7-2**.

Table 9.4.7-2 First and Second Priority Needs and Proposed Social Action Programs¹⁰

S.N.	First Development Priorities		Proposed Social Action Programs
1	Motor road linking to Damauli from the project sites		
2	Clean drinking water supply at the community level	⇒	2. Community's Initiative Support
3	School buildings and improvements in the school facilities	⇒	5. Community/Public Health and Education Enhancement
4	Employment opportunities	⇒	3. Skill Enhancement and Employment
5	Irrigation facilities at the tar areas	⇒	2. Community's Initiative Support
6	Motor bridge over Seti River		
7	Training on herbal farming and processing	⇒	4. Agricultural Development
8	Rural Electrification	⇒	8. Rural Electrification
9	Tourism development		
S.N.	Second Development Priorities		Proposed Social Action Programs
1	Health Posts and health service facilities	⇒	5. Community/Public Health and Education Enhancement
2	School buildings and improvements in the school facilities	⇒	5. Community/Public Health and Education Enhancement
3	Irrigation schemes	⇒	2. Community's Initiative Support
4	Employment opportunities	⇒	3. Skill Enhancement and Employment
5	Skill development training	⇒	3. Skill Enhancement and Employment
6	Foot trail development	⇒	1. Replacement of Affected Infrastructures
7	Clean drinking water supply at the community level	⇒	5. Community/Public Health and Education Enhancement
8	Restoration of religious places	⇒	1. Replacement of Affected Infrastructures
9	Protection from river erosion	⇒	7. Watershed Management
10	Rural electrification	⇒	8. Rural Electrification
11	Suspension bridges across Seti	⇒	1. Replacement of Affected Infrastructures
12	Community buildings	⇒	2. Community's Initiative Support
13	Tourism development		
14	Barbed weir fencing of the community forests	⇒	2. Community's Initiative Support

Source: Supplemental EIA Survey, JICA. 2006

All of the above listed community development needs, irrespective of the prioritization by the communities, are related to the livelihood and quality of life enhancement. Besides these needs, local women addressed their felt needs of various women development activities in order to improve their knowledge and skills, and enhance their socio-economic status. There are a number of Government of Nepal agencies working in the above development areas. Similarly, a host of national and international non-governmental organizations are also working. However, the services provided are insufficient to meet the needs of the people in the project area. Obviously peoples are looking forward to some assistance from the side of the project to fulfill their development needs. In the above context, the social action programs have been framed to ensure that the poor, destitute and disadvantaged groups remain the central focus of the designed programs.

It is proposed that the eight social programs should be conducted to mitigate the socio-economic impacts on the affected communities and affected persons and rehabilitate

¹⁰ Regarding the upgrading of affected stretches of road, further examination is needed. The construction of new roads outside the affected areas is out of scope of the project.

the quality of life of these communities and persons. The eight social programs are summarized in **Table 9.4.7-3**:

Table 9.4.7-3 Proposed Social Programs

S.N.	Name of Program	Target Group of Programs	Program Components
1	Restoration of Project Impacted Infrastructure Program	Affected local communities in which infrastructure, except for the irrigation canals, will be affected	Affected infrastructure such as motorable roads, bridges, suspension bridges, causeways, foot trails, and electricity distribution lines, will be restored.
2	Affected Community's Initiative Support Program	Affected communities of the 7 project-affected VDCs of the Reservoir area, namely, Bhimad, Majkot, Rising Ranipokhari, Chhang, Kotdurbar, Jamune, Kahun Shivapur and Vyas Municipality	Some development funds will be allocated to each of the affected VDCs. Each VDC will provide these funds to the affected ward communities and select programs. With the objective of enhancing a sense of ownership for the program, the local affected VDCs or ward are expected to contribute 25% of the estimated cost in cash or in kind for the selected program. Under this program, small- and medium-scale community infrastructure development programs can be carried out.
3	Skill Enhancement and Employment Program	Local interested and eligible people from affected people and communities. The priority should be given to the poor, destitute and disadvantaged people.	Training will be carried out at least 6 months before the start of the construction works focusing on enhancement of skills required for the project employment.
4	Agricultural Development Program	Affected persons and affected communities, particularly in Majkot, Rising Ranipokhari, Jamune, Chhang, Kotdurbar, Kahun Shivapur	It includes agricultural, horticultural and herbal and vegetable farming development by providing practical training and improved seeds or samplings.
5	Community/Public Health and Education Enhancement Program	One program is targeted near the construction sites such as Benitar, Huksetar, Jhaputar, Betini and Belatar areas The other is targeted in the close vicinity of the reservoir affected VDCs	It focuses on the improvement of public health, sanitation, water supply, health and education institutions. Various public awareness and education activities, focusing on environmental sanitation, HIV/AIDS, STI and other communicable diseases, and prevention, will be also undertaken.
6	Women Development Program	Women in the affected VDCs and municipality, namely Bhimad, Majkot, Rising Ranipokhari, Chhang, Kotdurbar, Jamune, Kahun Shivapur and Vyas Municipality	With the objectives of enhancing the quality of life of women, the program includes income generation skills, education on HIV/AIDS, STI, family planning, and girl trafficking, and micro-credit funds.

S.N.	Name of Program	Target Group of Programs	Program Components
7	Community-based Watershed Management Program	Affected communities located close to the reservoir in affected VDCs and municipality, namely Bhimad, Majkot, Chhang, Rising Ranipokhari, Kotdurbar, Kahun Shivapur, and Vyas municipality	With the technical support of the watershed management experts in the detailed design phase, the program will be launched and managed by the affected communities.
8	Rural Electrification Program	Unconnected part of the affected VDCs and municipality namely Bhimad, Majkot, Chhang, Rising Ranipokhari, Kotdurbar, Kahun Shivapur, and Vyas municipality	It is designed to meet the electricity connection needs of the local communities.

(4) Cost Estimates for Social Programs

The cost estimates for the proposed social programs are summarized in **Table 9.4.7-4**.

Table 9.4.7-4 Cost Summary

SN	Proposed Social Programs	Million NRs.
1	Restoration of Project Impacted Infrastructures Program	85.5
2	Affected Community's Initiative Support Program	52.13
3	Skill Enhancement and Employment Program	10.14
4	Agricultural Development Program	27.51
5	Community/Public Health and Education Enhancement Program at the Project Construction sites	9.66
	Community/Public Health and Education Enhancement Program at the Reservoir affected VDCs	6.27
6	Women Development Program	13.03
7	Community-based Watershed Management Program	12.31
8	Rural Electrification Program	19.55
Total		236.10

Note: The above cost estimates are based on lump sum from the experience of the Middle Marsyangdi Hydropower Project.

9.5 Stakeholder Meeting

9.5.1 Overview of Stakeholder Meetings

The consultation with local stakeholders at an early stage of projects is essential for considering the environmental and social factors and ensuring the success of development projects. The JICA 's Guidelines stipulates that a series of stakeholders meetings need to be held three times during the feasibility study by the recipient government with the assistance of JICA if the proposed project is classified as Category A that is likely to have significant adverse impacts on the environment and society. As per this Guideline, stakeholder meetings would be held by NEA with the assistance of the Study Team. They were scheduled three times—(i)during scoping phase, (ii)during the time of submission of interim report and (iii) during the time of submission of draft final report in Damauli and Kathmandu respectively.

9.5.2 First Stakeholder Meeting during Scoping Phase

(1) Advance notification

Before the 1st stakeholder meeting in Damauli, the public announce was widely made in national daily “Gorkapatra” and local newspaper “Bhanjang”, at local FM program “Machhapuchhre” and on local TV program. Invitation letters were also sent to the affected VDCs, the concerned Ministries, the concerned local government organizations, the political parties, the concerned NGOs, media, universities and other relevant individuals. Furthermore, NEA and the Study Team posted public notice in several villages of affected VDCs and requested them to participate in it (See **Annex D: Advance notification and List of invited institutions/persons in Environmental and Social Consideration (ESC) Report**).

(2) Damauli

On June 2 2006, the 1st Stakeholder Meeting was held in the District Development Committee office with the following objectives;

- To explain and disclose information regarding the Project including the scope of the Study, project layout, EIA scoping and issues
- To obtain various opinions, concerns, suggestions and feedback from the public

Close to 450 participants of the meeting included local people of affected VDCs and Vyas municipality as well as other VDCs, government officials, NEA and the Study Team (See **Annex D: List of participants in ESC Report**). The majority of the local participants were farmers and others were engaged in business, service jobs, studying, social activities, and media. It was found that some farmers left their village in the early morning and took a five-hour walk for the meeting. More than expected, a number of local people attended it. Unfortunately, the ratio of women participants was only 10% of the total participants. It was assumed that they were likely to be too busy in rice planting and other house work to attend the meeting. In order to collect the voices from women, focus group discussion was conducted targeting women separately by local consultants during the field studies of the supplemental EIA under the Study. The number of local people by affected municipality/VDCs is shown in **Fig. 9.5.2-1**.

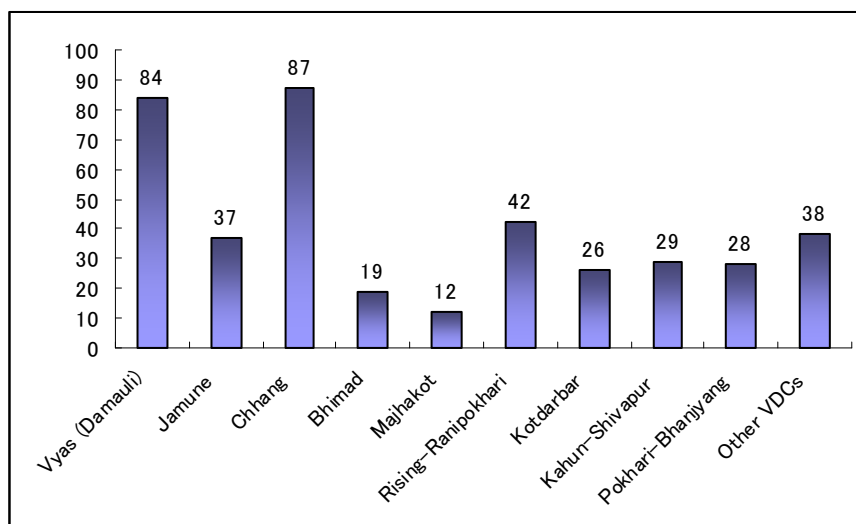
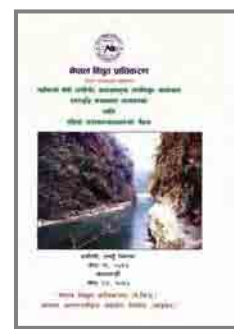


Fig. 9.5.2-1 Participants from Affected Municipality/VDCs

The meeting was moderated by the experienced NEA staff member in Nepali language that enabled the local participants to fully understand the presentations and participate in the discussions (See **Annex D: Program Schedule** in **ESC Report**). The brochure describing the project in Nepali was also distributed to participants (See **Right and Annex D: Brochure** in **ESC Report**). In the beginning, NEA started the meeting with a brief explanation of background and objectives of the proposed upper Seti storage hydroelectric project. They also gave an overview of



existing EIA conducted by NEA including a one-day Public Hearing in Damauli on January 25, 2004. Furthermore, the Study Team made presentations on the background of the Study, the layout of the project, and the scoping of supplement EIA to be conducted during the Study (See **Annex D: Presentation materials** in **ESC Report**).



Following that, the representatives of political parties made comments on the project, focusing that the proposed upper Seti storage hydroelectric project is extremely essential for the hydroelectric development not only in Tanahu District but also in Nepal. They emphasized that NEA and the Study Team need to consider providing the maximum benefits of the project such as sufficient compensation and employment opportunities to the affected households and the concerned communities, as well as rural electrification of target areas. During the meeting, several local people also expressed their views and made comments on the proposed project and the Study. Most of them showed their positive attitude towards

the implementation of the project, and simultaneously deep concern about the potential impacts on the environment and society. They strongly requested NEA and the Study Team to specify the affected areas and investigate the environmental and social impacts as soon as possible. They highly expected that the proposed project would provide sufficient compensation, employment and various training opportunities, and alternative mode of transportation to the affected families and the affected community people (See **Annex D: Meeting of Minutes in ESC Report**).

In order to get more feedback and comments from participants, a strip paper was distributed in the last session of the meeting. For the illiterate participants, the staff members of NEA and the local consultants of the Study Team helped write their views and comments. 127 participants in total submitted it before they left the meeting. Their opinion, concern and request can be summarized in **Table 9.5.2-1**.

Table 9.5.2-1 Suggestions, Feedback and Comments from the Participants¹¹

1	The propose project is requisite and essential in terms of development in the country as well as in Tanahu District. The development of this project is very crucial to meet ever increasing demand for electricity.
2	The information disclosure and the consultation with the affected areas and local people are very important. For interaction with the local people, VDC Specific Cooperation Committee should be formed as a focal point of the Project. It is necessary to continue to ensure transparency of the progress of project including the Study.
3	The proposed project needs to provide the maximum benefits to the local society.
4	The affected and inundated areas need to be urgently specified.
5	Due consideration should be given to the compensation and resettlement issues including identification of the entitlement and the timing for the compensation, the formation of compensation fixing committee, and the amount of compensation.
6	The priority for provision of employment opportunities should be given to, particularly the directly affected families and the affected VDC people.
7	The provision of training on agriculture development and capacity building need to be considered.
8	Priority consideration needs to be given to the road construction during the construction phase of dam as one of the alternative mode of transportation.
9	The newly constructed suspension bridges in replacement of the inundated bridges and other alternative mode of transportation need to be explored.
10	The environmental mitigation and countermeasures to erosion and landslide that are likely to take place in potentially affected areas need to be planned and carried out.
11	Adverse impacts on forests and specific areas should be assessed. Mitigation measures should be considered seriously.
12	Adverse impacts on aquatic ecology and fisheries should be assessed. Support program related to fisheries development needs to be planned and implemented to assist the affected fishermen.
13	Impacts on biological diversity should be further studied.
14	Electricity facility should be given to affected people and local people in Tanahu District at subsidized rate or cheaper rate.
15	Support program for promoting tourism in Tanahu District needs to be considered.

¹¹ Regardless caste and ethnic groups, these suggestions, feedback and comments were made by participants.

16	Various development needs should be met by the project. They include construction of irrigation facilities, supply of drinking water, women development activities, and improvement of school infrastructure.
17	We were concerned about the possibilities of the earthquake due to the project. An earthquake risk needs to be studied.

(3) Kathmandu

Following the meeting in Damauli, the 1st Stakeholder Meeting was also held in Kathmandu on June 7. There were 56 participants in total such as concerned government officials, intellectuals, donor agencies, NGOs, media, NEA staff members and the Study Team (See **Annex D: List of invited institutions/persons and List of participants in ESC Report**). The participants from donor agencies, NGOs and concerned ministries were limited since it was held on the day when many events to celebrate Environmental Day were organized in Kathmandu. The meeting was conducted according to the same meeting agenda as Damauli (See **Annex D: Program Schedule and Presentation materials in ESC Report**).

The former and active members of parliament from Tanahu District made remarks on the high expectation of the proposed project to meet the more demand for the power and promote rural electrification. They stressed that NEA and the Study Team should carry out the Study in the efficient and effective manner based on the feasible plan without the wasteful spending and time, which can be applied to smooth implementation of the project. They also requested that the mitigation measures against adverse impacts on the environment and society should be well planned and taken. Furthermore, they noted that the project should prioritize the provision of benefits to the local society such as rural electrification.

Some participants from the floor pointed out the necessity of assessing the adverse impacts on natural environment such as fisheries, lands slide and erosion. Others expressed their views that the past similar projects should be reviewed, and lessons learnt from these past projects should be incorporated into the proposed project, particularly in the areas of compensation arrangement and provision of employment opportunities. There were several questions such as the relation between the supplemental environmental assessment to be conducted by the Study and the existing EIA, the discussions of the 1st stakeholder meeting held in Damauli and so on. Both NEA and the Study Team replied the answers of these questions respectively (See **Annex D: Meeting of Minutes in ESC Report**).

(4) Media Coverage

1st Stakeholder Meetings in Damauli and Kathmandu were covered by the print media shown in **Table 9.5.2-2** (See also **Annex D: Media Coverage in ESC Report**).

Table 9.5.2-2 Stakeholder Meetings Covered by Print Media

S.N.	Print Media	Date
1-1	Gorkapatra (Nepali)*	May 24
1-2	Gorkapatra (English)/translation*	May 24
2-1	Bhanjang National Daily	June 1
2-2	Bhanjang National Daily (English)/translation	June 1
3	The Rising Nepal (English)	June 3
4-1	Gorkapatra (Nepali)	June 4
4-2	Gorkapatra (English)/translation	June 4
5-1	Rajdhani (Nepali)	June 4
5-2	Rajdhani (English)/translation	June 4
6	The Rising Nepal (English)	June 8
7	The Kathmandu Post (English)	June 8

Note: * public announcement before 1st Stakeholder Meetings

9.5.3 Second Stakeholder Meeting

(1) Advance notification

The methods of advance notification for 2nd stakeholder meeting were the same as those for 1st stakeholder meeting such as sending invitation letters to concerned stakeholders, using various media, and posting public notice in several villages of affected VDCs. The public notice was widely made in national daily “Kathmandu Post” and local newspaper “Bhanjang”, at local FM program “Mchhapurchhre” and on local TV program. Since the majority of populations in target VDCs are Magar and Gurung, the notice was also broadcasted before the popular song radio program to which most of Magar and Gurung were assumed to listen. In addition, the request to encourage women to participate in the meeting was made for the secretary of each target VDC and the local concerned organizations (See **Annex D: Advance notification and List of invited institutions/persons in ESC Report**).

(2) Damauli

The 2nd Stakeholder Meeting was held in the District Development Committee office on December 1 2006 with the following objectives;

- To explain and disseminate information on the Upgrading Feasibility Study and the Project including the following:
 - Study progress and justification for the Project
 - Physical and biological environmental impact (Supplemental EIA)
 - Socio-economic and cultural environmental impact (Supplemental EIA)
 - Optimization of development plan including layout of the Project
 - To obtain various public opinions, concerns and feedback through discussions

Approximately 600 people participated in the meeting, which exceeded the number of participants in the 1st Stakeholder Meeting. They included farmers, students, those engaged in service jobs and mass media, and local government officers. Regarding the ethnic composition of participants, Magar was 164 people, followed by Bhraman (69 people), Newar (60 people), Chhetri (34 people), Dalit (23 people) and Gurung (20 people).

Table 9.5.3-1 Participants of 2nd Stakeholders Meeting

	Municipality/VDC	2 nd Meeting	1 st Meeting
1	Vyas (Damauli)	176	84
2	Jamune	52	37
3	Chhang	35	87
4	Bhimad	43	19
5	Majhakot	10	12
6	Rising-Ranipokhari	57	42
7	Kotdarbar	18	26
8	Kahun-Shivapur	82	29
9	Pokhari-Bhanjyang	22	28
10	Others	79	38
Total excluding the Study Team, NEA and JICA		574	402

Following the 1st Stakeholder Meeting, the participation of women was limited in spite of taking several measures during the advanced notification. Close to 50 women attended the meeting, which accounted for less than 10% of total participants (See **Annex D: List of participants in ESC Report**).



Like previous stakeholder meeting, the brochure summarizing the results of supplemental EIA Study and optimization of development plan in Nepali was distributed to participants (See Below and **Annex D: Brochure in ESC Report**). The meeting was started at 11:00 with the welcome speech made by General Manger of NEA (See **Annex D: Program Schedule in ESC Report**). Following that, NEA gave a brief about the background of the proposed upper Seti storage hydroelectric project. The Study Team made presentations on the progress and status of the Study and the results of supplemental EIA Study from natural and socio-economic environmental aspects and the optimum project layout and scale. Regarding Full Supply Level, it was presented that Full Supply Level of 420 m was optimum at this moment, but might be changed later on considering other environmental indicators (See **Annex D: Presentation materials in ESC Report**).

During the 2nd half of meeting, the representatives of Ministry of Water Resources and various political parties made comments on the project. Most of these comments were favorable for the Project, focusing that the proposed project is critical to meet ever increasing demand for electricity and requisite for power sector in Nepal. The representative of each target VDC also expressed their own opinions, concerns and requests. The majority of people requested NEA and the Study Team to minimize environmental impacts as much



as possible and maximize the direct and indirect benefits for local communities. Furthermore, some people requested to provide more specific information on compensatory measures and employment measures. In addition, others requested to hold a consultation meeting at each target VDC level except for mass meetings. It was also pointed out that the Project should be

carried out effectively and efficiently unlike Middle Marshyangdi Hydro electric Project¹² (See **Annex D: Meeting of Minutes** in **ESC Report**).

Close to 60 participants submitted their comments and concerns on strip papers or request letters. They were summarized in **Table 9.5.3-2**, which were almost same as those of 1st Stakeholder Meeting.

Table 9.5.3-2 Suggestions, Feedback and Comments from the Participants¹³

1	The propose project is requisite and essential in terms of development in the country as well as in Tanahu District. The project should be implemented smoothly without any disturbances observed in Middle Marchyangdi Hydro Electric Project.
2	Consultation meetings should be carried out in each affected VDCs to provide more specific and detailed information on the inundated areas, the exact location and compensatory and employment measures. Other environmental mitigations should be provided in next stakeholder meeting.
3	The proposed project needs to provide the maximum benefits to the local society.
4	Due consideration should be given to the compensation and resettlement issues including identification of the entitlement and the timing for the compensation, the formation of compensation fixing committee, and the amount of compensation and measures for those who have no legal titles.
5	The priority for provision of employment opportunities should be given to, particularly the directly affected families and the affected VDC people. The detailed information should be provided as soon as possible.
6	As one of the alternative mode of transportation for inundated roads, due consideration should be given to the road construction. The road from Bhimad or Rising Patan to Damsite, or Damauli needs to be constructed.
7	New suspension bridges should be constructed or other mode of transportation should be considered for inundated suspension bridges.
8	The mitigation measures to protect Bhimad Bajar from erosion should be seriously considered and undertaken. The information about whether gabion walls will be constructed in the possible hazardous areas during the project construction should be provided to the local people.
9	The affected community forest and grazing lands need to be delineated. The mitigation measures should be provided to the affected Forest User Groups.

¹² As of the end of November 2006, there was a series of news reporting that the project would not be able to meet the deadline due to the ongoing stoppage of construction work caused by a Moist-affiliated worker's union and that the project cost has already doubled from the original estimate of NRs 13 billion to NRs 26 billion.

¹³ There were no significant differences of suggestions, feedback and comments among different caste and ethnic groups.

10	Electricity facility should be given to affected people and local people in Tanahu District at subsidized rate or cheaper rate.
11	Mitigation measures for fisheries should be addressed. Particularly fishery development activities should be carried out in reservoir areas
12	Various development needs such as support for water drinking and schools should be considered and undertaken.

NEA prepared their opinions and replies to comments and issues above mentioned and raised by participants (See **Annex D: Reply to comments and issues in ESC Report**).

(3) Kathmandu

The 2nd Stakeholder Meeting was held in Kathmandu on December 6 2006. There were a total of 74 people. They included concerned government officials, mass media, representatives of political parties, NGOs, intellectuals, NEA staff members and the Study Team (See **Annex D: List of invited institutions/persons and List of participants in ESC Report**). The meeting was conducted according to the same meeting agenda as Damauli (See **Annex D: Program Schedule and Presentation materials in ESC Report**).

The representative from Ministry of Water Resource and IUCN noted that the NEA should incorporate the results of supplemental EIA Study supported by JICA into existing EIA. The representative from Ministry of Environment, Science and Technology expressed his concern that it was not clear how to incorporate the updated data and information based on the results of supplemental EIA Study into existing EIA, which might potentially make the procedures of approval for EIA delayed. It was also discussed how development and environmental conservation could go together. Some participants suggested that policy-level rather than project-level initiatives need to be taken by National Planning Commission in order to coordinate among different stakeholders having different perspectives for development and environmental conservation. Furthermore, others noted that a coordination mechanism should be built in order to solve conflict of interests between development promoters and environmentalist and among sectors (See **Annex D: Meeting of Minutes in ESC Report**).

(4) Media Coverage

2nd Stakeholder Meetings were covered by the following print media in **Table 9.5.3-3** (See also **Annex D: Media Coverage in ESC Report**).

Table 9.5.3-3 2nd Stakeholder Meetings Covered by Print Media

S.N.	Print Media	Date
1	The Himalayan Times (English)	Dec 7
2	The Rising Nepal (English)	Dec 7

9.5.4 Third Stakeholder Meeting

(1) Methods to hold third Stakeholder Meeting

During the previous stakeholder meetings, a number of local participants requested the NEA and the Study Team to hold smaller-scale meetings rather than mass meetings, which enables the interactive consultation. Therefore, it was decided that the localized stakeholder meetings would be held in two areas namely Beltar in the project facility site and Rising Patan in the upper reservoir area while one stakeholder meeting would be organized in Damauli for the invitees alone.

(2) Advance Notification

The methods of advance notification for localized stakeholder meeting included using various media, posting public notice in several villages of affected VDCs. The public notice was made in local newspaper “Seti Madi Daily”, through local FM program “Annapurna”, and on caption of three TV programs. For the meeting in Damauli, the invitation was sent by NEA to political parties, government agencies and other relevant institutions (See **Annex D: Advance notification and List of invited institutions/persons in ESC Report**).



(3) Beltar, Rising Patan and Damauli

The 3rd Stakeholder Meeting including localized stakeholder meetings was held from May 4 to May 6 2007 with the following objectives;

- To explain and disseminate information on the Upgrading Feasibility Study and the Project including the following:

- Overall findings of Study including full supply level and inundated and affected areas
- Time-line of project stage
- Environmental mitigation measures
- Framework of resettlement plan and proposed social action plan

- To obtain various public opinions,



concerns and feedback through discussions

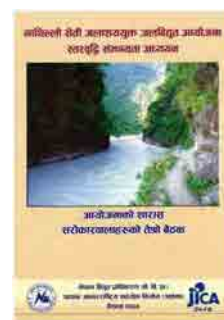
Close to 750 people in total participated in localized stakeholder meetings held in Beltar and Rising Patan. Because of the better access to the meeting places, it seemed that more people could attend meetings this time. Compared to previous meetings, the ratio of women participating meetings was increased from 10 % to 30%. Most of participants were farmers, while others included students, teachers and those engaged in service jobs and business. Among respondents, the majority was Magar (294 people), followed by Brahman (197 people), Newar (89 people), Dalit (81 people), Chhetri (40 people) and Gurung (35 people).

Table 9.5.4-1 Participants for the 3rd Stakeholder Meeting

	Name of Municipality/VDC	3rd Meeting in Beltar and Rising Patan
1.	Vyas (Damauli)	116
2.	Jamune	12
3.	Chhang	48
4.	Bhimad	13
5.	Majhkot	15
6.	Rising-Ranipokhari	262
7.	Kotdurbar	7
8.	Kahun-Shivapur	210
9.	Pokhari-Bhanjyang	37
10.	Others	34
Total excluding the Study Team, NEA and JICA		754

There were 68 participants in the meeting held in Damauli, including representatives of political parties, line agencies, NGOs and mass media (See **Annex D: List of participants in ESC Report**).

For the purpose of distribution in the stakeholder meeting, the brochure was published in Nepali and English. It outlines the Study, optimization of development plan, natural environmental and socio-economic and cultural impacts and mitigation measures, timeline of the Project and frequently asked questions (See **Right and Annex D: Brochure in ESC Report**).



During the first half of the localized stakeholder meeting, oral presentation was made by the local consultant on behalf of the Study Team. (See **Annex D: Program Schedule in ESC Report**). It included a briefing about the framework of Resettlement Plan, proposed Social Action Plan, and the timeline for the Project. The photos drawing a line of FSL of 415 m were also shown. In the case of the meeting in Damauli, the presentation was made by using computer (See **Annex D: Presentation materials in ESC Report**). Unlike previous stakeholder meetings, much time was allocated to the second half of the meetings, which enabled more participants to raise concerns and questions and make comments and

suggestions for the Study and the Project. There was no significant difference between opinions in the previous stakeholder meetings and those in the third stakeholder meeting in Beltar, Rising Patan and Damauli (See **Annex D: Meeting of Minutes in ESC Report**). They were summarized in **Table 9.5.4-2**.

Table 9.5.4-2 Suggestions, Feedback and Comments from the Participants¹⁴

1	The decision whether or not the Project will be implemented should be made as soon as possible. After the Upgrading Feasibility Study, will JICA implement the Project?
2	The proposed project needs to provide the maximum benefits to the local society. Some portion from NEA royalty should be handed over to Tanahu District. How much can Tanahu District receive royalty?
3	Due consideration should be given to the compensation and resettlement issues including identification of the entitlement and the members of compensation fixing committee, and compensation at replacement costs and measures for those who have no legal titles.
4	The priority for provision of employment opportunities should be given to, particularly the directly affected families and the affected VDC people. How many workers will be involved in the project construction works on a daily basis?
5	Electricity facility should be given to affected people and local people in Tanahu District.
6	Motorable roads should be built from Bhimad, Rising Patan to dam site, and Damauli.
7	For inundated suspension bridges, the alternatives need to be arranged.
8	Some mitigation measures for the possible hazardous areas including Bhimad Bajar should be provided by the Project.
9	The affected community forest and grazing lands need to be properly compensated. Newly registered community forest in Jamune VDC needs to be compensated.
10	Mitigation measures for fisheries should be undertaken by incorporating the good practices from other hydropower projects such as Kaligandaki A and Kulekhani.
11	Job opportunities, skill training and awareness raising program for avoiding girl trafficking should be given to the local women in affected VDCs.
12	More focus should be given to health education including prevention of communicable diseases.
13	Is there a possibility that a dam will collapse? Is there a possibility that the reservoir areas will be filled with sediments?

As in the previous meeting, NEA prepared their opinions and replies to comments and issues above mentioned and raised by participants (See **Annex D: Reply to comments and issues in ESC Report**).

(3) Kathmandu

The 3rd Stakeholder Meeting was held in Kathmandu on May 10 2007, in which 53 people including representatives of political parties, representative of Ministry of Forest and Soil Conservation, representatives of concerned organizations, media, NEA staff members and the Study Team



¹⁴ There were no significant differences of suggestions, feedback and comments among different caste and ethnic groups.

participated (See **Annex D: List of invited institutions/persons and List of participants in ESC Report**). The meeting was conducted in the same way of meeting held in Damauli (See **Annex D: Program Schedule and Presentation materials in ESC Report**).

Several participants were concerned about the estimated project cost, i.e. some US 340 million dollars. Some noted that not only donor agencies but also the Government of Nepal and people should share its cost. Others suggested that the accurate cost be estimated as much as possible before the implementation of the Project in order to avoid the situation of Middle Marsyangdi Project where the project has been significantly delayed, and consequently the project cost has continued to increase. In the end of meeting, the managing director of NEA emphasized the importance and necessity of the Project to meet the increasing demand for electricity. Furthermore, he strongly requested the government to make a policy in collaboration with the ministries concerned to enable the NEA to execute hydroelectricity projects more efficiently and effectively (See **Annex D: Meeting of Minutes in ESC Report**).

(4) Media Coverage

The print media in **Table 9.5.4-3** covered 3rd Stakeholder Meetings (See also **Annex D: Media Coverage in ESC Report**).

Table 9.5.4-3 3rd Stakeholder Meetings Covered by Print Media

S.N.	Print Media	Date
1	Nepal Samachar Patra (Nepali)	May 7
2	The Himalayan Times (English)	May 11
3	The Rising Nepal (English)	May 11

9.6 IEE for Transmission Line – Damauli to Bharatpur

9.6.1 Objective

The proposed 220 kV Transmission Line from Upper Seti (Damauli) Storage Hydroelectric Project (the Project) Switch Yard to Bharatpur Substation would deliver power from the Project to the National Grid System at Bharatpur. Presently, the 220kV transmission line development proposal is under study at the feasibility level to assess different viable options.

This IEE level study of the 220 kV transmission line has the objective to assess the implications of the different alignments of power line development on the existing bio-physical and social environment and to select the best alternative alignment for detailed study and design.

9.6.2 Project Line Route and Affected Areas

The selected 220 kV transmission line project, will connect the USSHEP to Bharatpur Sub-station, cut across five VDCs of Tanahu District, namely Kahun Shivapur, Pokhari Bhanjyang, Keshavtar, Dharampani, and Devghat VDCs, and one VDC and one municipality of Chitwan District, namely

Kabilas VDC and Bharatpur Municipality. The resources (physical, biological and social) of the above VDCs and municipality of Tanahu and Chitwan Districts lie under the 60 m ROW of the project and are directly affected, whereas the resources lying outside the TL ROW are indirectly affected by the project.

Nominal System Voltage	:	220 kV
Circuit	:	Double circuit
Length of Line	:	38.42 km
Nominal span		300 m
Number of Towers	:	Approximately 130
Right of Way	:	60 m
For tower foundation	:	5.2 ha (Agricultural land: 1.76 ha, Forest land: 3.44 ha)
Land use restricted under ROW	:	193.02 ha

9.6.3 Alignment Alternatives

The alignment of a new transmission line should be selected taking into consideration the following criteria:

- Right-of-ways which have minimal environmental impact
- Improvement of reliability of the power system
- Increase in competition in the generation market to lower the cost of electricity

Based on the above principles, three possible alternative alignments were selected to evacuate power from Upper Seti (Damauli) Storage Hydroelectric Project's switchyard to Bharatpur substation (NEA, May 2006). **Fig. 9.6.3-1** presents the three proposed alignments.

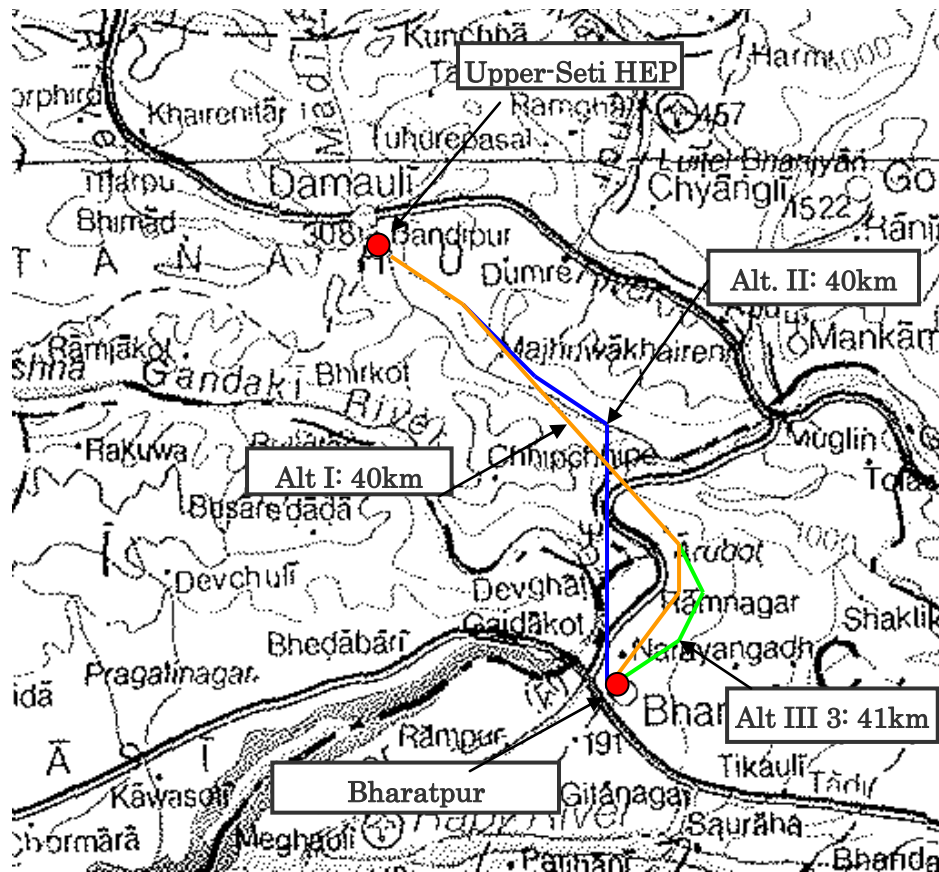


Fig. 9.6.3-1 Alternative Route of Transmission Line

Tables 9.6.3-1~3 present the land use characteristics of the three alignments and approximate areas required for acquisition and land use restriction under the ROW of the alignments. Land use under the ROW of the three alignments shows that:

- Alternative I and II passes mostly through the agricultural/grazing areas compared to the Alternative III
- Alternative I has the least ROW area under forest cover compared to Alternative II and III
- The number of built structures under Alternatives I, II and III are almost the same with Alternative III having 17 built structures compared to 19 and 24 in Alternative I and II respectively
- Alternative III is the longest followed by Alternative I and II but the lengths of Alternative I and II are comparable.

From the environmental viewpoint to avoid or minimize impacts, Alternative I is selected for detailed survey and design for the following reasons:

- The loss of forest due to clearance of trees under the ROW is minimized in comparison with the other two options including the opening up of new areas of the Narayani Protected Forest
- Total ROW area under Alternative I can be minimized by alignment of the ROW to the existing TL for about 11 km distance, which further reduces the forest losses

- Agricultural areas along the ROW could continue and the impact to local socio-economy is envisaged to be minimal.

Table 9.6.3-1 Land Use along Transmission Line Alternative Alignment I

District	VDC	Land Use								Total Length (m)	Total Area (ha)	Structures	Streams	Settlement/village
		Forest		Agriculture		River		Others						
		Length (m)	ROW (sq.m)	Length (m)	ROW (sq.m)	Length (m)	ROW (sq.m)	Length (m)	ROW (sq.m)					
Tanahu	Kahun Shivapur	675	40,500	675	40,500	125	7,500	0	0	1,475	8.85	0	Seti	Banchare
	Pokhari Bhanjyang	50	3,000	4500	270,000	15	900	0	0	4,565	27.39	7	Khirkhadi Khola	Simalswara, Chhapdanda, Arkhale Pani
	Keshavtar	2,000	120,000	3725	223,500	15	900	0	0	5,740	34.44	3	Dhad Khola (2)	Guwandanda, Marauto
	Dharampani	4,850	291,000	1775	106,500	125	7500	0	0	6,750	40.5	1	Bagar Khola, Seti	Huslan, Bagarkhola, Setigaon
	Devghat	0	0	2270	136,200	125	7500	2,575	154,500	4,970	29.82	4	Bar Khola, seti	Bargaon, Chaughare, Duighare
Chitwan	Kabilas	9,200	552,000	3,675	220,500	0	0	1,375	82,500	14,250	85.5	4	Das Khola	Duighare, Upper syalni, Tandran, Devitar
	Bharatpur	0	0	2125	127,500	0	0	0	0	2,125	12.75	0		
Total		16,775	1,006,500	18,745	1,124,700	405	24,300	3,950	197,500	39,875	239.25	19	8	16

Source: Based on the measurements in 1:25000 Topographic Maps of the Area, Transmission Line ROW = 60m

Table 9.6.3-2 Land Use along Transmission Line Alternative Alignment II

District	VDC	Land Use								Total Length (m)	Total Area (ha)	Structures	Streams	Settlement/ village
		Forest		Agriculture		River		Others						
		Length (m)	ROW (sq.m)	Length (m)	ROW (sq.m)	Length (m)	ROW (sq.m)	Length (m)	ROW (sq.m)					
Tanahu	Kahun Shivapur	675	40,500	675	40,500	125	7,500	0	0	1,475	8.85	0	Seti	Banchare
	Pokhari Bhanjyang	50	3,000	4,500	270,000	15	900	0	0	4,565	27.39	7	Khirkhadi Khola	Simalswara, Chhpadanda, Arkhale Pani
	Keshavtar	2,000	120,000	3,725	223,500	15	900	0	0	5,740	34.44	3	Dhad Khola (2)	Guwandanda, Marauto
	Dharampani	4,850	29,1000	1775	106,500	125	7,500	0	0	6,750	40.5	1	Bagar Khola, Seti	Huslan, Bagarkhola, Setigaon
	Devghat	0	0	2270	136,200	125	7,500	2,575	154,500	4,970	29.82	4	Bar Khola, Seti	Bargaon, Chaughare, Duighare
Chitwan	Kabilas	8,375	502,500	4000	240,000	875	52,500	1,375	82,500	14,625	87.75	6	Das Khola, Narayani	Duighare, Upper syalni, Tandran, Devitar, Jugedi Bazzar
	Bharatpur	0	0	1625	97,500	0	0		0	1,625	9.75	3		Ganeshsthan, Barmelichouk, Baseni
Total		15,950	957,000	18570	1,114,200	1280	76,800	3950	237,000	39,750	238.5	24	9	20

Source: Based on the measurements in 1:25000 Topographic Maps of the Area, Transmission Line ROW = 50m

Table 9.6.3-3 Land Use along Transmission Line Alternative Alignment III

District	VDC	Land Use								Total Length (km)	Total Area (ha)	Structures	Streams	Settlement/village
		Forest		Agriculture		River		Others						
		Length (m)	ROW (sq.m)	Length (m)	ROW (sq.m)	Length (m)	ROW (sq.m)	Length (m)	ROW (sq.m)					
Tanahu	Kahun Shivapur	1,250	75,000	0	0	125	7,500	0	0	1.375	8.25	0	Seti	Banchare
	Pokhari Bhanjyang	4,750	285,000	0	0	15	900	0	0	4.765	28.59	0	Khirkhadi Khola	Simalswara Chhapdanda, Arkhale Pani
	Keshavtar	4,325	259,500	1,175	70,500	20	1,200	0	0	5.52	33.12	0	Dhad Khola (2)	Guwandanda, Marauto
	Dharampani	10,800	648,000	575	34,500	90	5,400	0	0	11.465	68.79	5	Bagar Khola, Seti	Huslan, Bagarkhola, Setigaon
	Devghat	5,075	304,500	2450	147,000	340	20,400	3,500	210,000	11.365	68.19	9	Bar Khola, Narayani	Bargaon, Chaughare, Duighare
Chitwan	Kabilas	4,875	292,500	250	15,000	10	600	0	0	5.135	30.81	0	Das Khola	Duighare, Upper syalni, Tandran, Devitar
	Bharatpur	0	0	1,500	90,000	0	0	0	0	1.5	9	3		Ganeshsthan, Barmelichouk, Baseni
		31,075	1,864,500	5,950	357,000	600	36,000	3,500	210,000	41.125	246.75	17	8	19

Source: Based on the measurements in 1:25000 Topographic Maps of the Area, Transmission Line ROW = 60m

9.6.4 Physical Environment

Detailed field surveys of the transmission line corridor show that the total length of the corridor to be approximately 40 km. Of the total length approximately 1.7 km passes over the rivers, streams, creeks and roads. The length covered by forest, grazing land and cultivated land is approximately 21.6 km, 2.1km and 12.9 km, respectively. Taking 60m as the ROW for 220 kV transmission line (i.e. 30m either side from the TL central line), the total ROW area required for the proposed project is 230.5 ha. Since the ROW areas over rivers, streams, creeks and roads is not required for acquisition, the total ROW area is further reduced to 220.3 ha.

Also as the proposed ROW from 29210 Chainage onwards to the Bharatpur Sub-station is shared with the existing 132 kV transmission line, only 197.4 ha is actually required for the new ROW acquisition or restricted land use. Of the 197.4 ha of the ROW land requirement, about 73.7 ha falls under agricultural land use category, 12.8 ha under grazing land use category and remaining 110.9 ha under forest land use category.

9.6.5 Biological Environment

(1) Forest and Vegetation

In the Bio-geographic map (NARMSAP, 2002), the proposed 220 kV transmission line corridor lies in the Central Nepalese Bio-geographic region comprising *Schima-Castanopsis* Forest zone, Hill Sal Forest Zone and Lower Tropical Sal Forest Zone.

There is no distinct separation of the above forest zones in the TL corridor area. The *Schima – castanopsis* zone occurs usually between 1,000 to 2,000m. Below 1,000 m *Schima wallichii* is mixed with *Shorea robusta* and other elements of deciduous Hill Sal Forest. The TL corridor in the Dharampani, and parts of Keshavatr VDC of Tanahu District passes along this zone. The Hill Sal (*Shorea robusta*) occurs usually between 300m to 1,000m. *Shorea robusta* is the dominant tree species of this zone and the land is undulating to flat. Orchids are especially abundant in ravine areas. Besides, a number of endangered plant species such as *Cycas pectinanta*, *Gnetum montanum*, *Cyathea spinulosa* are found associated with *shorea robusta* in this zone. *Acacia Catechu* and *Bombax cieba*, the protected tree species in Nepal under the Forest Regulation, 1995 are also found along the ravine corridors and alluvial fans along the Seti River.

(2) Wildlife

The TL corridor extends from the Mid Hills region in the north to the Dun valley (a component of Siwaliks and Terai) in the south. It is the transition zone of the Lowlands and the Mid Hills, is diverse in its faunal composition. Ecologically, though the corridor area is dominated by the Lower Tropical Sal, Hill Sal and *Schima –castanopsis* Forests, it also consists of other ecological types of tropical and sub-tropical zones of central Nepal. Only a

few species of wildlife and birds are listed in the IUCN, CITES and HMG protection. None of these species is threatened to any degree by the T/L Project.

9.6.6 Socio-economic and Cultural Environment

(1) Affected VDCs

This section is based on available secondary information of the affected VDCs of the Tanahu and Chitwan Districts. **Table 9.6.6-1** presents the demography of the districts traversed by the 220 kV transmission line corridor. Population density is about 210 persons/km², average household size is around 5 and the female population is marginally higher than the male population.

Table 9.6.6-1 Demographic Characteristics of the Affected Districts

District	Chitawan	Tanahu
Total Population	472,048.00	315,237.00
Male	235,084.00	146,788.00
Female	236,964.00	168,449.00
Number of Households	92,863.00	62,898.00
Average Household Size	5.08	5.01
Area in km ² .	2,218.00	1,546.00
Population Density Person/km ² .	213.0	204.00

Source: CBS, 2001

The demographic features of the Village Development Committees (VDC) traversed by the transmission line corridor is presented in **Table 9.6.6-2**. Hill VDCs show slightly higher Household size than occurs in the Municipality of Bharatpur.

Table 9.6.6-2 Population Distribution in the Affected VDCs and Municipality

Village Development Committee / Municipality	Total Population	Total Household	HH size	Male	%	Female	%	M:F
Kahun Shivapur (T)	8,066	1,087	7.4	4,031	50.0	4,035	50.0	1 : 1
Pokhari Bhanjang (T)	4,082	832	4.9	1,902	46.6	2,180	53.4	0.87 : 1
Kesavtar (T)	5,423	1,054	5.1	2,513	46.3	2,910	53.7	0.86 : 1
Dharmapani (T)	3,914	709	5.5	1,780	45.5	2,134	54.5	0.83 : 1
Devghat (T)	7,620	1,666	4.6	3,691	48.4	3,929	51.6	0.94 : 1
Kabilas (C)	5,513	985	5.6	2,765	50.2	2,748	49.8	1.008 : 1
Bharatpur NP (C)	89,323	19,922	4.5	45,858	51.3	43,465	48.7	1.05 : 1
Total Affected Population	123,941	26,255	4.7	62,540	50.5	61,401	49.5	1.02 : 1

Source: CBS, 2001 Note (T) = Tanahu; (C) = Chitawan

In general the major ethnic composition of the TL corridor VDCs is mainly Magar and Gurung in the hills and rural areas with groups of Brahmins and Chettris outnumbering the other groups within the Municipality of Bharatpur. Kami, Damai and Sarki (KDS), the disadvantageous ethnic groups, are distributed all along the TL corridor of the various VDCs

in smaller numbers. Their numbers are comparatively higher in the hills of Tanahu District compared with Chitwan District.

(2) Characteristics of Affected Persons and Properties

Detailed information on the project affected people is not available. Detailed surveys are required for the above purposes along the TL ROW corridor. However, information on the potentially affected land and built structures can be roughly estimated from the available database of the detailed survey (Masina Continental Associates et.al, July 2006).

A total of 32 structures are located under the TL ROW, of which 18 are residential structures and 14 are cowsheds or field structures used seasonally during crop harvesting as noted in **Table 9.6.6-3**. Estimated agricultural land under the ROW of transmission line is 77.5 ha. Of this total of agricultural land, only 1.76 ha is required permanently for the construction of tower foundations, while 75.73 ha agricultural land will be restricted to some degree for land uses such as tree plantations and structures.

Agricultural land plots identified for permanent land acquisition and land use restrictions are presented in the Supplemental EIA. An indicated total of 447 land parcels located on 20 Cadastral Maps have been identified. Landowners of these land parcels are to be identified and their socio-economic and social conditions are to be ascertained through a structured questionnaire survey during the EIA for the TL to be undertaken by NEA Environmental and Social Studies Department (ESSD). Besides this is the factor that, in a number of places along ROW, there are land units under agriculture use that are not legally registered and identification of these plots and their users is also required during detailed filed surveys.

Table 9.6.6-3 Houses & Other Structures and Features along 220 kV Transmission Line

Drawing Number	Approx. Distance (m)	Village	No of Houses	No of Sheds	Total Structures	Feature	Along RoW C/L	Within T/L RoW	Outside T/L RoW	RoW Width (m)	Comments
2	230	Dharapeni	1	-	1	-	-	-	1R	60	
2	785	Banchare	1	2	3	-	-	1L	2L	60	
2	935	Banchare	1	1	2	-	-	-	2L	60	
2	1,365	-	-	-	-	Seti River	-	-	-	-	40m wide
3	1,425	-	-	-	-	Road to Belbas	-	-	-	60	
3	1,545	-	-	3	3	-	2	1R	-	60	
3	1,710	Majhkot	1	1	2	-	-	2R	-	60	
4	3,800	-	-	-	-	Gagate Khola	-	-	-	60	20m wide
4	4,127	-	-	-	-	Kirandi Khola	-	-	-	60	40m wide
5	4,555	-	-	-	-	Chisopani Khola	-	-	-	60	5m wide
5	5,126	Kukurdhunge Gudi	1	1	2	-	1	1L	-	60	
5	5,445	-	1	2	3	-	1	2L	-	60	
6	6,027	-	-	-	-	Khirekhadi Khola	-	-	-	60	
7	7,051	-	-	1	1	Road to Kesabata	1	-	-	60	
7	7,693	Guwan-danda	1	1	2	-	-	2R	-	60	
7	8,195	-	-	-	-	Road to Kesbata	-	-	-	60	
8	8,605-8,901	-	-	-	-	Sukaura Khola	-	-	-	60	300m along valley
9	9,854	No Name	1	-	1	-	-	1L	-	60	
9	10,380	-	-	-	-	Danda Kho;a	-	-	-	60	
9	10,685	No Name	1	-	1	-	-	1R	-	60	
9	10,835	No Name	1	-	1	-	-	1R	-	60	Track to Sukaura
10	11,781	-	-	-	-	Dhada Khola	-	-	-	60	30m wide
11	14,915	-	-	-	-	Bakse Khola	-	-	-	60	15m wide
14	17,935	Kesartar	1	-	1	Bagar Khola	-	1L	-	60	110m wide
15	18,285	Kesartar	1	-	1	-	-	1L	-	60	
15	18,578	-	-	-	-	Seti River	-	-	-	-	120m wide
15	19,010-19,245	Serenghat	2	-	2	Boad Khola	-	2R	-	60	235m wide

Drawing Number	Approx. Distance (m)	Village	No of Houses	No of Sheds	Total Structures	Feature	Along RoW C/L	Within T/L RoW	Outside T/L RoW	RoW Width (m)	Comments
16	20,045	-	-	-	-	Daduwa Khola	-	-	-	60	30m wide
18	23,460-23,620	-	-	-	-	Narayani River	-	-	-	-	160m wide
18	23,697	-	-	-	-	XXHighway	-	-	-	60	Mugling-Bharatpur
19	23,940	No Name	1	-	1	-	-	1R	-	60	
19	24,360	-	-	-	-	Parallel 132kV T/L	-	-	-	60	
19	24,600	-	-	-	-	Bench Mark 788	-	-	-	45	132kv T/L adjacent to East
21	27,450	-	-	-	-	Das Khola	-	-	-	45	25m wide
21	27,880	No Name	1	1	2	Tandrang Kholsi	2	-	-	45	80m wide junction
22	28,915	-	-	-	-	Khahare Khola	-	-	-	45	52m wide
22	29,210	No Name	2	1	3	-	1	2R	-	45	Crossing 132kV T/L
23	29,617	-	-	-	-	Bharlang Khola	-	-	-	30	For 160m follows Bharlang valley
23	29,990	-	-	-	-	Jugedi Khola	-	-	-	30	220m wide valley
23	30,415	-	-	-	-	Crossing of 132 kV T/L	-	-	-	30	
24	30,948	-	-	-	-	Bhateri Kholsi	-	-	-	30	30m wide + landslide
24	31,789	-	-	-	-	Sal-National Forest	-	-	-	45	Bench Mark 827 & reserve boundary
26	34,786	-	-	-	-	Ramnagar Khola	-	-	-	45	40m wide
27	36,200	-	-	-	-	Jal Binayak Khola	-	-	-	45	20m wide
28	37,858	Chihan	-	-	-	Temple Complex	1	-	-	45	80m long
29	38,151	-	-	-	-	132kV T/L exits	-	-	-	60	-
29	38,415	Ganesh sthan	-	-	-	Bench Mark 900	-	-	-	60	End of T/L _ Substation adjacent
TOTAL	38.42 km	8 Villages	18	14	32		8 + 1	14	5 + 5		

- Note:
- 1) Approximately 1702 m of river, creek and road crossing
 - 2) Approximately 21614 m of Forest crossing;
 - 3) Approximately 2138 m of grazing and scattered tree area crossing
 - 4) Approximately 12916 m of cultivated land area crossing
 - 5) ROW area required for restriction on land use in the grazing and agricultural land = 86.484 ha
 - 6) ROW area required for forest clearance = 110.94 ha
 - 7) ROW area under rivers, streams, creeks and road not required for acquisition = 10.212 ha

9.6.7 Environmental Impacts and Mitigation

Transmission lines are linear projects, covering long distance but limited in the area disturbed at any specific point. Unlike other linear projects such as roads, their area of influence is limited to the corridor only. Furthermore, their construction and operation activities are not as extensive as road projects requiring huge amount of excavation, quarries and drainage alterations bringing significant changes to local land systems. However, changes in the land use are the major and key environmental issues of transmission line projects with implications to the biological, social and socio-economic environments of the corridor area affected.

The impacts have been divided into insignificant and significant impacts in the Supplemental EIA of which only the significant are given in **Table 9.6.7-1**.

Table 9.6.7-1 Environmental Impact and Mitigation Measure Matrix for Significant Adverse Environmental Impacts of the 220 kV Transmission Line Project

SN	Environmental Issue	Environmental Impact	Stage of Project	Mitigation Measures
1. Physical Environment				
1.1	Soil erosion	Land degradation and landslides	Construction phase	<ul style="list-style-type: none"> • Ground clearance should not be carried out by uprooting of trees and ground vegetation • Tower foundation excavation should be minimized to required levels and spoil should be properly placed and compacted in designated areas
1.2	Land Use*	Change in land use	Construction & operation phases	<ul style="list-style-type: none"> • Reduction in ROW width
2. Biological Environment				
2.1	Terrestrial forests and vegetation*	Loss of forests and vegetation	Construction and operation phases	<ul style="list-style-type: none"> • Reduction in ROW width • Restriction on illegal felling of trees in areas other than required for ROW and T L itself
2.2	Wildlife and wildlife habitat*	Loss of wildlife habitat and wildlife	Construction phase	<ul style="list-style-type: none"> • Reduction in ROW width • Restriction on hunting of wildlife by the construction workforce
2.3	Avian Fauna*	Loss of avian fauna	Operation phase	
3. Socio-economic and Cultural Environment				
3.1	Telephone/electric lines and built structures*	Disruption of services and losses of built structures	Construction phase	<ul style="list-style-type: none"> • Adequate clearance height of the conductors above the telephone and electrical lines • Information to local people for the service disruption during construction • Adequate compensation to the owners of built structures without deduction of depreciation costs • Resettlement and rehabilitation package to the affected structure owner

SN	Environmental Issue	Environmental Impact	Stage of Project	Mitigation Measures
3.2	Public Health and safety*	Risks to public health and safety	Operation phase	<ul style="list-style-type: none"> • Bill boards and hoarding boards with information about the hazards • Public awareness programs on measures for public health and safety in the TL corridor
3.3	Agricultural production	Loss of Agriculture production due to disruption	Construction phase	<ul style="list-style-type: none"> • Adequate compensation of the loss of agricultural produce • Scheduling of the construction activity such that the agricultural fields are without crops during construction period.
3.4	Loss of Land and Property*	Livelihood and future opportunity	Construction & Operation phase	<ul style="list-style-type: none"> • Reduction in ROW width • Adequate compensation to the affected land and property owners with permanent occupation of areas affected • Adequate compensation for the affected land under ROW for restriction considering the future opportunity of the agricultural land • Resettlement and rehabilitation package to the affected population
3.5	Tourism and Aesthetics	Loss of tourism and aesthetic value	Construction and operation phases	<ul style="list-style-type: none"> • Restriction on haphazard storage, camp managements, and disposal of spoils • Design the tower structures that complements to the natural background
3.6	Occupational Health	Risks to the health of construction and operation workforce	Construction and operation phases	<ul style="list-style-type: none"> • Provision of appropriate protective equipment and gear to the construction and operational workforce • Trainings on the possible occupation hazards to the construction and operation workers

Note: * Irreversible impacts

9.6.8 Institutional Requirements and Environmental Monitoring Program

The Nepal Electricity Authority (NEA), compared to other institutions in Nepal, has established an Environment and Social Studies Department (ESSD) to deal with environmental studies and monitoring. However, it has shortages of trained manpower to effectively carry out environmental monitoring to the project requirements. There is a need to strengthen the ESSD in respect of its monitoring capabilities. Environmental and social monitoring, particularly in the construction phase of TL projects is very important.

9.6.9 Findings and Conclusion

This IEE level assessment has identified key issues of environmental concerns for the proposed 220 kV transmission line project. The project is not envisaged to have any significant damage to the physical environment except for limited erosion and land stability issues. But the concerns that are associated with clearance of trees in Protected Forests are a major issue to be addressed in the full EIA. Other issues such as tower foundation excavation and spoil management also require attention.

There is some potentials of irreversible damage to the local biological environments, particularly in forested areas, whereas the impacts on wildlife habitat are limited along the TL ROW in a stretch of about 21.6 km of forest land. About 1.76 ha of agricultural land will be permanently acquired for tower foundations and some restrictions within the corridor on land use would occur. A total of 18 residential house structures will have to be acquired as well as 14 ancillary structures.

In summary, the significance of the impacts due to loss of forest land, and agricultural land and property are yet to be assessed. Also there is a need to design site-specific mitigations to minimize and rehabilitate losses to natural and social infrastructure. A project specific mitigation program and monitoring program should be prepared and include an Environmental Management Plan and Resettlement and Rehabilitation Management Plan.

The IEE level study for the proposed 220 kV TL, has established sufficient justifications for the selection of the best TL alternative from among the various TL options and to proceed to the next phase of detailed design study. The study has also identified the key significant adverse environmental issues for the nominated TL alternative for the detailed EIA. It is concluded that the selected TL option be considered acceptable according to the provisions of Environmental Protection Rule (1997) of Government of Nepal and in compliance with the JICA Guidelines (2004).

9.7 Environmental Management Framework for the Project

The Environmental Management Plan (EMP) represents the key mitigation/enhancement measures and monitoring for major impacts, which are translated into concrete action programs/projects and defines the institutional framework and mechanisms for ensuring their appropriate implementation to actually be carried out in subsequent stages of project development. It likewise provides the estimated investment requirements and commitments/guarantees to carry out the proposed plan. The EMP is based on the experiences of previously constructed hydropower projects of similar nature, and findings of the EIA study, Social Action Plan (SAP), Resettlement Plan (RP), review of other EMPs prepared for the environmental management and Government of Nepal Act, Regulations and Guidelines relevant to the hydropower projects.

9.7.1 Overall EMP Summary

The overall EMP summary including mitigation/enhancement measures, schedule of implementation, estimated investment requirements, institutional responsibilities and guarantees/agreements is shown in **Table 9.7.1-1**. The cost computations are rough estimates and need to be verified/ validated during the detailed design stage.

Table 9.7.1-1 Summary of Environmental Impacts and their Corresponding Mitigation/Enhancement Measures and Environmental Management Plan

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact	Mitigation/Enhancement Measure	Cost	Responsible Institution	Guarantees/ Agreements
1. Pre-Construction/ Construction Period						
<i>A. Physical Environment</i>						
(1) Land Use and Topography						
<ul style="list-style-type: none"> ▪ Inundation of the land for reservoir 	Loss of current land use opportunity for villagers, and loss of habitat for wildlife and vegetation	S, P (negative)	<ul style="list-style-type: none"> ▪ Unavoidable impact, but selection of lower reservoir Full Supply Level could minimize existing land use changes drastically. 	<ul style="list-style-type: none"> ▪ n/a 	<ul style="list-style-type: none"> ▪ NEA 	<ul style="list-style-type: none"> ▪ n/a
<ul style="list-style-type: none"> ▪ Construction activities of various types in the dam site and project facility sites involving excavations, drilling, blasting and material removals 	Land instabilities	S, P (negative)	<ul style="list-style-type: none"> ▪ Locating the access road route under the Vyas-Shivapur footbridge rather than through the village, with associated benefits of traffic separation; ▪ Shifting the spoil bank to the river side to reduce the affected area; ▪ Locating the permanent NEA camp at the southern end of the flat area and close to the power station; ▪ Shifting the main access road to uphill from the present road so that project-related traffic is separated from schools and shops along the existing road in Beni Patan. 	<ul style="list-style-type: none"> ▪ Bio-engineering of the cut batter slopes of the access roads (lump sum): 2.0 million NRs 	<ul style="list-style-type: none"> ▪ Contractor, NEA 	<ul style="list-style-type: none"> ▪ Part of contractor's contract
<ul style="list-style-type: none"> ▪ Spoil bank to be constructed along with the right bank of the Seti River 	Soil erosion	S, P (negative)	<ul style="list-style-type: none"> ▪ Construction of a dry stone gabion structure at the toe of the spoil bank; ▪ Construction of a water collection system for the spoil bank to avoid free flow of the run off from the mountain slope over the spoil material; ▪ Proper grading of the spoil surface with adequate drainage provisions after the closure of spoil disposal at the site; ▪ Afforestation and bioengineering of the spoil area after proper grading and drainage management. 	<ul style="list-style-type: none"> ▪ Dry gabion wall approximately 1,300 m (1.5m high and 1m wide): 5.0 million NRs ▪ Run off catch drainage of mountain slope (approx. 900m): 3.2 million NRs 	<ul style="list-style-type: none"> ▪ Contractor, NEA 	<ul style="list-style-type: none"> ▪ Part of contractor's contract

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact	Mitigation/Enhancement Measure	Cost	Responsible Institution	Guarantees/ Agreements
(2) Air Quality						
<ul style="list-style-type: none"> Dust generated from excavation, filling, stockpiling and construction vehicle movements associated with the construction of the various surface and sub-surface structures and transportation of the spoil materials to the spoil bank. 	<p>Increase in particulates and gaseous emissions</p>	MS, T (negative)	<ul style="list-style-type: none"> On-site vehicle speed restrictions and vehicle washing before leaving the site; Frequent watering of the road in the dry season ensuring that the road surface does not generate dust. Frequent watering of the dusty barren areas or spoil disposal areas. 	<ul style="list-style-type: none"> Water sprinkling: 4.9 million NRs (2 tankers /day/245 days a year/5 year) Dust masks to workers: 0.7 million NRs (twice a year (lump sum)/5 year) 	Contractor, NEA	Part of contractor's contract
(3) Noise/Vibration Level						
<ul style="list-style-type: none"> Noise generated from cut-and-cover activities, excavation, back filling and construction of above ground structures and transportation of the construction vehicle. Vibration generated from and drill & blast activities in the dam, tunnel and powerhouse. 	<p>Increase in noise and vibration levels</p> <p>It is not expected to effect communities living away from source. However, impacts to wildlife are expected.</p>	MS, T (negative)	<ul style="list-style-type: none"> Care in the placement and orientation of noisy plants away from sensitive receivers; Use and correct fitting of silencers, mufflers and acoustic shields; Regular maintenance of plant and equipment; Awareness programs and information sharing with the communities on the noise related issues 	Part of construction cost	Contractor, NEA	Part of contractor's contract
(4) Water Quality						
<ul style="list-style-type: none"> Poor sanitation facilities to construction workforce at the construction camps and construction areas may promote the use of the adjacent river bed areas for open defecation dislodging of solid waste and other sanitation uses. 	<p>Changes in river water quality</p> <p>Such uses of the river area, especially in the dry season, may substantially degrade the water quality in the Seti River due to discharges of organic load.</p>	MS, T (negative)	<ul style="list-style-type: none"> Establishment of good water supply and sanitation facilities in the construction work camps, at actual construction sites; Establishment of effective solid waste collection facilities in the construction work camps; Public awareness program to the construction workforce and the construction on good health and sanitation practices 	<ul style="list-style-type: none"> Sanitation (toilet provisions) at all work and campsites 4.5 million NRs (lump sum, about 100 toilets) Camp solid waste collection management system and disposal facilities: 2.8 million NRs 	Contractor, NEA	Part of contractor's contract

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact	Mitigation/Enhancement Measure	Cost	Responsible Institution	Guarantees/ Agreements
<ul style="list-style-type: none"> Excavation works are expected to increase the turbidity and total suspended solids in the flowing water. Besides, accidental oil spills of the operating equipment will be released to the flowing water. And also, discharge of concrete plants, aggregate washing plants etc. provide huge amount of fine sediment to the receiving water bodies. 	Changes in river water quality	MS, T (negative)	<ul style="list-style-type: none"> Discharge of batching plant, aggregate washing plant, and tunnel seepage waters only after appropriate treatment (sedimentation facility) to the natural water bodies; Public awareness program to the construction workforce and the construction on good health and sanitation practices; Disposal of construction related spoils only into defined and well protected spoil disposal sites approved by concerned authorities. 	<ul style="list-style-type: none"> Sedimentation tank for batching discharges, tunnel discharges and aggregate crushing discharges and spoil disposal area: 10 million NRs 	Contractor, NEA	<ul style="list-style-type: none"> Part of contractor's contract
<i>B. Biological Environment</i>						
(1) Terrestrial						
<ul style="list-style-type: none"> Forest and vegetation clearing, excavation and grading and other construction activities 	Loss, disturbance and damage to existing vegetation; Habitat degradation of dependent species	MS, P (negative)	<p><u>Forest and vegetation</u></p> <ul style="list-style-type: none"> For every tree cut, the compensatory plantation at 1:25 trees must be made Secure necessary permit for tree cutting Implement tree balling where practicable Immediate revegetation To provide alternatives of kerosene rather than fuel wood <p><u>Wildlife</u></p> <ul style="list-style-type: none"> Selecting the appropriate layout to minimize the cutting trees (especially from the dam site to the lower reservoir area) To restrict hunting and trapping To save endangered animals by a rescue operation using boats during the filling of the reservoir and relocating them to compatible ecosystem in nearby forests. 	<ul style="list-style-type: none"> Part of construction cost 	Contractor, NEA	<ul style="list-style-type: none"> Part of contractor's contract

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact	Mitigation/Enhancement Measure	Cost	Responsible Institution	Guarantees/ Agreements
<i>C. Socio-economic Environment</i>						
<ul style="list-style-type: none"> ▪ Inundation by reservoir development 	Inundation of existing infrastructure facilities of the communities such as motorable roads, suspension bridges, foot trails, irrigation canals, and electricity distribution.	MS, T (negative)	<ul style="list-style-type: none"> ▪ Implementation of restoration of project impacted infrastructure program under social program of the project ▪ Implementation of rural electrification program under social program of the project 	<ul style="list-style-type: none"> ▪ Restoration of project impacted infrastructure program: 85.5 million NRs ▪ Rural electrification program: 19.6 million NRs 	<ul style="list-style-type: none"> ▪ Contractor, RSISU-PMO-NEA, local government 	<ul style="list-style-type: none"> ▪ Social program of the project
	Inundation of existing community built structure (cremation, resting places etc.).	MS, T (negative)	<ul style="list-style-type: none"> ▪ Provision of compensation for affected community structures under the framework of Resettlement Plan ▪ Implementation of affected community's initiative support program under social program of the project 	<ul style="list-style-type: none"> ▪ Compensation for community structures : 0.39 million NRs ▪ Affected community's initiative support program: 52.1 million NRs 	<ul style="list-style-type: none"> ▪ Contractor, RSISU-PMO-NEA, local government 	<ul style="list-style-type: none"> ▪ Social program of the project
	Inundation of land, loss of yield, involuntary resettlement, and impact on the livelihood of Affected Persons (APs)	MS, P (negative)	<ul style="list-style-type: none"> ▪ Land acquisition, and provision of compensation including the affected private land, the affected structures, loss of agricultural production equivalent to one year production, and other rehabilitation compensation fees for relocatee ▪ Implementation of separate package programs for restoration of livelihood and enhancement of quality of life. They include agricultural development program, skill enhancement and employment program, affected community's initiative support program, women development program, and community-based watershed management program. 	<ul style="list-style-type: none"> ▪ Compensation and relocation costs: 1,080 million NRs ▪ Agricultural development program: 27.51 million NRs ▪ Skill enhancement and employment program: 10.14 million NRs ▪ Women development program: 13.03 million NRs ▪ Watershed management program: 12.31 million NRs 	<ul style="list-style-type: none"> ▪ Contractor, RSISU-PMO-NEA, local government 	<ul style="list-style-type: none"> ▪ Resettlement action plan ▪ Social program of the project

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact	Mitigation/Enhancement Measure	Cost	Responsible Institution	Guarantees/ Agreements
	Risk of shoreline erosion and land failure, where the people often utilize the edge of land for cultivation and other purposes	MS, P (negative)	<ul style="list-style-type: none"> ▪ Acquire land as risk zones by delineating a 10 m vertical height from the FSL with measures such as planting work ▪ Implementation of community-based watershed management program and community's initiative support program 	<ul style="list-style-type: none"> ▪ Included in the land acquisition cost and in the mitigation cost for forest and vegetation ▪ Included in community-based watershed management program, and community's initiative support program 	<ul style="list-style-type: none"> ▪ RSISU-PMO-NEA 	<ul style="list-style-type: none"> ▪ Social program of the project
<ul style="list-style-type: none"> ▪ Influx of large number of workers 	Shortages of drinking water	MS, T (negative)	<ul style="list-style-type: none"> ▪ Provide water supply for construction workers by contractors ▪ Implementation of community/public health and education enhancement program under social program of the project including the support for water supply taps 	<ul style="list-style-type: none"> ▪ Part of construction cost ▪ Community/public health and education enhancement program: 15.9 million NRs 	<ul style="list-style-type: none"> ▪ Contractor, NEA ▪ Contactor, RSISU-PMO-NEA, local government 	<ul style="list-style-type: none"> ▪ Part of contractor's contract ▪ Social program of the project
	Deterioration of the existing sanitation conditions and break of the epidemics such as typhoid, cholera, and diarrhea and other communicable diseases like STD and HIV	MS, T (negative)	<ul style="list-style-type: none"> ▪ Implementation of community/public health and education enhancement program under social program of the project 	<ul style="list-style-type: none"> ▪ Included in community/public health and education enhancement program cost 	<ul style="list-style-type: none"> ▪ Contractor, RSISU-PMO-NEA, local government 	<ul style="list-style-type: none"> ▪ Social program of the project
<ul style="list-style-type: none"> ▪ Land clearing within project facility site; site grading, excavation, hauling/stockpiling of excavated and construction materials including land acquisition for project site 	Total or partial loss of land/farm area, properties and crops, involuntary resettlement, impacts on the livelihood of APs including loss of income due to land acquisition	S, P (negative)	<ul style="list-style-type: none"> ▪ Negotiate with PAFs/PAPs for an acceptable compromise on valuation and compensation ▪ Finalize the RAP incorporating therein the agreements reached during public consultations ▪ Land acquisition and provision of compensation as stated previously ▪ Implementation of several social programs for restoration of livelihood and enhancement of quality of life as stated previously 	<ul style="list-style-type: none"> ▪ Included in compensation and relocation costs ▪ Included in social action program costs 	<ul style="list-style-type: none"> ▪ RSISU-PMO-NEA 	<ul style="list-style-type: none"> ▪ Resettlement action plan ▪ Social program of the project

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact	Mitigation/Enhancement Measure	Cost	Responsible Institution	Guarantees/ Agreements
<ul style="list-style-type: none"> ▪ Construction activities for the project 	Work related injuries and accidents	MS, T (negative)	<ul style="list-style-type: none"> ▪ Project contractors will be responsible for the occupational health of workers. 	<ul style="list-style-type: none"> ▪ n/a 	<ul style="list-style-type: none"> ▪ Contractor 	<ul style="list-style-type: none"> ▪ Part of contractor's contract
	Girl trafficking, and sexual and labor exploitation, child labor	S, T (negative)	<ul style="list-style-type: none"> ▪ Implementation of women development program under social program of the project, including education on HIV/AIDS, STD, family planning, and girl trafficking. 	<ul style="list-style-type: none"> ▪ Women development program: 13.0 million NRs 	<ul style="list-style-type: none"> ▪ Contractor, RSISU-PMO-NEA, local government 	<ul style="list-style-type: none"> ▪ Social program of the project
	Increase in employment opportunities	MS, T (negative)	<ul style="list-style-type: none"> ▪ Require contractors to source workforce from qualified locals ▪ Contractors to orient workers on desirable working relationship especially if there are non-resident workers ▪ Implementation of skill enhancement and employment program under social program of the project 	<ul style="list-style-type: none"> ▪ n/a ▪ Skill enhancement and employment program: 10.1 million NRs 	<ul style="list-style-type: none"> ▪ Contractor, RSISU-PMO-NEA ▪ Contractor, NEA, local government 	<ul style="list-style-type: none"> ▪ Part of contractor's contract ▪ Social program of the project
	Increase in livelihood and business opportunities	MS, T (positive)	<ul style="list-style-type: none"> ▪ Priority to be given to local subcontractors ▪ Priority to be given to local suppliers of construction materials and equipment ▪ Supply of food and catering to be preferentially awarded to local suppliers ▪ Implementation of skill enhancement and employment program, agricultural development program, and women development program including income generation and micro credit funds 	<ul style="list-style-type: none"> ▪ n/a ▪ Included in social action program costs 	<ul style="list-style-type: none"> ▪ Contractor, RSISU-PMO-NEA 	<ul style="list-style-type: none"> ▪ Part of contractor's contract ▪ Social program of the project
	Potential health, sanitation and safety problems including accidental risks for local community people	NS, T (negative)	<ul style="list-style-type: none"> ▪ Contractor to provide construction camp as temporary housing facilities for workers equipped with adequate water and sanitation facilities ▪ Contractors to implement proper solid waste management in the work site, workers will be oriented to observe proper hygiene and sanitation practices and provided with appropriate protection gears while working ▪ Construction areas to be enclosed as necessary and provided with appropriate signage to avoid accidents 	<ul style="list-style-type: none"> ▪ Part of construction cost 	<ul style="list-style-type: none"> ▪ Contractor, RSISU-PMO-NEA 	<ul style="list-style-type: none"> ▪ Part of contractor's contract

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact	Mitigation/Enhancement Measure	Cost	Responsible Institution	Guarantees/ Agreements
2. Operations and Maintenance Period						
<i>A. Physical Environment</i>						
(1) Land Use and Topography						
<ul style="list-style-type: none"> Failure at the terrace breaks associated with the toe cutting by the stream, caving and overhanging 	Soil slides associated with the terrace materials in the upper reservoir area	S, P (negative)	<ul style="list-style-type: none"> Completion of protection embankment works with concrete blocks cover in the vicinity of Bhimad Bajar Land acquisition program and stabilization of erosion prone in the risk zone area from Full Supply Level to 10m high above Selective planting of ground cover and trees at the base of areas susceptible to erosion in tributary stream leading into the Seti River Land acquisition program and stabilization of erosion prone areas with suitable tree species in the vicinity of the Wantang Khola, the Pedhi Khola and Tittuwa 	<ul style="list-style-type: none"> Part of construction cost 	<ul style="list-style-type: none"> Contractor, NEA 	<ul style="list-style-type: none"> Part of contractor's contract
<ul style="list-style-type: none"> Full supply level at 415m and flushing operation 	Backwater effects of the reservoir	NS, T (negative)	<ul style="list-style-type: none"> The annual flushing of the reservoir at FSL 415 m will effectively control any sedimentation. In the case that nominated Full Supply Level is 415 m, the sedimentation will not happen around the Bhimad Bajar. The backwater effect after the sedimentation is minor. 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> NEA 	<ul style="list-style-type: none"> n/a
<ul style="list-style-type: none"> Diverted water flowing out from tailrace outlet and immediate increase of downstream water level by dam operation 	Impact to agricultural land in the downstream of the dam	NS, P (negative)	<ul style="list-style-type: none"> The agricultural land on the left bank appears to be high enough that it would not be affected. The agricultural land on the right bank will be acquired for the construction. The permanent river protection work will not be required in this section. Monitoring of sedimentation patterns should be undertaken in this zone for at least 10 km below the outlet. 	<ul style="list-style-type: none"> Land acquisition cost for agricultural land on the right bank 	<ul style="list-style-type: none"> NEA 	<ul style="list-style-type: none"> n/a

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact	Mitigation/Enhancement Measure	Cost	Responsible Institution	Guarantees/ Agreements
(2) Water Quality						
<ul style="list-style-type: none"> Environmental flow 	Changes in river water quality and flow volume	S, P (negative)	<ul style="list-style-type: none"> The mitigating effects of joining the Madi River downstream which has a flow regime equivalent to 75% of the Seti River flows. Impacts on the river's aquatic ecology and fish resources are unavoidable in the section of the Seti River immediately downstream of the dam and must be mitigated to the fullest extent possible. 	n/a	NEA	n/a
<ul style="list-style-type: none"> Eutrophication of the reservoir 	Changes in river water quality	S, P (negative)	<ul style="list-style-type: none"> Installation of Fraction Fence system in the reservoir Development of sewerage system in the upstream urban area to prevent waste water with nutrient salt flowing into the river 	<ul style="list-style-type: none"> n/a To be estimated, but not be covered by the project 	<ul style="list-style-type: none"> NEA Local government 	<ul style="list-style-type: none"> Part of contractor's contract n/a
<ul style="list-style-type: none"> Sediment flush operation 	Changes in river water quality	S, P (negative)	<ul style="list-style-type: none"> Optimum operation to minimize environmental impact based on experiences of operation in Japan 	n/a	NEA	n/a
B. Biological Environment						
(1) Freshwater						
<ul style="list-style-type: none"> Change of flow regime due to dam 	Local aquatic habitat alteration and permanent/temporary displacement of species	MS, P (negative)	<ul style="list-style-type: none"> Fish hatchery backed with open water stocking of suitable fish species, as is being done at NEA's Kali Gandaki A HEP. 	<ul style="list-style-type: none"> Financial and Technical Assistance to Kali Gandaki A hatchery for added production & facility development and research for Upstream & Downstream Stocking in Seti River system: 73.6 million NRs NEA Extension program for fisheries and mitigation to local fishermen: 1.0 million NRs 	NEA	n/a

Impact Items/ Project Activities	Potential Environmental Impacts	Degree /type of Impact	Mitigation/Enhancement Measure	Cost	Responsible Institution	Guarantees/ Agreements
<i>C. Socio-economic Environment</i>						
Downstream safety						
<ul style="list-style-type: none"> Immediate increase of water level in power generation and just after the sediment flushing operation 	Danger in downstream communities and river users	S, P (negative)	<ul style="list-style-type: none"> Installation of siren system Public awareness on safety for downstream communities 	<ul style="list-style-type: none"> Siren network along the Seti in the downstream of dam (lump sum): 3.5 million NRs Awareness training on the safety measures to downstream areas (lump sum): 0.3 million NRs 	<ul style="list-style-type: none"> Contractor, NEA 	<ul style="list-style-type: none"> Part of contractor's contract for installation
White water rafting in the downstream of the dam						
<ul style="list-style-type: none"> Decrease of flow volume in non-power generation period, and immediate increase of water level in power generation and just after the sediment flushing operation 	Danger of the rafting activity in the river and camp site at the riverside for the rafting participants	S or MS, P (negative)	<ul style="list-style-type: none"> Scheduled rafting activity to avoid immediate increase of water level Public awareness on safety for both rafting operators and participants Select safe location of the camp site for the rafting participants 	<ul style="list-style-type: none"> n/a 	<ul style="list-style-type: none"> NEA 	<ul style="list-style-type: none"> n/a

9.7.2 Stakeholders under the Environmental Management Plan

The EMP for the Project is prepared to show linkages with different parties envisaged to be involved during the different phases of project development and operation in compliance with the existing Act and Rules. The overall project environmental management is the responsibility of the Project, Project's Environmental Management Office (PMO) of NEA. There are a number of key stakeholders involved in project environmental and social management and they and their main roles and responsibilities are presented below.

Table 9.7.2-1 Environmental Management Roles and Responsibilities

Organizations	Roles and Responsibilities
MOEST	<ul style="list-style-type: none"> ▪ Ensure that the environmental measures and cost are included in the project documents and tender clauses prior to the final project approval ▪ Monitoring of the overall project once a year during construction ▪ Auditing of project performance during the operational phases two years after project completion
MOWR/ DOED	<ul style="list-style-type: none"> ▪ Ensure that the environmental measures and cost are included in the project documents and tender clauses prior to final project approval ▪ Monitoring of the overall project twice a year during construction and once during operation
NEA Board / NEA/ NEA-ESSD/ Upper Seti Hydroelectric Project- PMO	<ul style="list-style-type: none"> ▪ Ensure that the EIA and EMP measures are incorporated into the final project design and costs. ▪ Acquire the necessary permits and approval for project construction and operation. ▪ Ensure that the project construction activities are in accordance with legislative requirements. ▪ Implementation of repair and maintenance of project components, including environmental safeguards, as recommended by the EMP, MOWR, DOED and MOEST ▪ Monitoring and record keeping regarding environmental measures and impacts as per EMP ▪ Ensure public participation and involvement in all phases of project implementation
Panel of Experts (POE)	<ul style="list-style-type: none"> ▪ Review and recommend the final project design and ensure that the EMP measures are included in the design and tender ▪ Review the monitoring and auditing reports of the supervising consultants and Project- Environmental Monitoring Sub-unit (ESMU) and recommend corrective measures to meet the EMP objectives
Detailed Design Consultants	<ul style="list-style-type: none"> ▪ Incorporate environmental mitigation measures as per POE recommendation in the design, project cost and tender documents ▪ Include EIA recommendations in the design, project cost and tender documents

Organizations	Roles and Responsibilities
EIA Consultant	<ul style="list-style-type: none"> ▪ Verify and improve upon the earlier EIA reports and EMP and recommend environmental measures to the Detailed Design Consultants ▪ Verify and prepare detailed programs for Affected Persons/Affected Families and communities and recommend the final RP costs to Detailed Design engineers ▪ Verify and complete RP and recommend final RP measures and costs to Detailed Design Consultants
Supervising Engineers	<ul style="list-style-type: none"> ▪ Approval to civil construction as per design ▪ Monitoring of civil construction as per the detailed design ▪ Ensure that the EMP provisions are implemented and recorded ▪ Ensure that the Project corrective actions are duly implemented.
Upper Seti Hydroelectric Project - EMSU	<p>RSISU:</p> <ul style="list-style-type: none"> ▪ Implementation, and supervision of land acquisition, compensation and resettlement as per the RP, and record keeping of the same ▪ Implementation, and supervision of SAP as per SAPF ▪ Liaison with other Nepalese authorities for the EMP/RP/SAPF items ▪ Information Dissemination through the Public Information Center and other media and collection of feed back through regular consultation with various stakeholders ▪ Distribution of the Project's bimonthly monitoring reports of EMSU to different central and local level stakeholders ▪ Project grievance and complaint handling <p>EMSU:</p> <ul style="list-style-type: none"> ▪ Monitoring of natural environmental, RP and SAP mitigation measures as per EMP/RP/SAPF by EMSU and recommend concerned engineers and sections for corrective actions and bi-monthly report preparation ▪ The environmental impact and compliance monitoring of construction works as per EMP by EMSU and recommend corrective actions to supervising engineers and bi-monthly report preparation.
Construction Contractor	<ul style="list-style-type: none"> ▪ Implement civil construction, as approved by supervising engineers ▪ Implement mitigation measures, as specified in EMP and recommended by supervising engineers ▪ Front Line Monitoring and record keeping of environmental mitigation measures as per EMP through a special monitoring unit ▪ Maintain a good public relationship with the project area people
NGOs, CBOs, VDCs, / Municipality and DDCs and other stakeholders	<ul style="list-style-type: none"> ▪ Monitor implementation of all environmental and social mitigation measures in all stages of the project as per EMP, RAP, SPAF ▪ Ensure that the public participation and involvement in the project implementation is maximized by the project owner, consultants and contractors.

9.7.3 Project's Environmental Management Office

As per the Nepalese Environmental Protection Rules, environmental management of the project is the responsibility of the proponent. For the Project, NEA and the NEA-Project's Environmental Management Office (PMO) have the responsibility of Project's Environmental Management. NEA has a separate "Environment and Social Studies Department" to look into the environmental matters of projects, planned, under implementation and operational. The Department has limited manpower to fully undertake the environmental management of the Project.

To ensure that the Supplemental EIA recommended mitigation and monitoring actions are duly implemented, monitored, assessed, evaluated and disseminated to the stakeholders for feed back and improvement, the Project - PMO should establish a separate Environmental and Social Monitoring Unit (ESMU) within the Project-PMO as was done for the other ongoing hydroelectric projects. The proposed ESMU will comprise two sub-units, namely the RP and SAP Implementation Sub-unit (RSISU) and the Environmental Monitoring Sub-unit (EMSU). The former sub-unit, to which the staff members of NEA with past similar experiences are to be assigned, will be responsible for implementing RP and SAP, while the latter sub-unit will be managed by consultants with previous experience in environmental monitoring of hydropower projects. The project ESMU shall be established at least eight months before the project's civil construction award and the ESMU shall function directly under the Project Manager, although the EMSU will have responsibility to co-ordinate with the project's Supervising Consultant, while the RSISU will coordinate with NEA – ESSD and stakeholders of the project such as Local VDCs, DDCs, NGOs, CBOs, affected parties, DOED, MOWR, and MOEST.

9.7.4 Administrative and Management Cost for ESMU

An office for the ESMU shall be established in the engineer's camp as part of the civil construction workforce. The administrative and management cost is estimated based on the assumption that the majority of people shall be deputed from NEA and ESMU, particularly for RSISU, and no additional project cost shall be incurred. The cost required is for the EMSU consultants and administrative and management costs are illustrated below (see the breakdown costs in the Environmental and Social Considerations Report.)

Table 9.7.4-1 Summary of Administrative and Management Costs for ESMU

SN	Particulars	NRs. Million
1.	Consultant Remuneration	17.34
2.	Support facilities	32.47
3.	Information Dissemination and Feedback	1.70
Grand Total		51.51

Source: Supplemental EIA Survey, 2006, JICA Study Team

9.7.5 Environmental Monitoring Program

Environmental monitoring shall be undertaken;

- To ensure that the recommended mitigation and enhancement measures as embodied in the EMP;
- To undertake regular monitoring of specific parameters in compliance with existing environmental quality standards; and
- To determine the effectiveness of the EMP and make recommendations for any corrective or additional mitigating measures.

A monitoring plan shall be developed based on the mitigation/enhancement measures identified for

significant environmental impacts and those that are moderately significant, but can have critical effects if not mitigated. The environmental monitoring plan proposed including the key parameters to be monitored is presented in **Table 9.7.4-1**. This covers both the pre-construction/construction and operation stages. The baseline information generated during the EIA will generally serve as the benchmark data.

Table 9.7.5-1 Environmental Monitoring Plan

Project Phase	Method and Scope	Parameter	Location	Frequency	Responsibility	Cost (NR)
1. Pre-Construction/ Construction Period						
<i>A. Physical Environment</i>						
<ul style="list-style-type: none"> ▪ Land acquisition ▪ Vegetation clearing/tree cutting ▪ Excavation works ▪ Foundation works 	<ul style="list-style-type: none"> ▪ Measurement of ambient air quality 	<ul style="list-style-type: none"> ▪ Dust (TSP/PM10) 	<ul style="list-style-type: none"> ▪ Jhaputar and Damauli (close to the District Public Health Office) 	Three times a year in dry season (Nov., Feb., and May). Baseline data shall be taken before construction in dry season (April/May)	Contractor	NRs 5.3 million (lump sum including air, water, noise, spoil management, land erosion, etc.)
	<ul style="list-style-type: none"> ▪ Compliance of mitigation measures for air pollution 	a) Graveling of road and its maintenance b) Control on vehicle speed c) Watering of roads d) Careful handling the contaminant or dumping of dusty materials e) Covering of exposed areas and site restoration f) Provision of dust mask to drivers and workers	a) Along the construction road b) Along the construction road c) Along the construction road d) Temporary waste stock facility and disposal site e) Excavated area f) Construction sites	a) Once a three months b) Once a day c) Once a day d) Once a week e) Once a week f) Once a week	Contractor	Part of contractor's contract
	<ul style="list-style-type: none"> ▪ Water sampling and analysis 	<ul style="list-style-type: none"> ▪ Flow velocity, discharge, water temperature, pH, conductivity, total suspended solids (TSS), total phosphorous (T-P), Total Kjeldahl Nitrogen (TKN), ammonia (NH₃), nitrate , nitrite, dissolved oxygen (DO), and BOD₅ 	1) upstream of the reservoir, 2) reservoir area (close to dam site), 3) confluence with the Madi River, 4) immediate downstream of the tailrace outlet	4 times a year in 4 seasons (November, March, June, and September)	Contractor/EMSU-P MO-NEA	Included in the lump sum cost mentioned in air quality (dust) measurement.

Project Phase	Method and Scope	Parameter	Location	Frequency	Responsibility	Cost (NR)
	<ul style="list-style-type: none"> ▪ Compliance of mitigation measures for water pollution 	<ul style="list-style-type: none"> a) Adequacy and operation of water supply and sanitation facilities at engineers camps, construction camps and construction sites b) Collection of solid waste and safe disposal practices at engineers camps, construction camps and construction sites c) Awareness program on health and sanitation d) Prohibition on open defecation and solid waste disposal e) Storage facilities for fuel, lubricants, spent oils, and toxic chemicals f) Treatment facilities for waste water of batching plant, aggregate washing and tunnel seepages and its effective operation g) Water quality test for discharge of treated wastewater from batching plant aggregate washing plant, and tunnel discharges h) Disposal of construction spoils only in designated areas 	<ul style="list-style-type: none"> a) Engineers camps, construction camps and construction sites b) Engineers camps, construction camps and construction sites c) All over the construction site d) All over the construction site e) Storage facilities f) Treatment facilities g) Batching plant aggregate washing plant, and tunnel discharges h) All over the construction site 	<ul style="list-style-type: none"> a) Before project and every 3 month b) Once a week c) Every six month d) Once a week e) Before project and every 3 month f) Before project and every 3 month g) Once a three months h) Once a day 	Contractor	Part of contractor's contract
	<ul style="list-style-type: none"> ▪ Measurement of noise level 	<ul style="list-style-type: none"> ▪ Noise level 	<ul style="list-style-type: none"> ▪ Jhaputar and Damauli (close to District Public Health Office), and Beltar (near the school) 	<ul style="list-style-type: none"> ▪ Twice a year <p>Baseline data shall be taken before the construction.</p>	Contractor/ EMSU-PMO-NEA	Included in the lump sum cost mentioned in air quality (dust) measurement.

Project Phase	Method and Scope	Parameter	Location	Frequency	Responsibility	Cost (NR)
	<ul style="list-style-type: none"> ▪ Compliance of mitigation measures for noise 	<ul style="list-style-type: none"> a) Placement of noise arresting equipment b) Correct fitting of silencers, mufflers and acoustic shields c) Maintenance of plant and equipment d) Blasting restriction provisions as negotiated e) Blasting design and follow ups 	<ul style="list-style-type: none"> a) Construction site near the residential area b) Construction vehicles and machineries c) All over the construction sites d) Blasting site e) Blasting site 	<ul style="list-style-type: none"> a) Once before construction b) Once a three months c) Once a three months d) Once a day e) Once a three months f) Once a week 	Contractor	Part of contractor's contract
	<ul style="list-style-type: none"> ▪ Compliance of mitigation measures for land instability and erosion 	<ul style="list-style-type: none"> a) Vegetation clearance only to required limits b) Excavation works only to required limit by the design c) Side casting of excavated earth d) Management of spoil in the designated area e) Maintenance of toe protection structure, and drainage structure at spoil disposal; and sedimentation tank at batching yard, spoil disposal area and tunnel discharge areas f) Civil and bio-engineering protection works and their maintenance (including side drains) at access roads 	<ul style="list-style-type: none"> a) Along the project boundary such as FSL 415m area for the reservoir, dam site, and project facility sites. b) All over the construction site c) All over the construction site d) All over the construction site e) Batching yard, spoil disposal area and tunnel discharge areas f) Along the access roads 	<ul style="list-style-type: none"> a) Once a month b) Once a week c) Once a day d) Once a day e) Once a month f) Once a month 	Contractor	Part of contractor's contract
B. Biological Environment						
<ul style="list-style-type: none"> ▪ Land acquisition ▪ Vegetation clearing/tree cutting ▪ Excavation works ▪ Foundation works 	<ul style="list-style-type: none"> ▪ Compliance of mitigation measures for illegal tree cutting and poaching through frequent patrol activity 	<ul style="list-style-type: none"> ▪ Identification of illegal tree cutting and poaching 	<ul style="list-style-type: none"> ▪ All over the construction site and adjacent area 	Frequent and at random patrol	Contractor	Part of contractor's contract

Project Phase	Method and Scope	Parameter	Location	Frequency	Responsibility	Cost (NR)
	▪ Habitat loss around the project sites	▪ Number of habitat loss identified before construction	▪ All over the construction site and adjacent area	Every four months	Contractor/ EMSU-PMO-NEA	NRs 1 million
	▪ Species occurrence around project sites	▪ Number of wildlife species	▪ All over the construction site and adjacent area	Every four months	Contractor/ EMSU-PMO-NEA	
	▪ Construction disturbances around project sites	▪ Damage to habitat and/or death of wildlife due to construction activity	▪ All over the construction site and adjacent area	Once a week	Contractor/ EMSU-PMO-NEA	
	▪ Mitigation measures compliance for wildlife conservation	▪ Implementation of the proposed measures based on designated schedule	▪ All over the construction site and adjacent area	Every four months	Contractor/ EMSU-PMO-NEA	
	▪ Aquatic life and ecology survey (fish, phytoplankton, zooplankton and aquatic insects)	▪ Identification of aquatic species	▪ 7 baseline stations	Every six months (dry season and wet season) for 5 years	Contractor/ EMSU-PMO-NEA	NRs 1 million
	▪ Observation of compliance of contractual mitigation clauses	▪ Adequate implementation of the mitigation measures	▪ At the designated location of the measures	Every three months	Contractor	Part of contractor's contract
2. Operation and Maintenance Period						
<i>A. Physical Environment</i>						
▪ Operation and maintenance of dam	▪ Water sampling and analysis (except reservoir area)	▪ Flow velocity, discharge, water temperature, pH, conductivity, total suspended solids (TSS), total phosphorous (T-P), Total Kjeldahl Nitrogen (TKN), ammonia (NH ₃), nitrate, nitrite, dissolved oxygen (DO), and BOD ₅	1) Upstream of the reservoir, 2) Confluence with the Madi River, 3) Immediate downstream of the tailrace outlet	5 times a year in 4 seasons (November, March, beginning of June before the sediment flushing operation, end of July after the sediment flushing operation, and September)	EMSU-PMO-NEA	NRs 3 million for 20 years

Project Phase	Method and Scope	Parameter	Location	Frequency	Responsibility	Cost (NR)	
	<ul style="list-style-type: none"> ▪ Water sampling and analysis (reservoir area: close to the dam site) 	<ul style="list-style-type: none"> a) Water temperature, turbidity, DO b) pH, BOD/COD, SS, coliform counts, chlorophyll a, Pheophytin, inorganic nitrogen (I-N), inorganic phosphorus (I-P) c) Ingredient of bottom sediment d) Phytoplankton e) Heavy metals, hazardous substances, carcinogenic substance 	<ul style="list-style-type: none"> a) 0.1 m from the water surface, 0.5 m from the water surface, 1 m interval from the water surface to the bottom b) Surface layer (0.5 m from the water surface) Middle layer (half of the water depth) Bottom layer (1 m above from the bottom) c) First surface layer of the sediment d) Surface layer of water e) Surface layer of water 	<ul style="list-style-type: none"> a) Once a month b) Once a month c) Twice a year (End of May just before the sediment flushing operation, and November after stabilizing the bottom condition) d) Once a month e) Twice a year in dry season and rainy season) 	EMSU-PMO-NEA	Included in the above.	
	<ul style="list-style-type: none"> ▪ Monitoring of riverbed sedimentation and erosion 	<ul style="list-style-type: none"> ▪ Riverbed sedimentation and erosion 	<ul style="list-style-type: none"> ▪ Several designated locations in the downstream riverbed 	Once a year in dry season	EMSU-PMO-NEA	NRs 2 million for 20 years	
B. Biological Environment							
<ul style="list-style-type: none"> ▪ Operation and maintenance of dam 	<ul style="list-style-type: none"> ▪ Transect survey for wildlife 	<ul style="list-style-type: none"> ▪ Wildlife species and population, habitat condition 	<ul style="list-style-type: none"> ▪ All over the construction site and adjacent area 	Every 3 years for 20 years	EMSU-PMO-NEA	NRs 1.2 million	
	<ul style="list-style-type: none"> ▪ Aquatic ecology survey for impact analysis 	<ul style="list-style-type: none"> ▪ Species composition 	<ul style="list-style-type: none"> ▪ 7 baseline stations 	<ul style="list-style-type: none"> ▪ 7 baseline stations 	Every six months after 2 years of the project operation, Once a year for 10 years	EMSU-PMO-NEA	NRs 3 million
	<ul style="list-style-type: none"> ▪ Compliance of mitigation measures for aquatic lives 	<ul style="list-style-type: none"> a) Compliance to release of environmental flows at Seti b) Compliance to restriction of fishing activities below tailrace c) Compliance to fish stocking, fish release in the reservoir and downstream area 	<ul style="list-style-type: none"> a) Dam site b) Downstream area of the tailrace c) reservoir and downstream area 	<ul style="list-style-type: none"> a) Dam site b) Downstream area of the tailrace c) reservoir and downstream area 	<ul style="list-style-type: none"> a) Daily b) Daily c) Once a year for project life 	EMSU-PMO-NEA	Part of project operation cost

9.7.6 Records and Corrective Actions

To demonstrate compliance with the environmental management, the construction contractors shall maintain daily records of their mitigation implementation and monitoring works during the construction phase. The EMSU shall also carry out monitoring works with the Supervising Engineers and prepares Bi-monthly Monitoring Reports during the construction phase. He shall also maintain the records of any corrective actions recommended to the contractor and performance of the same. The Bi-monthly Reports produced by the EMSU, in co-ordination with other sections of the RSISU, shall be distributed to stakeholders for their comments and suggestions following approval by the Project Manager. The ESMU shall compile the Final Environmental Monitoring Report of the construction phase within 3 months of the construction completion and submit the same to the Project. The Project shall pass the report to stakeholders to obtain feedback and provide a database of environmental management works of the project for future use.

9.7.7 Environmental Audit

As per the EPR, the Ministry of Environment, Science and Technology shall prepare an environmental audit report on the project after two years of project operation. This shall be based on the monitoring reports of the ESMU, Supervising Engineers, and POE, with limited field visits and data collection. The project performance audit reports include a final assessment of the extent to which the project satisfied the proposed environmental requirements, the effectiveness of mitigation measures and institutional development and whether any unanticipated effects occurred as a result of project activities. Though auditing is the legal responsibility and work of MOEST, it lacks adequate resources to cover these works, which is why the proponent is recommended to allocate a sum of NRs. 0.35 million for auditing purposes.