SN|POWER

TAMAKOSHI 3 HYDROELECTRIC PROJECT

EXECUTIVE SUMMARY - VOLUME XI

Document for Disclosure

Final Report – November 30, 2009

SWECO

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Abbreviations and Acronyms

ACBP	Awareness and Capacity Building Plan
ADB	Asian Development Bank
CF	Community Forest
CFUG	Community Forest User Group
CITES	Convention of International Trade in Endangered Species
CSR	Corporate Social Responsibility
DFO	District Forest Office
DOED	Department of Electricity Development
EHSP	Environment, Health and Safety Plan
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMU	Environmental Management Unit
EPA	Environmental Protection Agency
EPR	Environmental Protection Rules
GLOF	Glacial Lake Outburst Floods
GON	Government of Nepal
GRU	Grievance Redressal Unit
GW	Giga-watt
GWh	Giga-watt per hour
HEP	Hydroelectric Project
HH/hh	Household
ICAMDP	Immediate Catchment Area Management and Development Plan
IFC	International Financial Corporation
IUCN	International Union for the Conservation of Nature
LSEP	Livelihood Support and Enhancement Program
m asl	meters above sea level
MOE	Ministry of Energy
MoEn	Ministry of Environment
MoWR	Ministry of Water Resources
MT	Million Tons
MW	Mega Watt
NEA	National Electricity Authority
PAF	Project Affected Families
PAP	Project Affected Persons
PCDP	Public Consultation and Disclosure Plan
PS	Performance Standards

RAP	Resettlement Action Plan
RRP	Resettlement and Rehabilitation Plan
SBA	Safeguard Buffer Area
SchEMS	School of Environmental Management and Sustainable Development
SEMD	Social and Environmental Management Division
SNP	SN Power
SPAF	Severely Project Affected Families
SPS	Safeguard Policy Statement
TA3HEP	Tamakoshi 3 Hydroelectric Project
TOR	Terms of Reference
VDC	Village Development Committee
WBG	World Bank Group
WHO	World Health Organization

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1 Project Proponent and Organization Responsible for Preparing the EIA Report

1.1 Project Proponent

The name of the project is Tamakoshi-3 Hydroelectric Project (TA3HEP) and the project proponent is SN Power Holding Singapore Pte. Ltd., henceforth referred to as the "proponent"[1] or "SNP". The Department of Electricity Development (DoED), under the then Ministry of Water Resources (now the Ministry of Energy (MOE)), Government of Nepal (GON) awarded a survey license to SNP on March 5, 2007 for conducting the Feasibility and EIA study of Tamakoshi 3 Hydroelectric Project. SNP is submitting this EIA Report in compliance with the Environmental Protection Regulations (1997, amended 1999).

The address of the project proponent is:

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1.2 Consultant Responsible for Preparing the EIA Document

The Proponent has employed independent consultants to prepare the report. SWECo Norge AS, Norway, is the responsible agency to prepare the EIA and its associated reports for the Tamakoshi 3 Hydroelectric Project. The contract between Sweco and SN Power was signed on October 22, 2008 to conduct the 'Feasibility and Environmental and Social Impact Assessment (ESIA)[2] Study' of Tamakoshi 3 Hydroelectric Project. Sweco has engaged SchEMS, Nepal, as the local partner to conduct the EIA study.

The addresses of the Consultant and its local partner are as follows:

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[1] The term "Proponent" is used as per practice in GoN. It refers to the term "Sponsor" as is often the term used in IFC/WBG documents.

[2] The term EIA is used as required by the GON, and is henceforth used in this document to refer to Environmental and Social Impact Assessment (ESIA) or Social and Environmental Impact Assessment (SEIA), as used by the IFC/WBG.

2 Executive Summary

2.1 Introduction

On 6 March 2009, the Department of Electricity Development awarded a survey license to SNP with amendments to conduct the Feasibility and EIA study of TA3HEP with an installed capacity of 600 MW. The DoED on 26 April 2009 amended the list of VDCs/municipality potentially to be affected by the project. Given the capacity of the TA3HEP, and in compliance with the Environment Protection Rule (1997)[3] of GON, WBG and ADB a full EIA was carried out by the international consultant Sweco Norge AS with the assistance of national consultant SchEMS. Expert input was also drawn from the Feasibility study.

2.2 Project Location and Features

2.2.1 Location

The Tamakoshi River is a snow and glacier-fed perennial river, a tributary to the Sunkoshi River, which in itself is a major tributary to the Koshi River system. The Tamakoshi River has its upper reaches high in the Tibetan Himalayas. Rolwaling, Khare, Singati, Tineku, Jhyaku, Jugu, Gumu, Dholti, Maren, Charange, Gopi, Adheri, Milti, Khimti are some of the major tributaries of the river. Tamakoshi is located in Dolakha and Ramechhap districts of Janakpur Zone in the Central Development Region of Nepal (Figure 1). The catchment area down to the proposed D2 Downstream (D2D) dam site is 2,932 km² of which almost 1,495 km² is located within Tibet, China. The catchment contributing to the river stretch downstream of the dam site to the proposed outlet is 418 km².

The area within the boundary of VDCs mentioned in the survey license issued by DoED of GON for TA3 HEP is considered as the project influenced area and will be hereafter referred to as the project area. A total of 19 VDCs (Dolakha and Ramechhap Districts) and one municipality (Dolakha District) are identified within the project area (Table 1 and Figure 2).

Table 1 Districts, municipality and VDCs of the project area, TA3 HEP Survey License

District	VDCs and Municipality
Dolakha	Laduk, Jhyaku, Jugu, Lamidada, Sunkhani, Chhetrapa, Namdu, Phasku, Garimudi, Powati , Bhirkot, Jhule, Japhe , Ghyang Sukathokar, Bhedpu, Melung, Shahare, Malu VDCs and Bhimeshwor Municipality (18 VDCs and 1 municipality)
Ramechhap	Phulansi (1 VCD)

2.2.2 Main Project Features

The project area is located from the confluence of Tamakoshi and Singati Khola down to about 100 m upstream of the bridge crossing Tamakoshi at Kirnetar, Sahare VDC. Salient features of TA3HEP are given in Table 2.

[3] EPA, 1997. Environmental Protection Act of Nepal and EPR, 1997. Environmental Protection Rule of Nepal (Schedule 2, Rule 3).

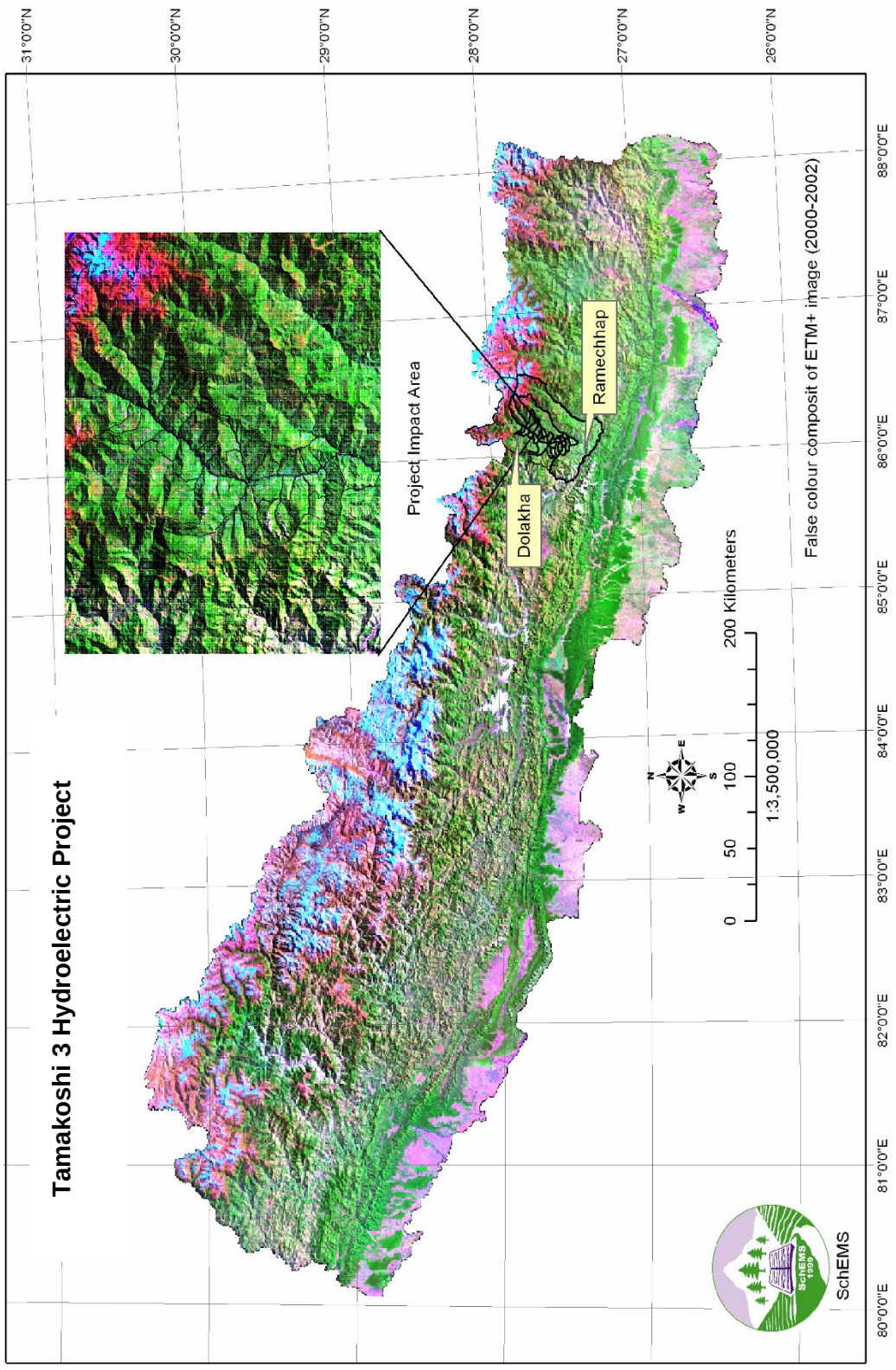

Figure 1 **Location of TA3HEP in Dolakha and Ramechhap Districts, Nepal.**

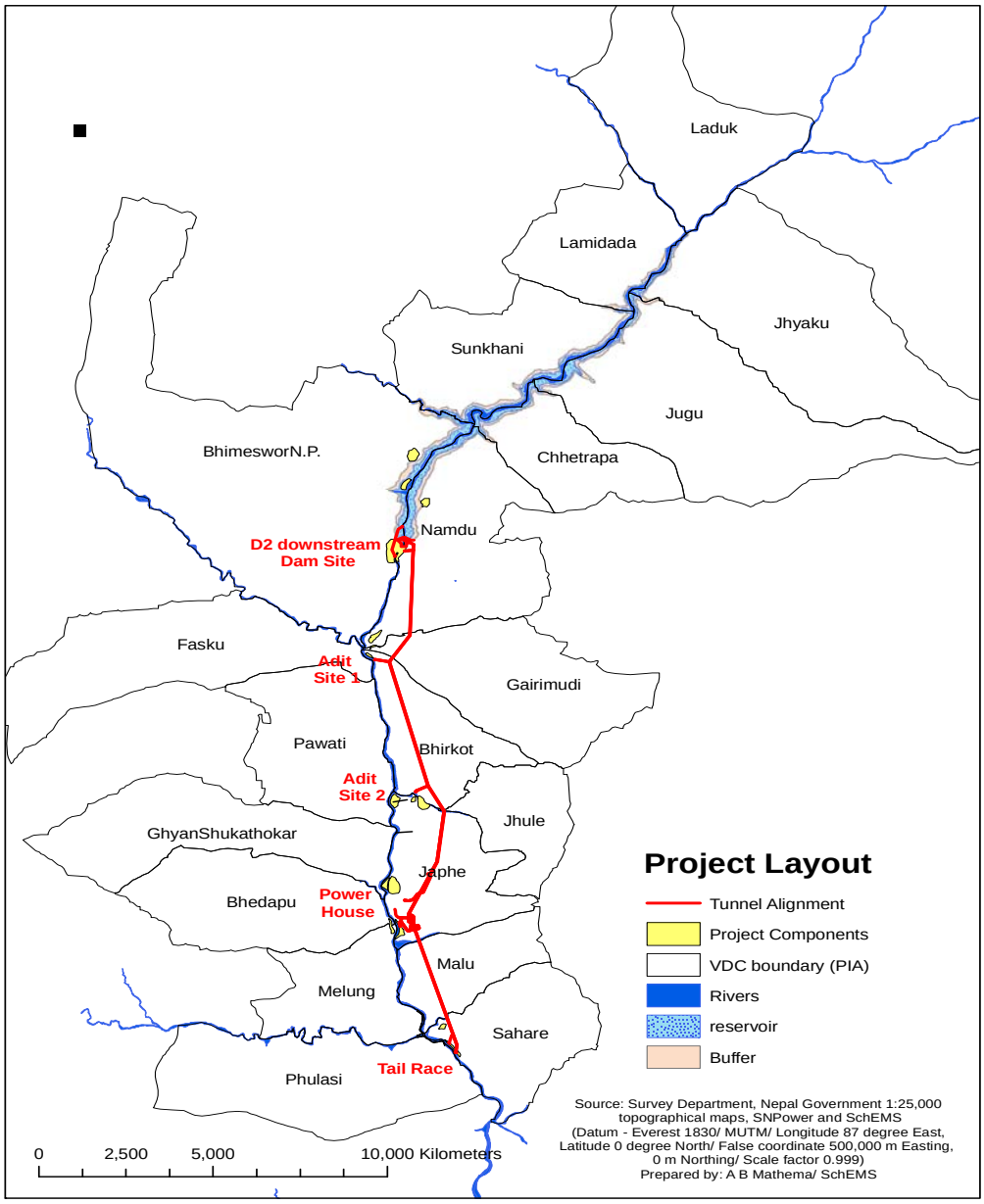

Figure 2 **Map on project affected VDCs, Municipality and project layout**

The proposed project is a Peaking - Run - of - the - River (PRoR) type. It is envisaged that the project will store excess water in a reservoir during high flow to be utilized during low flow. To achieve this, a dam will be built about 1,200 m upstream of the Busti Gauging Station at a location named D2 Downstream (D2D). The height of the dam will be about 96 m above the existing river bed and the full supply water level will be 940 m a s l., giving to a reservoir length of about 15.7 km and a total reservoir volume of 157 Mm^3. The water will be lead through a tunnel down to an underground power station located at Sitapaila, and released back in the river upstream the bridge at Kirnetar and Devitar (see Figures 1 and 2).

The dam will create a reservoir that will extend up to Singati Bazaar, but will not impact Singati Bazaar. The area between Singati and the dam will be inundated up to 940 masl during part of the year. The flow in the river between the dam and the outlet at Kirnetar

(Sahare VDC), will be considerably reduced, particularly during the dry season. Below the outlet, the river will be subject to daily flow fluctuations due to the peaking operation of the power plant.

The plant is optimized for maximum energy generation throughout the year. During the dry season, the plant will run only as a peaking plant during daytime, while in the wet season, the project will generate approximately 24-hours at full capacity.

An alternative analysis of the project was performed during feasibility study and found the technical feasibility of the project ranges from 600-1320 MW. However, the survey license of the project is 600 MW and thus the EIA is based on this plant capacity. Based on the planned installed capacity and dam location at D2D, the total annual energy generation in an average year will be approximately 2,300 GWh.

Table 2 Salient features of Tamakoshi 3 Hydroelectric Project

Project Location :	**Dolakha district and Ramechhap district**		
Zone :	Janakpur Zone		
Development region :	Central Development Region		
Nearest highway :	Arniko Highway		
Project area* :			
Direction	**Longitude**	**Direction**	**Latitude**
East	86^0 06' 48" E	North	27^0 39' 50" N
West	86^0 04' 34" E	South	27^0 34' 36" N
East	86^0 07' 09" E	North	27^0 34' 36" N
West	86^0 05' 00" E	South	27^0 29' 34" N
* The upstream boundary of the project is the Tamakoshi-Singati River confluence which is defined in the license document as "the reservoir created by construction of dam".			
Hydrology at Intake			
a. Catchment area	2,932 km²		
b. Annual mean flow	152.5 m^3/s		
c. Maximum recorded discharge	1310.2 m^3/s		
d. Minimum recorded discharge	17.7 m^3/s		
e. Design discharge	306 m^3/s		
Other Features			
Installed capacity	600 MW		
Annual energy production	2 300 GWh		
a. Headworks			
Location Latitude Longitude	Namdu VDC (Left Bank) and Bhimeshwar Municipality (Right Bank) 27°38'37"N 86°05'11"E		
Dam type	Hard fill concrete gravity dam with overflow spillway		
Dam height (above existing river bed)	96 m		
Crest length	350 m		
Approx. reservoir length	15.7 km		

Total reservoir volume incl. dead storage	157 mill. m^3
Highest regulated water level	940 masl
Lowest regulated water level	890 masl
Spillway Weir length- total/effective Stepped spillway - Step height/width	Free overflow spillway 221 m / 200 m 1.2 m / 0.96 m
b. Headrace Tunnel	
Tunnel Inlet Elevation	860 masl

2.2.3 Reservoir Operation

(i) Reservoir operation rules

The annual operation is divided into 4 operation periods. The periods will have to be adjusted each year to the actual flow situation:

(a) Operation period 1: October – December, post monsoon season

The main monsoon season is over. The reservoir will be filled and kept close to Full Supply Level, and generation will be as per inflow. All generation during this period will be during the peaking price period(s) of the day.

(b) Operation period 2: January – May, dry season to pre monsoon season

At the beginning of the dry season the reservoir will be at Full Supply Level. This period the inflow is at its minimum, and the reservoir will gradually been drawn down to maximize the energy production this period. All generation during this period will be during the peaking price period(s) of the day. To guide the production, a reservoir draw down curve will be worked out, and the production will aim to meet preset periodic (daily or weekly) reservoir levels. Generation shall be adjusted to meet the allowed periodic draw down (or fluctuation) of the reservoir.

(c) Operation period 3: Approximately 1st week of June, flushing period

As the reservoir is impounded, a delta will form in the reservoir and backwater deposition will take place in the river upstream the reservoir. If no actions are taken, these deposits will (i) occupy live storage and cause reduced peaking capacity and (ii) raise the riverbed and cause flooding at Singati Bazaar. To counteract the above impacts the operation of the plant will be as such:

(a) that the water level is drawn down during periods with high discharge and/or bed load transport in the river.
(b) that adequate flushing is performed to remove sediment deposits including as much as is economical of coarse delta material deposits.

Much water will be required to flush all sediments at present river slope of the reach. It may be economical to allow a limited delta to build up inside the reservoir in order to create a steeper slope and more efficient flushing.

Sediments will be where necessary removed annually with flushing through the bottom gates which are as close as possible to the river bed level. Flushing is proposed to be performed at beginning of the monsoon season, when reservoir is drawn down and when pre-monsoon floods with initially high sediment loads can be used to flush sediments. This flushing will allow for minimum accumulation of sediments downstream the dam site.

(d) Operation period 4: June – September, monsoon season

After the annual flushing is completed, the reservoir will be built up to 934 masl as fast as possible, taking the allowable periodic reservoir fluctuation and minimum required generation into account. During the monsoon season the reservoir level will be kept at an average of 934 masl to minimize raising of the riverbed, and thereby eliminating the risk of flooding at Singati Bazar.

When the daily inflow is larger than maximum turbine discharge capacity, generation will be at full capacity 24 hours a day. If the inflow in larger than 450 m^3/sec, the regulating gates will be opened and the reservoir level will be reduced to 928 masl. If the daily inflow is less than the maximum turbine discharge capacity, generation will be aimed to keep the reservoir level at 934 masl. Generation during peaking hours will be prioritized, excess water will be used for off-peak generation. By the end of this period, the reservoir will be filled up to Full Supply Level.

2.2.4 Construction Manpower

The estimated required manpower for construction is shown in the Table 3. In addition an influx of new settlers and small businesses will normally establish themselves at such large construction sites. In addition unregistered persons and "camp followers" could come to the area, whose numbers will be held at a minimum.

Table 3 Assumed project personnel for implementation

Technical and administrative staff:	**200**
Workforce, (temporary, migrating):	1000-1200
Workforce (local):	200- 400
Total	**1400-1800**

2.2.5 Project Structures and Facilities

During the construction of the dam, the river will be diverted through a tunnel. In addition to the construction of the dam, the tunnels and the power house, the project will need new roads/upgraded roads spoil tip areas, sand quarry areas, rig areas, permanent housing, and temporary and labour camps to complete the project (Table 4; Figures 2 and 3). Some of these planned construction areas and structures will be permanent while others will be temporary. The project structures and activity areas proposed and those assessed in this EIA are listed in Table 4. The river stretch is divided into sections that have been assessed for impacts particularly for river water quality; aquatic ecology and fisheries are also listed in the first column of Table 4. Transmission lines and roads alignments have not been finalized or that will be the subject of separate EIAs and plans have not been assessed in this EIA.

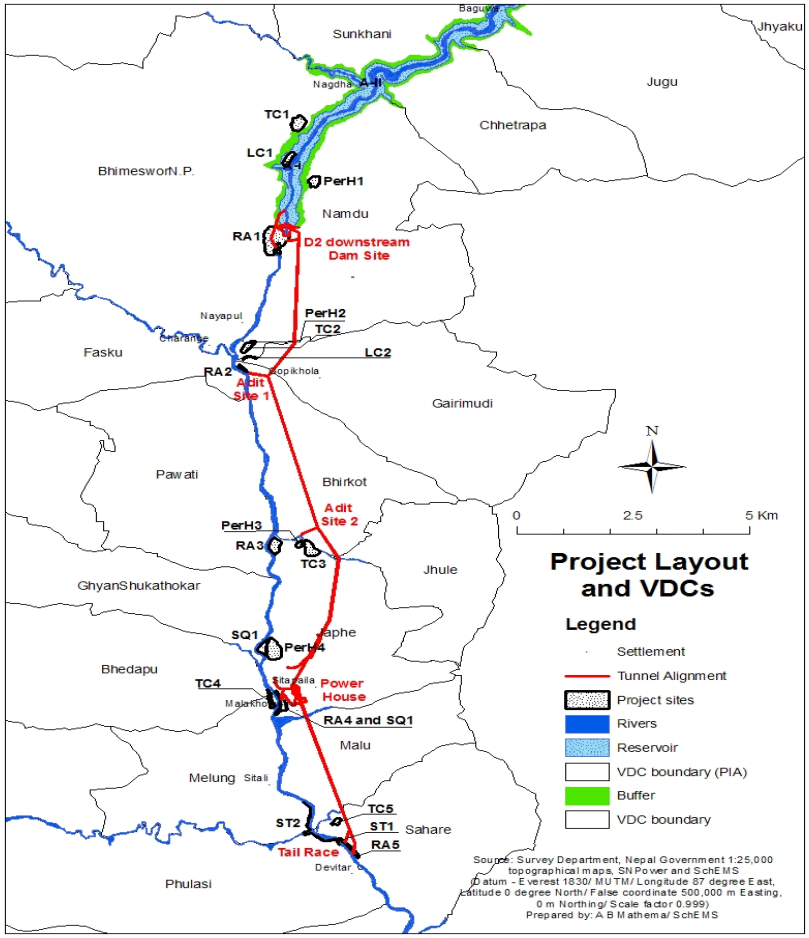

Figure 3 **Detailed project layout showing project structures and activity areas. For key to identification codes see Table 4.**

2.2.6 Methods

The EIA study utilized secondary sources as well as conducted field studies to yield primary data. Extensive reviews of literature, study of maps and photographic images, and national and district level statistics were done. Primary sources of information included administrating questionnaires and checklists for interviews, focus group discussion and field observations and surveys. The work on primary sources spanned from January through August 2009. Public consultations, and disclosure on project details, built upon the scoping study and were carried out through the EIA period. The public hearing will be held on (*date will be added after the hearing*).

2.2.6.1 Project Impact Area and Affected People

(i) Direct impact area

Direct impact area refers to a direct alteration in the existing environmental condition as a consequence of project activity (National EIA Guidelines of 1993)[4]. In general, the project areas to be inundated in the reservoir, areas to be occupied by project structures and facility sites, quarry sites, spoil disposal area, the low flow area downstream from the dam,

[4] GON (previously HMGN). 1993 Nepal Environmental Policy and Action Plan 1. EPC, Nepal, and GON documents that follow.

physically high risk area, and the access and haul road to various sites area are categorized as Direct Impact Areas. This study considers five types of areas as direct impact area:

(a) Inundation area

This is the area covered by reservoir at operation level of 940 masl. This is the permanent impact area where the local inhabitants will lose their land and assets on land, and physical and productive infrastructures and facilities. There could be irreversible losses to natural resources requiring re-establishment in another area. The land in this area will have to acquired by the proponent for the proposed TA3HEP.

(b) Safeguard buffer area

In order to ensure safety from the reservoir to the people and to protect reservoir shoreline, the project has proposed to, where possible, to maintain a 'safeguard buffer area' between settlements and their lands in use, and the reservoir. This is to cover an additional 50 m elevation contour (i.e. a 50 meter strip) above the 940 masl operating level of the reservoir. This 50 m strip will in addition include the adjoining high risk soil erosion and landslide prone area. The proposed buffer area could ideally be 'greened' through vegetation restoration and thus function as to stabilize the immediate catchment area, provide habitat to wildlife and non-timber forest products for local use thus enhancing ecosystem services. Land in this strip may be acquired, leased, co-managed with local communities, or managed by local communities or the GON.

(c) Project structure and activity area

The 'Project Structure and Activity Area' would include areas with permanent and temporary project structures/activity as listed in Table 4.

(d) Low flow area

The 'Low Flow Area' includes the stretch of the Tamakoshi River between the dam site and the tailrace outlet where the flow will be significantly reduced during project operation. The local inhabitants using riverine resources for their socio-cultural and economic activities will be directly affected. The major concern is the aquatic ecosystem and the fisheries.

(e) Water level flow fluctuation area

The riverine area between the tailrace outlet and the Tamakoshi-Sunkoshi river confluence is included in 'high flow fluctuation area'.

For baseline and impact assessment of aquatic ecology and fisheries the river channel was divided into four sections: (I) upstream reservoir, (II) reservoir, (III) low flow stretch and (IV) water flow fluctuation stretch (downstream tailrace outlet).

(ii) Indirect impact area

As per the definition of the National EIA Guidelines 1993[5] the areas with environmental component having repercussions by other environmental component affect/changed by the project component or its activity are considered as the 'Indirect Impact Area'. The areas of the project influenced VDCs, where project structures are proposed to be placed are regarded as indirect project impact area. People in the indirect impact area may partially

[5] The description of the environmental condition of the project area (project influence area) is in accordance with GoN requirements and practice, as well as meeting the requirements of ADB (2009)

lose their land or dependable natural resources such as forests and grazing lands or partially or fully deprived of community infrastructure and facilities, built-in structures, religious or cultural sites, market centres etc which could be permanently lost in the reservoir area or in other direct impact area. Habitat fragmentation in such areas may result and influence wildlife mobility and limit food resources.

(iii) Project affected families[6]

Families in the direct or indirect impact areas whose land, properties or livelihoods may be affected due to construction or operation of project components are considered as 'Project Affected Families'. The members of these families are usually considered as Project Affected Persons (PAP). In this EIA the term "Project Affected Families" follows World Bank/IFC terminology and thus is not limited to those subjected to physical displacement[7]. Project Affected Families include, depending on the case, those affected by:

(a) the involuntary taking of land resulting in:
- relocation or loss of shelter;
- lost of assets or access to assets; or
- loss of income sources or means of livelihood, whether or not the affected persons must move to another location; or

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

More detailed characterization of PAPs and PAFs is provided in the RRP.

In addition to the generic PAF category, the entitlement matrix presented in the RRP does classify the affected families under different classes depending on the degree of affect. One of these categories is represented by the SPAFs defined in accordance to practices and guidelines of the GoN.

(c) Severely Project Affected Families (SPAF)

Severely Project Affected Families (SPAF) include those families who are physically displaced from their residences or commercial establishments and those who are severely affected through loss of agricultural land as defined in the "Entitlement Matrix".

2.3 The Present situation

2.3.1 Physical Environment

2.3.1.1 Land use

The proposed reservoir will require the permanent acquisition of 424 ha of land (Table 4). The project as a whole will acquire about 29 ha of land permanently and 76 ha temporarily, of which 61 ha is agriculture and 41 ha is classified as forest. The reservoir and buffer strip fall into five VDCs and a municipality list below.

[6] The terms are in accordance of practices and guidelines of the GoN. These categories, land acquisition and resettlement (IFC and ADB refer to it as Involuntary Resettlement) processes that and will be used also meet the requirements of the Work Bank Group (IFC's Guidance Notes: Performance Standards on Social and Environmental Sustainability. 2006 (see also Guidance Note 5, 2007); and that of the Asian Development Bank (ADB Safeguard Policy Statement, 2009; ADB Handbook on Resettlement: A Guide to Good Practice. 1998).

[7] World Bank 2004. Involuntary Resettlement Sourcebook.

- Left bank: Jhyaku, Jugu, Chhetrapa and Namdu VDCs
- Right bank: Lamidanda and Sunkhani VDCs and Bhimeshwor Municipality

The land for the proposed safeguard buffer amounts to about 291 ha, whereas that of the high risk erosion area comes up to 110 ha making a total of about 401 ha. Parcels within these areas may be acquired, leased, or improved for management as community/government forests.

Detailed views of land use in the TA3HEP project structure and activity areas are shown in Figure 4 (see also Table 4).

2.3.1.2 Noise, Sound and Water Quality

All measured values (PM_{10}, TSPM and NO_2) of air quality at five stations were well below the GON and international standards. The measured minimum-maximum range of noise at five stations ranged from 50.7 to 73.9 dBA, except for two measurements (73.9 and 66.3 dBA) the other levels were below 60 dBA.

The drinking water quality analysis from community and household taps, and the river and tributaries showed that all the physical and chemical parameters within the limit as prescribed by GON and WHO. However, the biological parameters of coliform bacteria (including faecal), *Escherichia coli*, and ova of worms were found as contaminants at many sampling stations, and exceed acceptable standards.

2.3.1.3 Geology, Hydrology and Sediment

The geological mapping done in the reservoir area has allowed for the identification of more than 20 suspected sliding areas dispatched between Singati Bazaar and the dam site. These areas, obviously if experiencing sliding, will extent to parts much beyond the reservoir or safety buffer zone boundaries. Several of the slides could be stabilized old slides, whereas other could be dormant slides that might be reactivated by the creation of the reservoir. Since the sliding movements are slow, it has not been possible at this level of the project to differentiate between stabilized old slides and creeping slides. To stabilize the slope a detailed mitigation plan has been proposed.

From January, temperatures increase, reaching a maximum in August. Relative humidity is varies between 65% and 90%. The mean annual precipitation for a typical year at Nagdaha and Charikot is about 2190 mm and 2100 mm, respectively. The tributaries contribute to the Tamakoshi but in the dry season several tributaries remain dry, and a contribution of about 2-3 m3/s is anticipated to the stretch between the proposed dam and tailrace outlet.

The general impression of Tamakoshi is that there is less sediment transport than one could expect in a river in Nepal. A single large flood event with slides may increase the sediment transport significantly for several years. The reasons why sediment transport seems to be less than one could be expected in a river in Nepal are likely to be the following: (i) There are no recent large floods, neither recorded or in the memory of local people up to 79 years old. The catchment area is therefore characterized by relatively few active slides; (ii) Much of the catchment is in higher Himalayas which is characterised both by low monsoon rainfall and by hard and less erodible rock; (iii) There are glacier lakes (mainly at Tsho Rolpa) that traps practically all sediment from upstream glacial areas, (iv) Bed load is partly stopped by the ancient slide at Lamabagar. This slide blocks the valley to a height of very approximately 200 metres and traps / has trapped sediment over length of 4 – 5 km.

The annual average sediment inflow to the TA3HEP reservoir is estimated to 6 million ton/year. Assuming the dry density is 1500 kg pr m^3, the annual incoming sediment volume is 4 million m^3.

The potential GLOFs in the Tamakoshi River basin are an important consideration for dam safety in the watercourse. A GLOF risk assessment has been reported in the Feasibility Study. In the report the bursting of three glacial lakes has been simulated separately in the Tamakoshi River basin, coinciding with a 2-year flood and a 100-year flood. A GLOF from Tsho Rolpa would result in a peak flood wave of almost 10 000 m^3/s rushing out of the breach. The flood wave arrives at the proposed reservoir inlet at Singati Bazaar after just over three hours and rapidly reaches its maximum between four and five hours after the dam burst has been initiated.

Table 4 Land use in the proposed TA3 HEP inundation and safeguard buffer areas, and project structures and facilities

Site Codes	Project Sites and Proposed Areas	Land to be acquired			Land proposed for acquisition, leasing, or community management	Land Use		
		Permanent	Temporary	Total		Farmland	Forest	Others*
	A. Reservoir, Safeguard Buffer & Erosion Risk Areas							
A-i	Inundation area including dam structures	424.00	0	424.00		106.00	167.00	151.00
A-ii	Safeguard Buffer Area	0	0	0	290.59	84.95	202.82	2.82
A-iii	High Risk Erosion Area	0	0	0	109.51	65.30	44.21	0
	Subtotal Reservoir, Buffer and Erosion Risk areas	**424.00**	**0**	**424.00**	**400.10**	**256.25**	**414.03**	**153.82**
	B. Project structure and activity area							
	B-i Headworks							
PerH1	Permanent Housing, Namdu VDC	5.08	0	5.08		5.01	0.07	0
TC1	Temporary Camp, Bhimeshwor M	0	9.39	9.39		9.39	0	0
LC1	Labour Camp, Bhimeshwor M	0	4.87	4.87		4.87	0	0
RA1	Rig Area at Dam site, Bhimeshwor M & Namdu VDC	*0*	*27.04*	*27.04*		*0.39*	*24.37*	*2.28*
	Bhimeshwor M			22.53		0.32	22.21	0
	Namdu VDC			4.51		0.07	2.16	2.28
	Subtotal headworks	**5.08**	**41.30**	**46.38**		**19.66**	**24.44**	**2.28**
	B-ii Headrace Tunnel Area (13 km)							
	Adit 1 Area	***0.76***	***7.21***	***7.97***		***2.38***	***5.59***	***0***
PerH2	Permanent Housing, Namdu VDC	0.76	0	0.76		0	0.76	0
TC2	Temporary camp, Namdu VDC	0	4.83	4.83		0	4.83	0
LC2	Labour camp, Namdu VDC	0	1.03	1.03		1.03	0	0
RA2	Rig Area – 2, Bhirkot VDC	0	1.35	1.35		1.35	0	0
	Adit 2 Area	***1.51***	***14.76***	***16.27***		***10.10***	***6.17***	
PerH3	Permanent Housing, Japhe VDC	1.51	0	1.51		0	1.51	0
TC3	Temporary camp, Japhe VDC	0	6.90	6.90		6.90	0	0
RA3	Rig Area -3, Japhe VDC	0	7.86	7.86		3.2	4.66	0
	Subtotal headrace & tunnel area	**2.27**	**21.97**	**24.24**		**12.48**	**11.76**	**0**
	Haul/service Road							
	B-iii Powerhouse Complex							
PerH4	Permanent Housing, Japhe VDC	13.85	0	13.85		12.43	1.42	0
SQ1	Sand Quarry, Japhe VDC	4.03	0	4.03		4.03	0	0
TC4	Temporary Camp, Bhedapu & Melung VDCs	*0*	*3.28*	*3.28*		*3.08*	*0.20*	*0*
	Bhedpu VDC	0	1.01	1.01		1.01	0	0
	Melung VDC	0	2.27	2.27		2.07	0.2	0

Site Codes	Project Sites and Proposed Areas	Land to be acquired			Land proposed for acquisition, leasing, or community management	Land Use		
		Permanent	Temporary	Total		Farmland	Forest	Others*
RA4	Rig & spoil tip area, Japhe VDC	0	5.40	5.40		3.95	1.45	0
	Subtotal power house	**17.88**	**8.68**	**26.56**		**23.49**	**3.07**	**0**
	Haul/service Road							
	B-iv Tailrace Area							
ST1	Spoil Tip, Sahare VDC	1.96	0	1.96		0.91	0.95	0.10
RA5	Rig Area -5, Sahare VDC	0	1.35	1.35		1.35	0	0
TC5	Temporary Camp, Sahare VDC	0	2.36	2.36		2.19	0.17	0
ST2	Spoil tip, Melung & Phulasi VDC	*1.34*	*0*	*1.34*		*0.96*	*0*	*0.38*
	Melung VDC	0.96	0	0.96		0.64	0	0.32
	Phulasi VDC	0.38	0	0.38		0.32	0	0.06
	Subtotal tailrace area	**3.30**	**3.71**	**7.01**		**5.41**	**1.12**	**0.48**
	Haul/service Road							
Subtotal (Project structure & activity area)		**28.53**	**75.66**	**104.19**		**61.04**	**40.39**	**2.76**
TOTAL		**452.53**	**75.66**	**528.19**	**400.10**	**317.29**	**454.42**	**156.58**

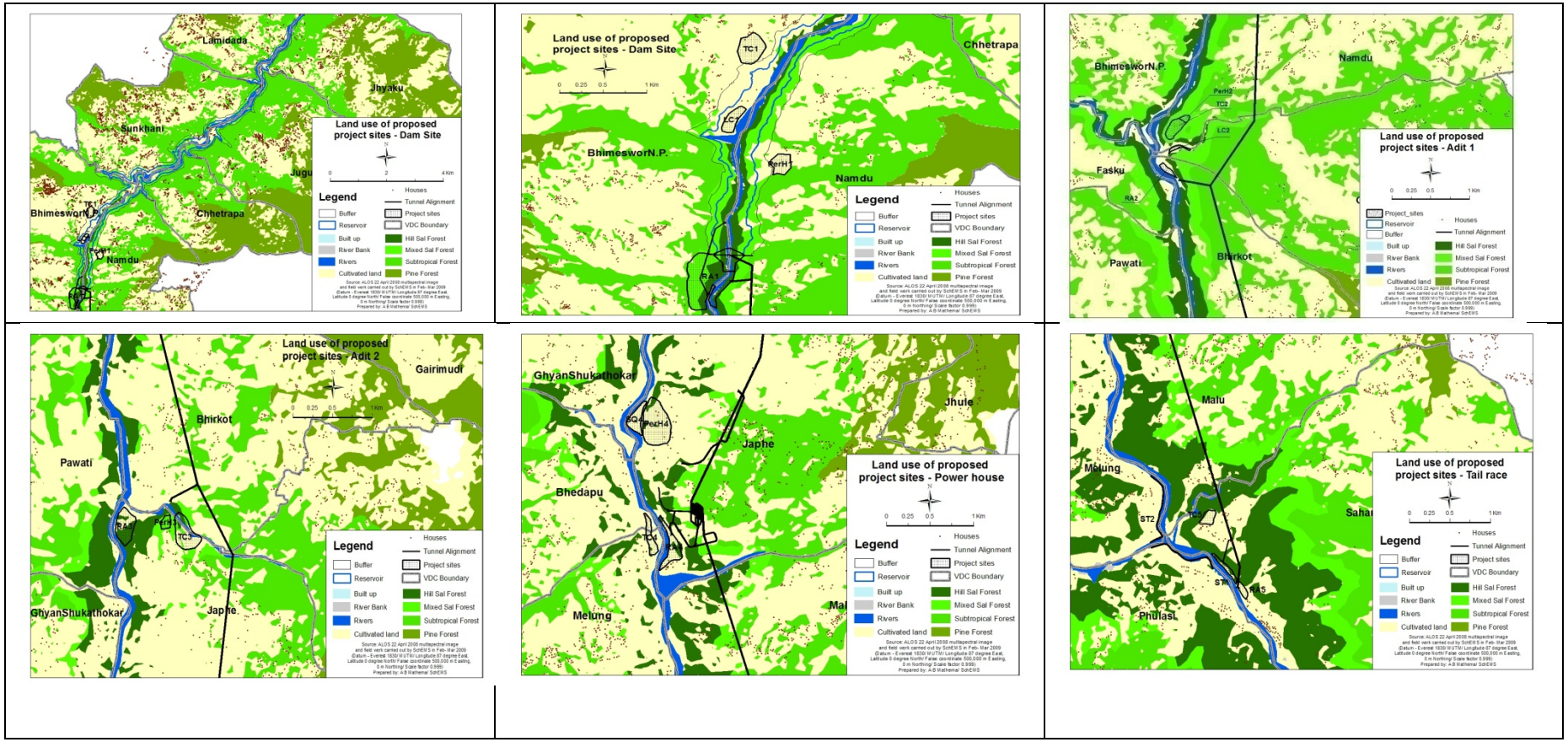

Figure 4 **Land use of project structures and activity areas. See Table 4 for site code identification.**

2.3.2 Biological Environment

2.3.2.1 Vegetation and Forestry

(i) Forests types, area and vegetation

There are three types of forests namely Hill Sal, Mixed Sal and Sub-tropical broadleaved forests within the core project area (Figure 4 and 5). In total, 100 wild plant species have been recorded in reservoir to the tailrace sites. Of these 44% are trees, 27% shrubs and 11% herbs. Other forms of plant species are very few (≤6%). The forest are mainly managed either by community user groups or the district offices. Much of the forest has a shrub-like appearance due to human exploitation.

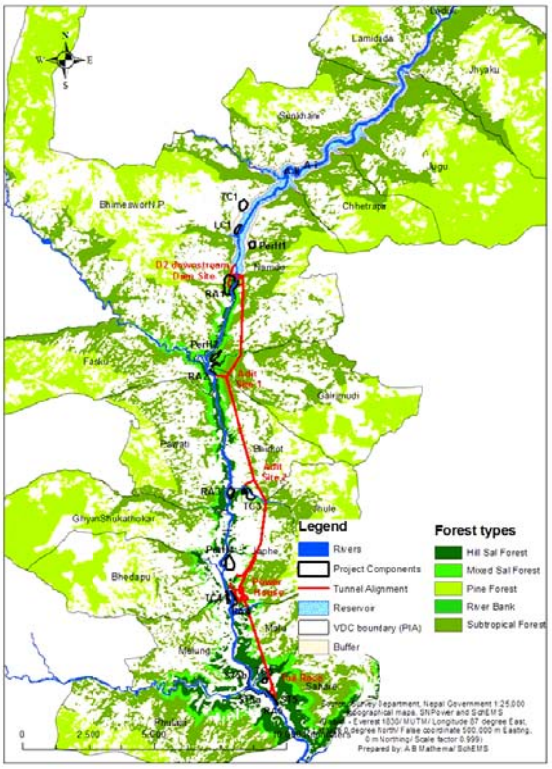

Figure 5 Forest types in the project VDCs, Municipality and Project area

Forest types and coverage in the project influenced VDCs and Bhimeshwor municipality area shown in Figure 5. About 57% of the total area has forest cover, and the major forest types are Hill Sal, Mixed Sal, Pine and Sub-tropical broadleaved forests (Table 6.23). Pine forest covers about 53% of the total forest area followed by Subtropical broadleaved forest covers (37%), Hill Sal forest (5%0 and Mixed Sal forest (5%).

Regeneration, standing volume and total biomass

The annual average increment of forests in the project area is 1.4%, which is good. The growing stock of forests the project sites, e.g. permanent housing, rig areas and spoilt tip area, have very poor growing stock with 175 standing trees (including poles and saplings) per hectare. Growing stock in inundation, safeguard buffer, permanent housing for office complex area, rig area near the dam site are of fair quality. These forests constitute on the average more than 330 standing trees (including poles and saplings) per hectare. Average basal area of trees in inundation and safeguard areas is around 14.5 m^2/ha and average volume is 21.5 m^3/ha. In other areas these figures are lower (1-10 m^3/ha). There are 167 ha forests in inundation area, 247 ha in safeguard buffer area, and 40 ha in project structure and activity area. All forest removed will be replanted as per regulations.

(ii) Conservation status and use of species

No endemic species was recorded in the project area. All species recorded have wide distributions. Sal (*Shorea robusta*) is the only tree species that is in on the GON protection list ('Trees banned for transportation, export and felling'). Two species occur on the IUCN red listed - Sunakhari (*Dendrobium spp.)* and Sungava (*Vanda coerulea*) (Figure 6). These species are valued predominantly as ornamental plants and are known to be removed illegally and traded, although based on interviews the project area does not appear to subject to this removal of species. Sunakhari and Sungava are also categorized under CITES Appendix II as 'Not necessarily threatened with extinction but trade must be controlled'. Gurjo lahar (*Tinospora sinensis*) is the only species recorded as vulnerable in the CAMP list (list prepared based on a regional workshop on Conservation Assessment and Management Plan). During the tree removal for the project, the orchids will be relocated as a mitigation.

Of 100 plant species found in the direct and indirect impact areas of the project, 26% have some conventional uses.

Figure 6 Picture of *Vanda coerula* (Sungava)

Common name: Autumn lady's tresses orchid; blue vanda. **Scientific name**: *Vanda coerulea*. **Distribution:** India, Thailand. **CITES listing:** Appendix II (112/01/05). **Photo**: © CITES MA of Thailand

(iii) Forest management and use

Altogether, there are 28 community forests in the project's direct and indirect impact areas in Dolakha District. Of these, 18 are in the upstream of the dam site and 10 in low flow area. The average CF area per household is only 0.67 ha. There are 75 Leasehold Forest Groups that have been registered in the project affected VDCs in Dolakha District but there are only four leasehold forests (Ghattakopakha, Khodakopakha, Titegund and Simpakha) in the project affected core areas.

Of 393 HHs surveyed in the project affected VDCs, use of forest products as fuel wood was recorded from 368 HHs (93.6%). On average, 1900 kg of fuel wood was used per household last year. This is equivalent to about 328 kg of fuel wood per person in a HH. Of different sources of fuel wood, users in the project VDCs collected about 386 MT (56.3%) of fuel wood from the community forests.

2.3.2.2 Wildlife and Birds

A total of 17 species of mammals and 69 species of birds were reported in the project area and its immediate surroundings. Habitats covered the whole area, with forested areas being the best. Among the reptiles, few species of snakes and lizards were also recorded. There are higher numbers of wildlife species including birds in the proposed reservoir area and its surroundings than in the low flow and other project areas, mainly due to more forest habitats in these areas. There is no conservation area or national park in project VDCs and municipality.

Among mammals six species are listed in the IUCN (2008) threatened list (Table 5). None of these species observed, and known to be solely dependent on habitats in the project area of influence. They are widely distributed throughout the project districts and the country, and the Himalayan region.

Table 5 Threatened animals and birds in the project area

Common name	Zoological Name	IUCN (2008)	CITES	NPWC Act 1973	Occurrence
Mammals					
1. Common leopard	*Panthera pardus*	NT	I	-	C
2. Jackal	*Canis aureus*	-	III	-	C
3. The common mongoose	*Herpestes edwardsi*	-	III	-	C
4. Yellow throated marten	*Martes flavigula*	-	III	-	C
5. The common otter	*Lutra lutra*	NT	I	-	R
6. Himalayan goral	*Naemorhedus goral*	NT	I	-	R
7. Macaque monkey	*Macaca mulatta*	-	II	-	C
8. Assamese monkey	*Macaca assamensis*	NT	II	P	C
9. Hanuman langur	*Semnopithecus hector*	NT	I	-	C
10. Chinese pangolin	*Manis pentadactyla*	E	II	-	-
Birds					
11. Greater spotted eagle	*Aquilla clanga*	V			
12. Pallas's Fish-eagle	*Haliaeetus leucoryphus*	V			
13. Little egret	*Egretta garzetta*	-	III		

E = Endangered, NT= Near Threatened, P= Protected by government of Nepal, Occurrence: C= Common if the species is frequently seen throughout the year by local informants and , R= Rare, if animal is encountered only once or twice in a year. CITES I= species to be threatened with extinction, CITES II= species could become threatened if their trade is not properly controlled, CITES III= species require international cooperation to control trade.

There is considerable wildlife movement including the cross river movement in the project area. Leopards usually cross Tamakoshi River to use different riverine forest habitats and hill slopes. Local inhabitants reported monkeys, leopards and langurs using suspension bridges to cross Tamakoshi River. Domestic animals fall prey to the leopard and jackle in the settlement areas, while crop damage by monkeys, deer and the Kalij pheasant was often reported. Hunting and poaching is not common and no obvious signs of such activity were observed. Hunting is banned in the community forests.

2.3.2.3 Aquatic Ecology and Fisheries

(i) Aquatic life

Diatoms were the most dominant algal group found in Tamakoshi River, but green algae and blue green algae was recorded as well. *Daphnia spp.* and *Bosmina spp.* were the only specimens of zooplankton observed. A total of 28 taxa distributed in 8 orders, 24 families and 5 genus' of macro invertebrates was recorded. EPT-taxa (Ephemeroptera, Plecoptera and Trichoptera) dominated at all stations.

(ii) Fish

(a) Species, migration and distribution

A total of 1685 individuals of representing 13 species were caught during the two field studies in February and April (Table 6). All the species were known by the local fishermen. Interviews with local fishermen resulted in 10 more species that were said to occur in the river, making a total of 23. Of the 23 possible species: 14 are known to be as resident, four are midrange migrating species and five are long range species. Of the five long range migrating species only Sahar (*Tor putitora)* and Falame Sahar (*Tor tor)* were known by the local fishermen to occur, but seldom caught, upstream the planned dam site. None of the long range species were caught during the field studies. No fish species reported in this study is listed as protected by the GON or in the IUCN Red list (2009) or CITES appendices.

Table 6 Fish species recorded and reported in February and April 2009

No.	Local Name (Nepali)	Common English Name	Latin Name	Caught during field study in river Section*	Recorded from interviews section*	Migratory Status**
1	Buche Asala	Blunt-nosed Snow trout	*Schizothorax richardsonii* *	I, II, III; IV	I, II, III, IV	MD/RE
2	Chuche Asala	Point-nosed Snow trout	*Schizothorax progastus*	I, II, III, IV	I, II, III, IV	MD
3	Titae	Stone Carp	*Psilorhynchus pseudecheneis*	I, II, III; IV	I, II, III, IV	RE
4	Katle	Copper Mahseer	*Neolissochilus hexagonolepis* (*Acrossocheilus hexagonolepis*)	I, II, III, IV	I, II, III, IV	MD
5	Nakato or Ghopte	Sucker Head	*Garra gotyla gotyla*	I, II, III; IV	I, II, III, IV	RE
6	Kabre/ Katuse	Sucker Throat Catfish	*Pseudecheneis sulcatus*	I, II, IV	I, II, III, IV	RE
7	Kadhe/ Halunde	Three-lined catfish	*Glyptothorax trilineatus*	I; III, IV	I, II, III, IV	RE
8	Lohari/ Petphora	Stone Roller	*Crossocheilus latius latius*	III; IV	III, IV	RE
9	Telkabre	Draw Fish	*Glyptosternum blythi*	II, III	I, II, III, IV	RE
10	Buduna	Stone Sucker	*Garra annandalei*	III; IV	I, II, III, IV	RE
11	Sime/ Gadela	Stone Loach	*Schistura multifaciatus*	I, II, III; IV	I, II, III, IV	RE
12	Labre	River Cat	*Glyptothorax pectinopterus*	IV	I, II, III, IV	RE
13	Masane/Gadela	Creek/Gravel Loach	*Schistura beavani*	I, II, III, IV	I, II, III, IV	RE
14	Gurdi	River rohu	*Labeo dero*		III, IV	RE
15	Sun/ Dhadhe Asala	Blunt-nosed snow trout	*Schizothorax plagiostomus*		I, II, III, IV	MD
16	Bhayatal	Kapuri	*Pseudolaguvia kapuri*		III, IV	RE
17	Falame Sahar	Tor Mahseer	*Tor tor*		III, IV	LR
18	Jalkapoor	*Clupisoma montana*	Jalkapoor		III, IV	LR
19	Sahar	Golden Mahseer	*Tor putitora*		I, II, III, IV	LR
20	Goonch	Bagrid Catfish	*Bagarius bagarius*		III, IV	LR
21	Rajabam	Fresh Water Eel	*Anguilla bengalensis*		III,IV	LR
22	Fageta	Torrent minnow	*Barrilius barila*		III, IV	RE
23	Baghi	Tiger Loach	*Botia almorhae*		III, IV	RE

*I= upstream reservoir; II = reservoir area, III low flow area, IV = fluctuating flow area (down stream planned outlet of the power station). RE= resident, MD= midrange migrating; LR = long range migrating....

All eight stations varied from 49.1 individuals/ 100 m^2 at station 6 in Section II (reservoir area) to 533.4 individuals/ 100m^2 at station 10 (Section IV, downstream the planned outlet of the power station). The mean total density of the catch was 144.8 individuals/ 100 m^2. *Schizothorax richardsonii* dominated the catch at all stations, counting for more than 87 % of the total catch. *Schizothorax richardsonii* therefore appears to be the key species in this part of the river system, as also reported in other

Figure 7 Schizothorax richardsonii, Blunt nosed snow trout (Buche Asala)

studies (Figure 7). The high catch especially of fry close to the river edge shows that this is an important area that might be vulnerable to effects of changes in water flow (peaking).

(b) Migration, spawning and spawning grounds

Table 7 indicates a major upstream migration between March and September (with differences for Freshwater eel and the Copper Mahseer), and a major downstream migration in October/November.

Table 7 Migration and spawning of species recorded and expected in the Tamakoshi.

Species name Latin / English / Nepali	Migratory status	Migratory Pattern (Months) J	F	M	A	M	J	J	A	S	O	N	D	Spawning Season	Spawning Substrate
Tor putitora (Golden Mahseer) Sahar	Long range						↑	↑	↑	↑	↓	↓	↓	Sept-Oct	Gravel bed (Adult-rest in deep pools)
Tor tor (Mahseer) Falame Sahar	Long range						↑	↑	↑	↑	↓	↓	↓	Sept-Oct	Stones and gravel
Anguilla bengalensis (Fresh water Eel) Raja Bam or Bam	Long range		↑	↑	↑	↑	↓	↓	↓					June-July	Mud & Sand detritus in sea water
Clupisoma montana (Jalkapoor) Jalkapoor	Long range							↑	↑	↑	↓	↓		Sept-Oct	
Bangarius bangarius (Bagarid catfish) Goonch	Long range			↑	↑	↑	↑	↑	↑	↑	↓	↓	↓	July-Aug	Mud & Sand detritus (Adult-
Neolissochelius hexagonolepis (Copper Mahseer) Katle	Mid range			↑	↑	↑	↑	↓	↓	↓				May-July	Gravel (Adult-resting in deep pools)
Schizothorax richardsonii (Spotted snow trout) Buche	Mid range	↑	↑	↑								↓	↓	Sept-Oct March-April	Pebbels and gravel
Schizothorax plagiostomus (Spotted snow trout) Sun Asala	Mid range	↑	↑	↑								↓	↓	Sept-Oct March-April	Pebbels and gravel
Schizothorax progastus (Long nosed snow trout) Chuche Asala	Mid range	↑	↑	↑								↓	↓	Sept-Oct March-April	Pebbels and gravel
Labeo dero (River rohu) Gurdi	Short range			↑	↑	↑	↑	↑	↓	↓				June-July	Gravel bed

As described in habitat description, rapids dominate in all the four sections of the river which contributes to keep the water well oxygenated. This is important for many fish species especially when it comes to spawning, because both eggs and fry are the most sensitive stage in the life cycle of the fish. However, the rapids are constantly alternated by pools and intermediate habitats giving a high variability for spawning and nursery areas for different fish species. Especially confluences between Tamakoshi and the bigger tributaries as Khare, Singati, Gumu, Dolti, Charange, Milti and Khimi Khola appear to be important spawning areas for many fish species.

(c) Fishery

Based on interviews with the local fishermen, there are no professional (fulltime) fishermen along the Tamakoshi (Sections I –IV). The number of fishermen was estimated to be 75 within the project area. In addition there are estimated to be about 125 occasional fishermen comprising mostly school children, fishing with Lahare passo. An accurate estimation of the fishermen population in the Tamakoshi area is difficult mainly because people who were found fishing did not claim themselves as fishermen.

Figure 8 Cast net fishing at downstream of Khare Khola confluence at Tamakoshi and Lahare Passo with three Asala caught in the loops in Tamakoshi

The fishermen mainly use loops (Lahare passo) and cast nets for fishing (Figure 8). Some of the fishermen from the Tamakoshi valley also fish by hook line, tango and occasionally by gill net. Fishing with Lahare passo was reported to be practiced mainly from October to May. The fishermen say that October is the best month for fishing with Lahare passo, possibly because this is the main month for fish migration downstream. Some fishermen use the cast net as well. The cast net is largely used during the monsoon season from June to September, due to more water in the river. According to the fishermen, the size of fish in the Tamakoshi River has declined over the last few years due to over fishing, using the Lahare passo and electro-fishing. Blasting is also reported by local fishermen from Nagdaha (Section II) and Nayapool (Section III).

2.3.3 Social, Economic and Cultural Environment

2.3.3.1 Socio-economic and Cultural Aspects

(i) Main settlements and infrastructure in the project area

The main settlements in the project affected VDCs/Municipality is presented in the Table 8 and main infrastructure is shown in Figure 9 below. Most of the “Bazaar” or trade centers such as Singati, Gumukhola, Nagdaha, Nayapool and Kirnetar (Sahare VDC) are located by the river banks and are characterized by higher density of houses, buildings and population; whereas the rest are usually scattered settlements.

Table 8 Key Settlements in Project Area

District	VDCs & Municipality	Key Settlements
Dolakha	Laduk	Singati
	Lamidanda	Singati
	Jhaynku	Kattike
	Jugu	Pikhuti
	Sunkhani	Ghumu Khola
	Chhetrapa	Malepu
	Namdu	Marbu
	Bhimeshwor Municipality	Charikot, Dolakha, Nayapool, Busti, Nagdaha, Nyagal
	Gairimudi	Gopi, Mudi
	Phasku	Charange, Sayed
	Bhirkot	Puranogaon
	Jhule	Panyubote
	Pawati	Simta
	GhyangShukathokar	Amate, Kalleri, Tapu
	Japhe	Barhabise
	Bhedpu	Baguwa besi, Baikath, Koiralabote, Piple, Thamidanda
	Malu	Phedi, Malukhola Gaon
	Melung	Sitale, Jyamire
	Sahare	Nayabasti, Kirnetar
Ramechhap	Phulasi	Devitar

Source: TA3HEP Household Survey, 2009

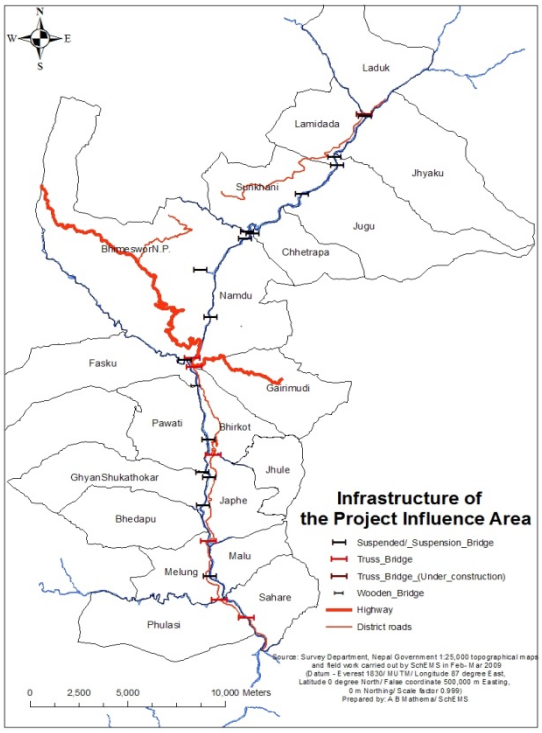

Figure 9 Map showing infrastructure of the Project Area

(ii) Project Affected VDCs

The 18 VDCs and 1 Municipality of Dolakha District to be influenced by the proposed project include 105 359 inhabitants which constitute about 52% of total District population; whereas one VDC of Ramechhap District (Phulasi) to be influenced by the project contains only 5 985 inhabitants, about 2.8% of the total District population. The total population of the project affected VDCs and municipality which include the proposed inundation and Safeguard Buffer areas is 55 949 representing 50% of the total population within the project affected VDCs. The average household size in the proposed inundation area of about 5.4 is similar to the average project districts. The total population of the Low Flow Area is 55 395 which represent about 50% of the total population in the project affected VDCs. The overall average household size in the Low Flow Area VDCs is 5.5 and the literacy rates vary from 35 to 81%.

(iii) Project Affected Households in the Inundated Area

The household survey was carried out among 123 households: 80 houses that fall within inundation zone (Table 9) and thus are likely to be displaced and 43 houses that lie within safeguard buffer zone. The average household size is 5.3 persons. About 72% percent are literate and 54% have agriculture as their main occupation. The reason for having a higher percent in non-agriculture in Sunkhani is due to business being the main occupation of Gumukhola settlement.

Table 9 Socio-economic characteristics of affected households in inundation area

Affected VDC/ M	Population and Households Total numbers			Literacy (%)	Main occupation (%)	
	Household	Population	Household size		Agriculture	Other
Bhimeswor	26	127	4.9	80.3	66.7	33.3
Chhetrapa	7	31	4.4	42.9	64.7	35.3
Jugu	15	95	6.3	66.3	63.8	36.2

Affected VDC/ M	Population and Households Total numbers			Literacy (%)	Main occupation (%)	
	Household	Population	Household size		Agriculture	Other
Lamidanda	7	40	5.7	62.5	81.0	19
Namdu	7	34	4.9	65.2	55.6	44.4
Sunkhani	18	99	5.5	79.5	29.5	70.5
Total	80	426	5.3	71.6	54.1	45.9

The socio-economic characteristic of safeguard buffer area is similar to inundation area. The affected households surveyed in safeguard buffer included 31 in Lamidanda, 11 in Sunkhani, and one in Chhetrapa.

The average landholding size of the surveyed households in the inundation area is 0.8 hectare. Sixty-seven households that reported to own land operate 52 hectare of land in the project area. The land ownership pattern is rather skewed, one-third households belong to having less than 0.5 hectare of land.

The average landholding size of the surveyed households in the inundation area is 0.8 hectare. Sixty-seven households that reported to own land operate 52 hectare of land in the project area. The land ownership pattern is rather skewed; one-third households belong to having less than 0.5 hectare of land.

Detail inventory of the number of registered parcels affected and their area within inundation and safeguard buffer zone is in progress. Table 10 gives the details on number of parcels affected and their area by VDC and municipality in the inundation zone. There are a total of 1604 parcels that are likely to be affected. The parcel sizes of farm land are smaller whereas forest and shrub areas have larger parcel sizes.

Table 10 Affected parcels and their area in the Inundation zone by VDC and municipality

VDC and Municipality	Description of affected parcels		
	Number	Total area (ha)	Average parcel size (ha)
Bhimeshwor	372	92.5	0.25
Chhetrapa	29	41.1	1.42
Jhyaku	187	15.5	0.08
Jugu	320	55.3	0.17
Lamidada	206	26.4	0.13
Namdu	152	75.7	0.50
Sunkhani	337	104.8	0.31
Total	1604	411.2	0.26

The average parcel size of affected area is 0.26 ha or five *ropani*. In VDCs and municipality where the land use of affected parcel is farmland, the average size is small. Jhyaku, Bhimeshwor and Lamidana are some examples. In the safeguard buffer zone, there are a total of 1168 parcels with 241.2 ha of land. The average parcel size is smaller in safeguard buffer zone than in the inundation zone.

(iii) Indigenous Groups in Project Affected VDCs and Inundation Area.

In general, caste group such as Brahmins, Chhetris, and advanced indigenous group Newars have concentrated in the river valley, low lying productive areas or in market centres. Whereas, the indigenous group such as Tamangs, Gurungs, and Sherpas are usually settled in hills. Overall the project affected VDCs are dominated by Chhetris followed by Tamang, Brahmin, Newar.

The National Federation of Disadvantaged and Indigenous Nationalities (NEFIN) has categorized Nepal's *janajati* into five categories namely endangered groups, highly marginalized groups, marginalized groups, disadvantaged groups and advanced groups.

None of the affected households in the inundation area belong to endangered group. The households belong to only marginalized, disadvantaged and advanced indigenous group and caste group. Table 11 presents the distribution of affected households by caste and ethnic categories. Of all the households affected in the inundation zone Newar constitutes the

largest group with 33 households (41%). Brahmin/Chhetri comes next with 24 households (30%). Tamang households constitute 12.5% with 10 households. The number of affected households of Thami, Magar and Dalit comes out as seven, four and two, respectively. This means among janajati households there are seven highly marginalized households, 10 marginalized ones, four disadvantaged and 33 advanced ones.

Table 11 Caste and Ethnic composition of Affected Households in the Inundation area

Affected VDC/ Municipality	Caste group		Janajati (indigenous)						
	Brahmin/ Chhetri	Dalit	Newar	Tamang	Thami	Majhi	Magar	Other	Total
Inundation Zone									
Bhimeswor	-	2	19	2	-	-	3	-	26
Chhetrapa	-	-	-	-	7	-	-	-	7
Jugu	10	-	1	4	-	-	-	-	15
Lamidanda	4		1	2	-	-	-	-	7
Namdu	-	-	7	-	-	-	-	-	7
Sunkhani	10		5	2			1	-	18
Total	24	2	33	10	7		4	-	80

(iv) Religion, religious and cremation sites

Hinduism is the major religion practiced in Dolakha and in Ramechhap districts. Buddhism is the second largest religion in both districts. People practicing other religions are very few.

There are 50 major temples and 9 major gumbas in Dolakha District. Among them, Bhimeshwor temple (Figure 10A) at Bhimeshwor Municipality and Tashi gomba in Bigu VDC are famous religious sites. None of these temples are located within the direct affected areas.

There are 5 shrines in the proposed inundation area which will be affected. Among them Tribhuwaneshor in Gumukhola is the major one. This temple is made of cement and concrete and is in Sikhar style. Similarly, six small temples are located in Safeguard Buffer Area, but they are located at higher elevations than the affected project area. Among them two small temples of Singati are of local importance. Likewise, there are 12 small temples located in the Low Flow zone area.

There are 10 cremation sites in the proposed inundation area starting from Pikhuti in the North to Maryang Khola in the south (Figure 10B). These cremation sites are distributed in both sides of the Tamakoshi River. Almost all the cremation sites are made with small stone spouts and one story sheds with corrugated zinc coated iron sheet roofs.

A. Bhimeshwor Temple

B. Nagdaha cremation site

Figure 10 Important temple and a cremation site

(v) Tourist activities

Dolakha District is an important tourist destination for short-period trekking tourists and for sightseeing tourists. This District falls on a trekking route to the Everest Base Camp. Singati

is a trekking route to the Gauri Shanker Himal area. Gauri Shanker Himal, Tsho Rolpa Lake, Bigu Gumba and Beding Gaon are some of the most attractive destinations among foreign tourists. The Government of Nepal is preparing a plan for developing a Gauri Shanker Conservation Area to attract more tourists to this destination. Gaurishanker Himal, Sailung Danda, Kalinchwok Bhagwati, Bhimeshwor temple, Deu Dhunga, Bigu Gomba, Beding Gaon, Tsho Rolpa Lake, etc. are among the major tourist destinations in the project districts.

(vi) Educational Institutions

There are primary schools (within 15 minutes walk) in 12 settlements in the proposed inundation and Safeguard Buffer Area areas. There are primary schools in most settlements; however, few settlements such as Benishwara, Jasuwara, Kade, and Pikhuti lack primary schools. Institutions for higher education are further away from the settlements within the proposed inundation and safeguard buffer areas.

(vii) Food Security

The overall food crop sufficiency in the VDCs of the project area is given in Table 9. Food crop sufficiency is a good indicator of the living standard in the project area. Within the inundation VDCs only 19% of households have food sufficient for 12-months a year. The majority of households within inundation VDCs fall in the category of food sufficiency for up to 6-months a year.

The food situation of the Low Flow Zone is comparatively better than in the proposed inundation and Safeguard Buffer Zone areas. The share of households with food sufficiency for 12-months a year is about 32%. This may be due to the availability of more agricultural and flat land in the southern part in the project area. The southern VDC's of the project area such as Malu and Sahare posses more arable land with irrigation facilities too, and some households even sell cereals in Charikot and other parts of the District.

Food sufficiency status is poor in the inundation area. Of the total households who had their own land and who responded to food sufficiency status, 59 percent stated that their own production is sufficient for whole year. Among them 9 percent reported to have some surplus for sale. Thirty one percent households had food sufficiency of less than six months. Furthermore, households with food sufficiency status up to three months only comprised seven percent.

Table 12 Food Crop Sufficiency Status by Household in the VDCs

S.N.	VDCs	Food Crop for 3 months	Food Crop for 6 months	Food Crop for 9 months	Food Crops for 12 months	Total
1	Laduk	20	234	262	198	714
2	Lamidanda	275	279	230	178	962
3	Jhyanku	282	360	210	94	946
4	Jugu	282	335	189	96	902
5	Sunkhani	307	372	278	205	1,162
6	Chhetrapa	99	177	142	80	498
7	Namdu	208	234	322	323	1,087
8	Bhimeshwor Municipality	NA	NA	NA	NA	NA
9	Gairimudi	159	158	359	359	1,035
10	Phasku	120	319	164	432	1,035
11	Bhirkot	131	104	96	197	528
12	Jhule	125	156	117	151	549

S.N.	VDCs	Food Crop for 3 months	Food Crop for 6 months	Food Crop for 9 months	Food Crops for 12 months	Total
13	Pawati	326	202	166	250	944
14	Ghyang Shukathokar	238	468	160	113	979
15	Japhe	53	91	145	317	606
16	Bhedpu	88	337	288	246	959
17	Malu	89	80	137	344	650
18	Melung	175	185	193	256	809
19	Sahare	189	158	139	149	635
20	Phulasi	NA	NA	NA	NA	NA
	Total	3,166	4,249	3,597	3,988	15,000
	Percentage	21.11	28.33	23.98	26.59	100

Source: District Profile of Dolakha, 2001

(viii) Use of river resources

Among the resources used from the Tamakoshi River, fishing and stone quarrying are the prominent uses for the population in the proposed project area. Very few people have used water from Tamakoshi river for drinking purposes (only 2 households reported occasional use). The river is a source of very seldom income from aquatic plants (reeds). Other water uses include recreation swimming (children), animals (especially buffalo), generation of electricity with help of pump (peltric set). Tributaries are used for running water mills in the wet season.

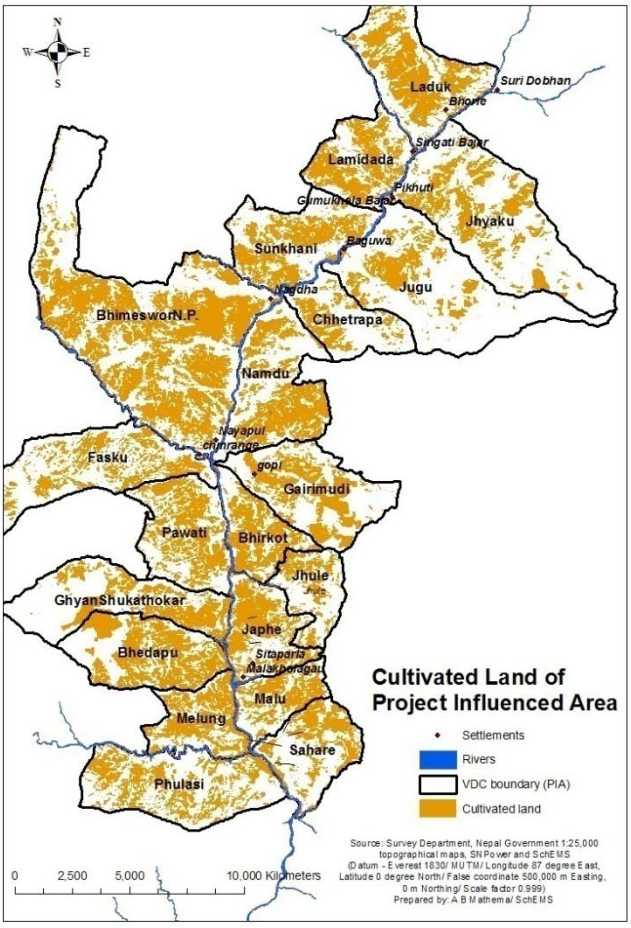

Figure 11 Map showing cultivated land in the project

2.3.3.2 Agriculture

influenced VDCs and municipality

(i) Agriculture in the project area

Cultivated land in project influenced VDCs and municipality is shown in Figure 11. About 4% of the cultivable land in the project influenced VDCs and municipality is flatland, level/gently sloping area with a gradient of less than 5^o, 67.6% has moderate slopes, 25.6% has very steep slopes, and about 3% has slopes more than 50^o. In the project VDCs and municipality, 7.3% of the farmland is 'Pakho – upland steep slope rainfed' (1,263 ha), 61.2% is 'Bari – upland gentle slope rainfed' (10,568 ha), and 31.5% is 'Khet – flat to gentle slope irrigable'. However, not all the land categorized as Khet is the paddy growing area. Irrigation facility with potential command area of 2,115 ha has been developed in Gairimudi, Shahare, Melung, Pawati, Ghyang Shukathokar, Lamidanda, Japhe, Namdu VDCs and in Bhimeshwor municipality in Dolakha district. This facility relies on the monsoon will not be affected by the project.

The 19,180 households (population: 105,359) in project influenced VDCs and municipality in Dolakha district have altogether 16,390 ha of cultivable farmland which constitute about 30% of total district cultivable land.

(a) Land Holding

Altogether 393 households were surveyed in the river valley and adjoining area of 19 VDCs and one municipality in the project area. The total cultivated land in the surveyed area is 221.8 ha averaging 0.56 ha per household. These households cultivate 87.8 ha irrigated Khet land, 60.5 ha rain fed Khet land, 56.3 ha Bari land, 17.2 ha Pakho and Kharbari. About 67% of the total farmland is Khet and the remaining 33% Bari and other uplands. The higher percentage of Khet land is mainly due to survey sites in river valley.

Among the 393 households surveyed, majority of them (89.8%) owned land and rest are either tenants and/or landless. Majority of the landless population still are engaged with agriculture in the capacity agriculture labour. Amongst the landholders, the amount of landholdings varied significantly. The smallest parcel of land of 0.01 ha was recorded in Sunkhani VDC, whereas largest piece of 3.26 ha was recorded in Melung VDC.

(b) Crop Production

The main crops of the project affected area are paddy, maize, wheat, millet and potato. The other subsidiary crops include soybean, fruits and vegetables. The selection of the crops to be planted is based on the land quality, irrigation and altitude. The cropping system varies based on land type (Khet and Bari) and availability of water for irrigation. Fertilizer, seed, irrigation and pesticide are major production inputs for agricultural development.

Cropping intensity in Khet land and Bari and Pakho land is estimated to be 227.2% and 157.5%, respectively. The 148.1 ha of Khet land produced 558 MT of cereal grain, 395 MT potato and 6.5 MT pulses. While the 70.9 ha Bari and Pakho land produced 152 MT of cereal grain, 78 MT potato and about 4 MT pulses. The average yields per ha for field crops are: paddy 2.47 MT, wheat 1.52 MT, maize 1.7 MT, millet 1.1 MT, potato 7mt and pulses 0.78 MT.

(c) Vegetable and Fruit Production

Traditionally, agricultural practices favoured cereal grain and potato production in the project area. However, farmers grow vegetables and fruits for their household consumption, and in recent years, few farmers in pocket area have started growing vegetables and fruits for sale.

Road access and availability of market has favoured vegetable farming. Farmers from Gopitar, Bhirkot are intensively cultivating vegetables, which are supplied to nearby markets – Nayapool, Charikot, and also to Kirnetar and Manthali. The Nayapool – Manthali road passing through Gopitar has regular transport service. On the other hand, farmers from Lamidanda and Sunkhani supply their vegetables and fruits regularly to the closest market - Singati Bazzar in Lamidanda and Charikot.

(ii) Agriculture in the Inundation Area

(a) Land Holdings and Crop Production

Nine partial settlements from Bhimeshwor municipality and other 5 VDCs are situated in the proposed dam and inundation area. There are 80 households in the proposed inundation area and together they cultivate 106 ha of farmland averaging 1.33 ha per household (Table 13). These VDCs and municipal area have together 7,705 ha of farmland averaging 0.81 ha cultivated land/household. The inundation area covers only 1.4% of the total cultivated land in project influenced VDCs in the inundation area.

Table 13 Cultivated land in the inundation area

VDC'S and Municipality	Settlements	No. HH	Population	Agricultural Land (ha)			
				Khet	Bari	Pakho	Total
Lamidanda	Bhasme & Jauswara	7	40	10	3	1	15
Jugu	Baguwa & Pikhuti	15	95	22	4	1	28
Sunkhani	Gumukhola	18	99	2	4	2	8
Chhetrapa	Malepu	7	31	8	2	0	10
Namdu	Kande	7	34	1	1	0	2
Bhimeshwor Municipality	Nagdah and Nyagal	27	127	32	11	2	44
	Total	80	426	75	25	6	106

Table 14 Major crop production in the Inundation area

Crops	Khet (mt/yr)	Bari/Pakho (mt/yr)	Total (mt/yr)
Cereal grains			
Paddy	182.6	0	182.6
Wheat	74.1	8.5	82.6
Maize	25.5	51.0	76.5
Millet	0	6.9	6.9
Total	**282.2**	**66.4**	**348.6**
Potato	199.5	34.3	233.8
Pulses	3.5	1.6	5.1

About 71% of the total cultivated land in the inundation area is Khet land and the rest 29% is Bari and Pakho land (Table 14). The river valley in the inundation area has flatland and gently sloping area with a gradient of less than 5^{o} with irrigation infrastructure tapping rivulets that confluence with Tamakoshi River. Currently, 348.6 MT cereal grains, 233.8 MT potato and 5.1 MT pulses are produced in the inundation area (Table 14). In the proposed inundation area, there are 43 mango trees, 337 guava trees, 1066 banana stems and 473 fodder trees. Due to the climate of the river valley only tropical fruits area grown. Red rice is grown mostly in Nagdah and its immediate surrounding areas. This local rice genotype is grown in smaller area and it is sweeter than other rice varieties. Nothing much is known about this genotype and its conservation status.

(b) Livestock

The 80 households in the inundation area have reared altogether 88 cattle, 83 buffalo, 273 goats and 12 pigs (Table 15).

Table 15 Livestock Population in the inundation area

Livestock kind	Adult		Young Stock		Total	Livestock/ household
	Male	Female	Male	Female		
Cattle	29	24	17	18	88	1.1
Buffalo	9	38	14	22	83	1.04
Goat	40	84	41	99	273	3.41
Pig	1	1	7	3	12	0.15

(iii) Agriculture in Project Structures and Activity Area

In the proposed project structure and activity area covers 104.2 ha and 58.6% of this total area is under cultivation. Out of the total 61.0 ha of cultivated land 26.3 ha is irrigated Khet, 20.9 ha rain-fed Khet, 11.2 ha Bari and 2.6 ha Pakho land (Table 13). About 39% of the total cultivated land will be required for powerhouse complex followed by 32% in headwork, 20% on tunnel area and 9% in tailrace area. Cultivated land in the proposed project structure and activity area, 61.0 ha, annually produces 207.4 MT cereal grains, 140.9 mt potato and 2.9 MT pulses (Table 16). Paddy contributes about 56% to the total cereal grain production.

Table 16 Types of cultivated land in project structure and activity area (Area in ha)

Project Area	Khet		Bari	Pakho	Total	%
	Irrigated	Rainfed				
B- I Headwork	6.2	8.3	4.76	0.40	19.66	32.2
B-ii Headrace Tunnel	6.03	2.48	3.07	0.9	12.48	20.4
B-iii Powerhouse complex	11.47	7.56	3.14	1.32	23.49	38.5
B-iv Tailrace area	2.59	2.6	0.22	0	5.41	8.9
Total	26.29	20.94	11.19	2.62	61.04	100

There are few settlements along the Tamakoshi River valley in this stretch and random sampling conducted in 116 households indicate a larger proportion of Khet land on the riverbanks; out of 65.7 ha of farmlands 39.0 ha are irrigated Khet, 11.5 ha rainfed Khet, 12.2 ha Bari land and 3.0 ha Pakho and Kharbari. About 77% of the Khet land has access to irrigation facility. Almost all of the irrigation systems in the area are small scaled farmer managed systems utilizing the water from tributaries of the Tamakoshi Rivers. However, one

irrigation system in Sitali of Melung-1 VDC utilizes the water from Tamakoshi for irrigation (Figure 12). Some important specifications of Sitali irrigation are:

- It is a seasonal system which utilizes monsoon water of Tamakoshi River from June to August/September, thus is mainly used for paddy cultivation,
- The channel is about 1.5 km long and is located on the right bank of the Tamakoshi River. The intake is located near Jyamire. The discharge is said to be 0.3 m^3/sec,
- About 20 households of the settlements rely on the irrigation and the command area is about 25 ha. About 154 parcels are located within the command area and are mainly owned by those in Sitali and settlements in the vicinity.
- Given the project operation regime the irrigation will still be functional when TA3 HEP is in operation. The channel discharge will also be monitored and the length of the intake into the river may be adjusted, if required, after monitoring its function.

Irrigation channel

Intake of the Sitali Irrigation

Figure 12 Sitali irrigation system

2.3.3.3 Public Health and Sanitation

(i) Water and waste

Piped water is the major source of drinking water for most of the surveyed households. About 47.7% of the total surveyed households have the access to drinking water through pipes connected to their households. Other sources include well (kuwa) and river/stream. More than 80% of the households in inundation area, safeguard buffer zone and indirect impact area cook their food on traditional stoves using fuel wood.

In totality about 67.9% of the surveyed households in the project area have toilet facilities. This figure is slightly more than district figure for Dolakha district (65.05%). More than half of these latrines are of the drained pit type. For households which do not possess toilets, private agricultural land nearby house, forest areas and river/stream banks are places for urination and defecation among which forest is used by about 40.3% of the total surveyed population.

About 41% of the surveyed households dispose the households in their manure pit and 38.5% throw the wastes near their houses, while 19.9% throw household wastes far from their homes. 58.6% of the surveyed households have separate sheds to keep their livestock and the remaining 41.4% households share their house with their cattle. About 68% of the surveyed households put their livestock waste in the manure pit, 21.6% pile up livestock waste nearby their house and 10% throw livestock waste far from their houses.

(ii) Health

Water borne diseases such as diarrhoea, intestinal worms, cholera, jaundice and air borne disease like respiratory infections are the major diseases incident to the population in the surveyed households. In general male are found to be more affected than female by diarrhoea. Considering the total populations in the surveyed households, male are affected than female by the diseases like diarrhoea, intestinal worm, jaundice and skin infection whereas diseases such as typhoid, cholera and respiratory infections are more incident to female than male.

About 1.2% of the total populations in the surveyed households are disabled physically or mentally among which, 18.3% of the total disabilities are inborn and remaining are results of different accidents. Among the total 28 disabled population, 89.3% are physically disabled and the remaining 10.7% are with mental disability.

A total of 182 children were born during previous five years in the surveyed households. Twenty-three among the 182 child died of different causes such as cold fever, pneumonia, diarrhoea and others during last 5 years.

Treatment in the house is adopted by majority of the surveyed households (32.6%) followed by visiting nearby clinic/medical shops (27.8%). About 24.15 surveyed households go to traditional faith healers to treat their ailments.

2.3.4 Public Consultation and Disclosure

The project proponent, SNP; has up till now had consultations with the residents of the affected villages along the Tamakoshi river. SNP has also interacted with local administration for gaining access to land records and other relevant documents. The consultations have been conducted by Sweco Norge AS assisted by the national organization ScHEMS. The project has utilized the several modes of communication to provide information to various stakeholders. The following Tables 17 and 18 provide information on dates/periods when a certain mode of communication was utilized. Consultations and Disclosure have consisted of the following:

- For the preparation of Scoping Report and the ToR for the EIA
- For the EIA

As part of the scoping process a Public Notice seeking public comments and suggestions from all the relevant stakeholders was published in Nepali on 14 and 15 March, 2009 in Kantipur and Gorkhapatra (national daily) newspapers. The Notice sought opinions and suggestions from all the relevant stakeholders regarding possible impacts on the physico-chemical, biological, socio-economic and cultural environment of the project area from implementation of the project. In total 10 postal letters from the affected people of the project sites were received as responses to the public notice announcements of March 14 and 15, 2009 representing more than 50 people from 8 institutions. The responses were incorporated into the Scoping report of TA 3 HEP and for the preparation of the ToR for the EIA.

Table 17 List of mode of communications that have been utilized and when these have implemented

No.	Mode of communication	Utilization	No.	Mode of communication	Utilization
1	Public notices-announce-ments	Public notices (in Nepali newspapers , *Kantipur* (March 14, 2009) and *Gorkhapatra* (March 15, 2009) during the scoping process and opening of Information Office (see no. 6 this Table)	5	Focus Group Discussions	Specific thematic or issue discussions
2	Public Consultations	Throughout EIA period (see following list)	6	Information Office (contact office) in the Project Area.	August 31, 2009 –current. Information on the opening of office was announced in the Newspapers and the radio*.
3	Specific written project information for consultations	Used for all consultations beyond Scoping Period (see following list and Annex III)	7	Setting-up of a project website Provision of internet address for enquiries	Internet August onwards (given in Brochure) Website September onwards
4	A brochure in English. A brochure in Nepali.	Distributed during consultations August 2009 onwards and placed in Project Area office. Ready in September 2009.	8	Summary in English and Nepali of the EIA. (The Executive Summary of the EIA will be used.)	To be used as the disclosure document for the Public Hearing & a National Workshop NOTE: this is planned for January 2009

*Information to the public on the opening of the office at Gopitar is as follows;
(i) FM Radio Charikot, Dolakha District: Kalinchock FM on 1st September '09 and 3rd September '09 (Tuesday and Thursday); Sailung FM on 2nd September'09 and 5th September '09 (Wednesday and Saturday); and Hamro Radio: 4th September '09 and 6th September '09 (Friday and Sunday).
(ii) Weekly Newspapers, Charikot, Dolakha District: Navataranga Weekly on 8th September'09; Sailung ko Surya weekly on 8th September '09; and Kalinchock Sandesh weekly on 10th September'09
(iii) FM Radio Ramechhap: Hajur ko Radio on 15th September '09
(iv) Weekly Newspaper, Ramechhap District: Janapushpa weekly on17th September '09; and New Nayan Weekly:20th September '09

Table 18 List of consultations with stakeholders

No	Date /Place, Type of Consultation	Consultants & Company Staff in attendance	Stakeholders
1	February 2-4, 2009 Charikot, Information meeting	EIA consultant team and SNP Senior Environmental Manager	Public Institutions in Dolakha District; 8 participants from 6 offices
2	April 29, 2009 Nagdaha Public consultation and information meetings	EIA consultant team and SNP Project Engineer and Senior Environment Manager	Public from Project Affected 6 VDCs and one municipality; organizations; 187 participants – farmers, fishing community, businessmen, social workers
3	May 01, 2009 Gumukhola, Public consultation and information meetings	EIA consultant team and SNP Project Engineer and Senior Environment Manager	Public from Project Affected 5 VDCs; 191 participants; farmers, fishing community, businessmen, social workers, politicians
4	May 02, 2009 Devitar, Public consultation and information meetings	EIA consultant team and SNP Project Engineer and Senior Environment Manager	PAF, organizations; people from 4 VDCs; 18 participants – farmers and service holders
5	May 26, 2009 Charikot, Public consultation and information meeting	EIA consultant team	Public Institutions in Dolakha District; 15 participants from 13 offices
6	June 18, 2009 Kathmandu. Public	EIA consultant team	Public Institutions-National (Forestry and Agriculture); 9 participants from 9

No	Date /Place, Type of Consultation	Consultants & Company Staff in attendance	Stakeholders
	Consultation and information meeting,		national level offices
7	June 24, 2009 Charange Public consultation and information meeting	EIA consultant team and SNP CSR Senior Manager, Senior Environment Manager and Project Engineer	Public from affected VDCs, settlements, PAF, organizations; 137 participants from 8 VDCs; farmers, fishermen, priest, businessmen, student & service holders
8	June 25, 2009 Malukhola Bazar, Public consultation and information meeting	EIA consultant team and SNP CSR Senior Manager, Project Engineer, and Senior Environment Manager	Public from affected VDCs, settlements, PAF, organizations; 87 participants from 5 VDCs and one Municipality
9	August 21, 2009 Kathmandu, Public consultation and information meeting	EIA consultant team and SNP CSR Senior Manager, Senior Environment Manager and Environmental Coordinator	Public Institutions-National (Forestry and Agriculture); six participants from 6 national level offices

2.4 Project impacts and mitigation

2.4.1 Physical Environment

2.4.1.1 Loss of Agriculture and Forest Land

As shown in Table 4 the total land loss in the proposed inundation area is 424 ha of which 106 ha is agriculture and 167 ha is under forest cover. The largest agricultural area lost is in Bhimeshwor Municipality (40 ha, 37%) while Namdu VDC losses the largest area of forest (50 ha, 30 %) (Table 19).

Table 19 Loss of Land by Type of Use by VDC/Municipality in the Inundation Area

VDC/M	Cultivated land		Forest		River, river bank and wasteland		Total	
	Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%
Bhimeshwor(M)	39.4	37.1	37.3	22.3	22.8	15.1	99.4	23.4
Chhetrapa	6.8	6.4	17.7	10.6	17.1	11.3	41.6	9.8
Jhyaku	3.9	3.7	2.5	1.5	9.1	6.0	15.5	3.7
Jugu	15.8	14.9	22	13.2	18.2	12.0	55.9	13.2
Lamidada	5.7	5.4	5.2	3.1	17.2	11.4	28.1	6.6
Namdu	7.6	7.2	50	29.9	18.3	12.1	75.9	17.9
Sunkhani	27.0	25.5	32.3	19.3	48.4	32.1	107.7	25.4
Total	106.0	100	167.0	100	151.0	100	424.0	100

Project will acquire about 61.4 ha of cultivated land for project structure and activity area, of which 23.3 ha will be acquired permanently, whereas 37.7 ha will be temporarily acquired (Table 20). Land use of permanently acquired land will be changed to dwellings and other project structures while land use of about 38 ha farmland will be changed to various camps and project construction area.

Table 20 Loss of cultivated land for installation of project structure and activity areas

Project structure and activity areas		Total Area Required (ha)	Affected Cultivated Area (ha)	Affected Cultivated area (%)
Headworks (intake)	Permanent housing (PerH1)*	5.08	5.01	99
	Temporary camp 1 (TC1)	9.39	9.39	100
	Labour camp 2 (LC1)	4.87	4.87	100
	Rig area (RA1)	27.04	0.39	1.5

Project structure and activity areas		Total Area Required (ha)	Affected Cultivated Area (ha)	Affected Cultivated area (%)
Adit 1	Labour camp (TC2)	1.02	1.03	100
	Rig area (RA2)	1.35	1.35	100
		4.83	0	0
	Permanent housing (PerH2)	0.76	0.00	0
Adit 2	Temporary camp (TC3)	6.9	6.9	100
	Rig area (RA3)	7.86	3.20	41
	Permanent housing (PerH3)	1.51	0.00	0
Power house	Permanent housing (PerH4)	13.85	12.43	90
	Sand quarry (SQ1)	4.03	4.03	100
	Temporary camp (TC4)	3.28	3.08	94
	Rig area (RA4)	5.40	3.95	73
Tail race	Rig (RA5)	1.35	1.35	100
	Spoil tip (ST1)	1.96	0.91	46
	Spoil tip (ST2)	1.35	0.96	71
	Temporary camp (TC5)	2.36	2.19	93
	Total	**104.19**	**61.04**	**58.59**

*site identification codes follow Table 4.

A total of 40.4 ha of forest land is proposed to be acquired, out of which about 36.6 ha (90.6%) will be acquired temporarily, where as 3.8 ha (9.4%) will be acquired for permanent housing (Table 21). The largest area of forest to be acquired falls within the rig area of intake site (RA1) which amounts about 24.5 ha of land. The temporary camp for the Adit 1 (TC2) and Rig area for Adit 3 (RA3) also have large areas of forest land covering 4.83 and 4.66 ha, respectively. Land cover of 36.6 ha of forestland will be disturbed and some vegetation cover will be removed while 3.8 ha of forestland will be lost to permanent housing area.

Table 21 Forest type and area in project structure and activity areas

Project structure and activity areas	Forest type	Forest Area[ha]	Acquisition type
Permanent Housing (PerH1)	Pine-Broad Leaved Forest	0.07	Permanent
Rig Area (RA1)	Broad leaved Mixed forest (60%), Hill Sal Forest (38%) and Pine-Broad Leaved Forest (2%)	24.37	Temporary
Permanent Housing (PerH2)	Broad leaved Mixed forest	0.76	Permanent
Temporary Camp (TC2)	Broad leaved Mixed forest	4.83	Temporary
Rig Area (RA3)	Hill Sal Forest	4.66	Temporary
Permanent housing (PerH3)	Broad leaved Mixed forest	1.51	Permanent
Permanent Housing (PerH4)	Hill Sal Forest	1.42	Permanent
Rig Area 4 (RA4)	Hill Sal Forest	1.45	Temporary
Temporary Camp (TC4)	Hill Sal Forest	0.20	Temporary
Spoil Tip St1 (ST1)	Hill Sal Forest	0.95	Permanent
Temporary camp (TC5)	Hill Sal Forest	0.17	Temporary
	Total	**40.39**	

2.4.1.2 Landslide Hazards

The reservoir can be divided into 3 major slope failure hazard zones. The most critical zone (zone 1) includes all the major and the most obvious slides and stretches from the dam site

to Malepu. The high-risk areas for landsides have been mapped and included as extensions of the safeguard buffer area, and will be stabilized during the constructions phase.

2.4.2 Biological Environment

2.4.2.1 Vegetation and Forestry

(i) Forested area and types

The total forested area required by the project is about 172 ha permanently. Of this, the greatest adverse impact is seen on forests that are in inundation area because it submerges 167 ha of forest. In addition about 36 ha forest area is required temporarily by TA3 HEP for temporary camps, rig, spoil tip and quarry purposes. The losses of hill Sal, mixed Sal, sub-tropical and Pine-mixed forests are 37.06 ha, 139.59 ha, 24.57 ha and 6.17 ha, respectively. The effect will be greatest in mixed Sal forest as it will lose 134.76 ha (96.5% of total forest area) of forest permanently followed by hill Sal forest of 36.33 ha (95.6%). The forest lost will be replanted as per GON regulations.

(ii) Tree numbers, volumes and diversity

The submergence of 167 ha of forest area lose 65,130 number of standing trees (>10 cm dia.). This amounts to the extraction of a volume of 3,590 m^3 of wood from all plant species. Removal of trees (> 10 cm dia.) in temporarily used forest lands is predicted to amount to 7,350 trees making up a volume of 57.3 m^3. In total, 72,925 number of trees need to be felled during construction phase. *Pinus roxburghii* and *Shorea robusta* trees have to be felled most from the construction sites. A large number of shrubs and herbs present in the project areas will also be lost.

(iii) Loss of community (CF) and leasehold (LF) forests

Altogether, 25 CFs will be directly and partially impacted by TA3 HEP mainly due to clear felling of forests and acquiring of lands for project purposes. The project will partially inundate some 17 CFs and 3 LFs. In addition, 2 patches of private forests and 4 GF connected to Tamakoshi River will also be submerged. Of the 167 ha forest inundation, CF area is about 137.3 ha (83%), LF approximately 14 ha (8%), GF approximately 9 ha (5.5%) and private forest 5 ha (3%). There are eight CF having direct impact with these activities affecting about 41.2 ha (from total of 44.46 ha excluding 167 in the inundation area) of forests.

Negative pressure on existing forests due to workforce and forest fires may occur due to influx workers, camp followers and families.

2.4.2.2 Wildlife and Birds

Adverse Impacts during the construction phase will include habitat loss, direct mortality and disturbance to animals movements, illegal hunting and intentional killing.

During the Operational Phase the impact of habitat loss and shrinkage will continue, some fragmentation of populations due to the lack of crossing possibility over the reservoir may result, illegal hunting can continue.

2.4.2.3 Aquatic Ecology and Fisheries

During the construction Phase in **Section I,** upstream the reservoir area, no construction or activities related to the TA3HEP are planned. No impacts are anticipated on aquatic life and river water quality due to TA3HEP. Migrating fish and fishery might be negatively impacted if

the diverting tunnel at the dam construction site blocks migration. Resident fish might benefit because of reduced competition.

In **Section II, III** and partly in Section IV, there will be construction of the dam, the tunnels, the power house, new/upgraded roads, spoil tip areas, sand quarry areas, rig areas, permanent housing, temporary and labour camps. The highest activity will be in Section I and II, but this will also indirectly impact Section IV. The direct and indirect impacts in these sections will be approximately the same and will be increased erosion from logging and building and operating the mentioned constructions, possible pollution from chemical spills, oil, and remnants from blasting. In the end of the construction phase the dam will fill, changing the reservoir area and reducing the flow in the two lower sections. The sum of all these impacts will be high to medium downstream the outlet of Khimti Hydroelectric Project, local concerning water quality, aquatic life, resident and midrange migrating fish and fishery, and trans-boundary for long range migrating fish. The impacts on erosion and chemical spills can to a certain degree be mitigated, possibly reducing the impact to medium in section III and section IV. The impact in section II (reservoir) will remain high due to inundation.

During operation phase the migration up- and downstream of fish and aquatic life will be blocked by the dam. Section I and partly Section II will be impacted by daily peaking activity due anticipated hydroelectric projects upstream. Health and sanitation might also change in Section I if more people move to Singati Bazaar. The impact on water quality and aquatic life can be medium to low, depending on mitigation (water quality). The impact on fish is expected to be high on migrating fish due to blockage from the dam and peaking from other projects.

In **Section II**, the reservoir, the water quality will change due to increased erosion. Further due to decomposition of organic material accumulated in the deeper strata of the reservoir, the water quality will change in the deep part (low oxygen content, release of CO_2, CH_4, N_2O and possibly H_2S), although impacts are expected to be low. The change in habitat, loss of spawning and nursing areas, daily and yearly fluctuations and flushing the reservoir and blocking of all up- and downstream migration the impact on aquatic life, fish and fishery will be direct, high and local regarding aquatic life, resident and midrange migrating fish and trans border regarding long range migrating fish. The negative impact from increased erosion will be of short term. The impact from the dam will be of long term.

In **Section III** (low flow zone) the released water flow will be approximately 2.5 m^3/s from October to June (except during flushing), and maybe a part of July. Flushing the reservoir will possibly take 10 – 12 days. This together with possible impacts from permanent housing, roads, logging and leakage from former spoil tips might impact water quality, aquatic life, fish and fishery. Reduced water flow will in addition reduce wetted area, change river habitat, spawning and nursing areas as well. This will impact the water quality, aquatic life, fish and fishery direct; possibly give a medium to high impact on water quality and aquatic life and high impact on fish and fishery. Over fishing and use of illegal fishing methods might add another threat to fish and outcome of fishery.

In **Section IV** water quality will be impacted from Section III and from the water from the power station, affecting aquatic life, fish and fishery as well. The highest impact in this section will be due to daily peaking. This will increase erosion, change habitat and lead to stranding, reduce numbers of species of aquatic life and possibly fish, reduce the biomass, reduce growth, and possibly lead to shifts in the composition of communities of aquatic life and fish. All this will affect fishery as well as the possibility to fish with for example Lahare passo. The impact will be direct/indirect, high for aquatic life, medium to high on fish and fishery and local on water quality.

2.4.2.4 Cumulative, Additional Downstream and Transboundary[8] Impacts

In the Tamakoshi basin (including its tributaries) 16 survey licences have been applied and 8 are awarded for HPP, including TA3HEP. Due to peaking in Upper Tamakoshi HEP when under operation the water quality, aquatic life, fish and fishery in Section I as well as the other sections of TA3 HEP will be negatively affected even before TA3 HEP is build. Other projects might also be built enhancing the negative impact. Additional hydropower projects exist and are planned further downstream in the Kosi River, including the huge Sapta Kosi High Dam Multipurpose Project (dam height 269 m and 3000 MW) and the Sun Kosi Storage-cum Diversion Scheme (dam height 49 m). These and other projects will block all long migrating fish species reaching the Tamakoshi River, and add to the fragmentation of aquatic life. Irrigation diversion channels (e.g. Sitali) may not be operative if new projects are developed downstream the tail race to the confluence of Sunkoshi.

Transboundary impacts due to TA3HEP are predicted to be minimal due to the location of the project and the planned and existing schemes downstream of the project. The discharge into the Sun Koshi from the Tamakoshi will be noticeable but will dampen within the Sun Koshi thus impacts further downstream are expected to be low.

Furthermore the project plans to utilize a highly mechanized construction process and the number of the labour force is expected to less than >2000. It is not expected that labour will be brought in from the riparian neighbour, India, thus the transmission of transboundary diseases (like cholera, influence, meningitis, SARs, etc.) and occurrence of epidemics is seen as minimum.

Although the transboundary impacts are predicted to be minimum or none the proponent will formally inform the riparian nations of this planned project as required international guidelines.

2.4.2.5 Global impacts

In the deeper strata of the reservoir the oxygen content will be reduced compared to the surface layers, due to the decomposition of organic matter accumulated at the bottom of the reservoir. A possible effect will be increased emission of carbon dioxide (CO_2), methane (CH_4) and N_2O, but also increased nutrients and it will possibly lead to toxic values of manganese, iron and H_2S. However, since the water quality are oligothrophic today, the turnover time of the water in the reservoir is short during the warm part of the year, with relatively longer turnover time in the part of the year that is colder, and that the reservoir will be flushed every year, the emission of green house gases is not expected to be high. Since CO2 evolution is not regarded as a serious concern in associated with dams, methane would be monitored. The overall impact is expected to be low.

2.4.3 Social, Economic and Cultural Environment

2.4.3.1 Socio-Economic and Cultural Aspects

The impacts of the proposed TA3HEP on socio-economic and cultural aspects have been grouped under the following main categories:

- Impact on household assets
- Impact on community assets
- Impacts on indigenous groups
- Impact on social and cultural values

[8] The transboundary impacts are addressed required by international guidelines for impact assessments (World Bank), although the impacts are minimum or none.

- Alterations of landscape and visual impacts
- Impacts on livelihoods

The magnitude, extent, duration and overall importance of all these impacts has been assessed both for the construction and operation phases of the project. The assessment of impacts has resulted in the identification of the following impacts of **high** importance:

Adverse impacts of high importance during construction phase
- Loss of residential housing and change of settlement locations
- Alterations or disruptions of social networks
- Alterations of connectivity
- Loss of household assets among indigenous groups
- Disruption of social networks among indigenous groups
- Alteration of cultural and religious sites
- Cultural disruption and social problems due to influx of external population
- Increased demand for housing and land
- Impacts on livelihoods due to reduced fish catches
- Loss of local business activities of Ghumukhola and Nagdaha

Adverse impacts of high importance during operation phase
- Disruption of social networks among resettled households
- Alterations in livelihood among indigenous households
- Disruption of social networks and social capital among indigenous populations
- Change in livelihood due to loss/modification in accessibility to natural resources

Positive impacts of high importance
- Generation of employment opportunities
- Generation of business opportunities

Related agricultural aspects are covered under sections on land use loss and the RRP in the mitigation chapter.

2.4.3.2 Health and Sanitation

Activities of a hydropower project affecting public health and sanitation are more related with construction phase. There are very few operation phase activities which affect health and sanitation of the project area. Some psychological impacts such as fear and anxiety to lose property, future uncertainty can arise even before the construction phase. The potential impacts of TA3 HEP are mainly related to three principally different mechanisms, which are related to the impacts outlined in the social, economic and cultural section.

- Changes in social environment bought by the project generated population influx.
- Changes in physical environment bought by constructional activities and
- Changes due to increased engineering process and exposure that change into hazardous environment.

Construction phase activities of the proposed Tamakoshi 3 HEP influencing health and sanitation are:
- Acquisition of land, house and property causing involuntary displacement of people
- Resettlement of displaced population
- Construction related activities such as excavation, blasting, quarrying, stones and aggregate crushing, hauling of materials to construction site
- Movement of vehicles, operation of heavy machinery and equipment
- Construction of access roads

- Influx of outside workforce and other immigrants in the project area
- Labor camps and contractor's camp
- Permanent Project Camps
- Scrap yards
- Hotels/Restaurants/Lodges

Operation phase activities affecting health and sanitation are;

- Creation of reservoir impoundment caused by damming
- Operation of turbines and generators in the powerhouse complex
- Increased development in the project area

2.5 Mitigation and Enhancement Measures

2.5.1 Programs and Key Plans in EMP

Specific and general measures have been proposed to mitigate impacts. Below are flows charts of the key plans in the EMP which are proposed address mitigation and enhancement measures (Figures 13 and 14). Elaboration of the key plans spanning all programs is provided after the presentation here.

Physical and biological impacts of hydropower projects can be significant and permanent and if proper mitigation is not conducted at the appropriate time consequences can be dire. Similarly, the loss of land and properties and the displacement of population from their settlement areas are probably among the major social and cultural impacts of the TA3HEP. Part of the impact mitigation process has already taken place during the project design and optimization phase. As part of the project optimization process a number of measures have been taken to minimize the social and ecological footprint of the proposed HEP. This process is part of SWECo's "Sustainable Engineering Design" which aims at procuring the best possible technical solution with the lowest ecological and social consequences.

This section provides details on mitigation and enhancement measures which from the EMP. A summary of the measures are provided in a mitigation matrix in the report, while EMP builds on them. There are five umbrella programs, which encompass thematic plans.

- Physical Environment Program
- Biological Environment Program
- Socio-Economic and Cultural Program
- Agricultural and Livestock Support Program
- Community Health and Sanitation Program

The plans within each program are listed in the respective sections in this chapter. There are however three plans placed under the Physical Environment Program which span across all programs and these are:

- Immediate Catchment Area Management and Development Plan (ICAMDP)
- Environment, Health and Safety Plan (EHSP)
- Awareness and Capacity Building Plan (ACBP)

There are also mitigation measures which are specific stand alone actions proposed and these are listed in the sections of concern in the report. The above three plans are elaborated below. Selected plans are presented in following sections. All plans are elaborated upon in the EIA.

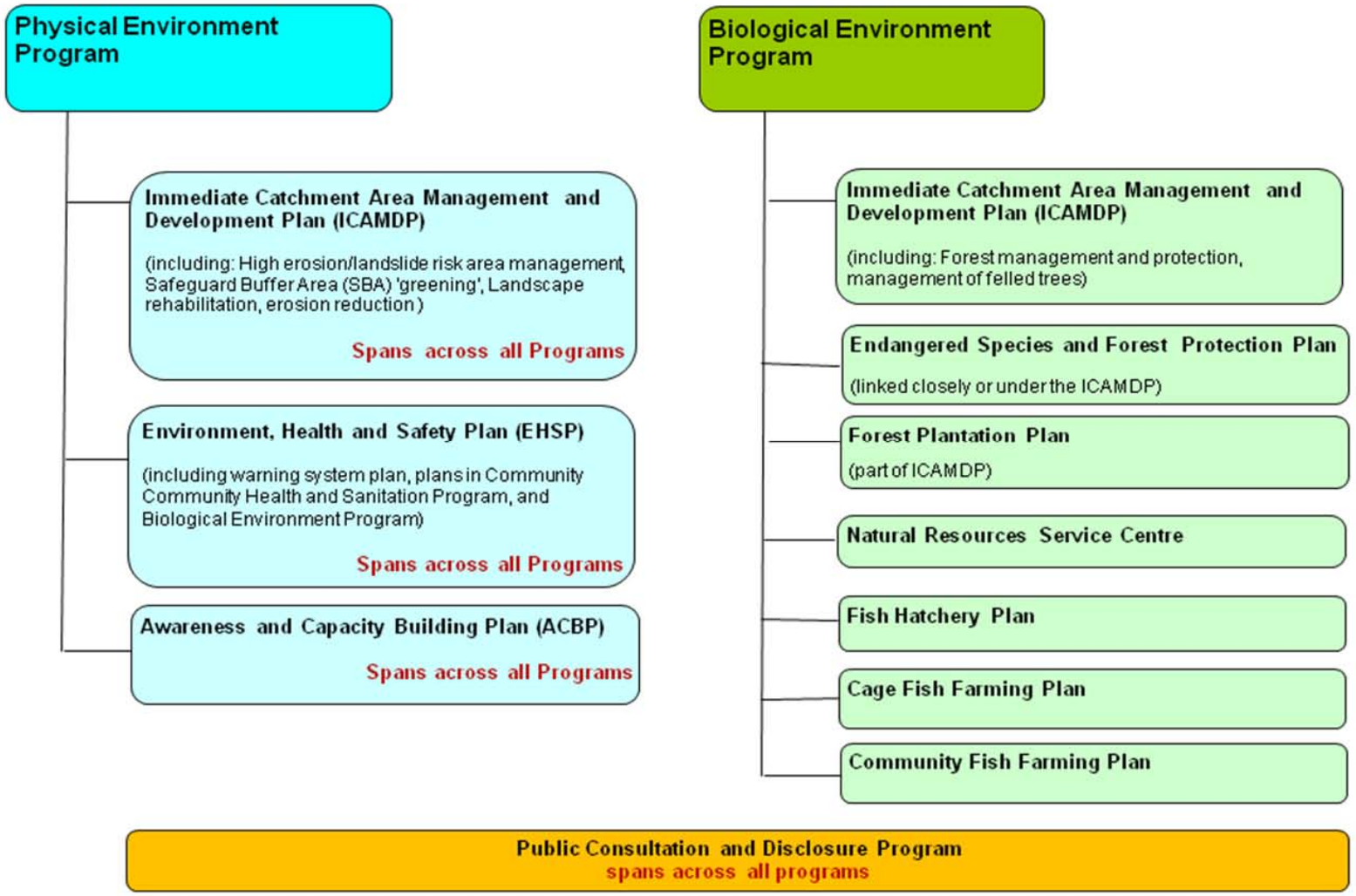

Figure 13 **Flow charts of physical and biological environment programs of the EMP**

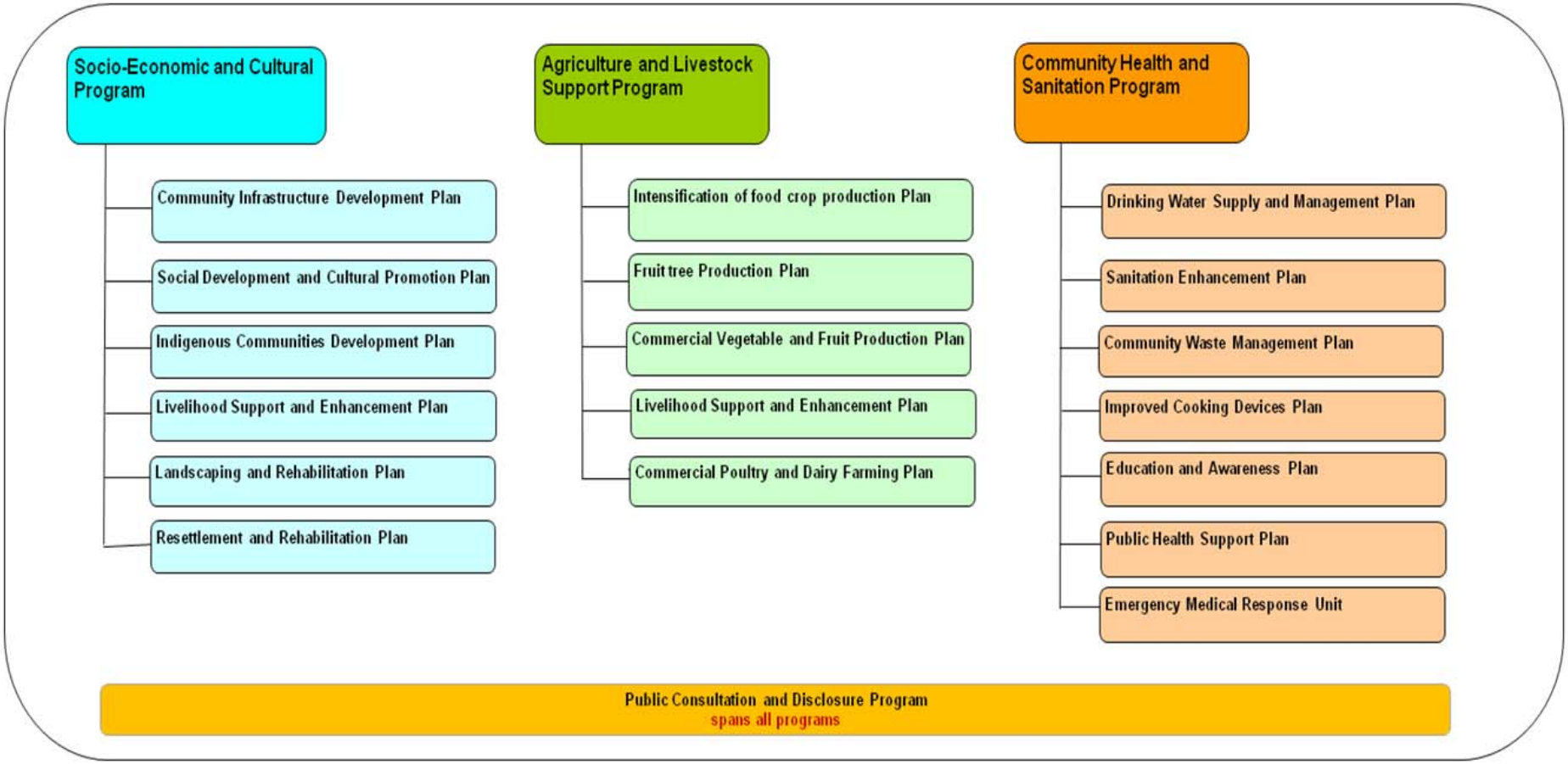

Figure 14 Flow charts of physical and biological environment programs of the EMP

2.5.1.1 Immediate Catchment Area Management and Development Plan (ICAMDP)

The maintenance of the stability and integrity of slopes of the reservoir, and the immediate catchment is essential for human safety, upland land-in-use stability, and reducing potential devastating landslides. A significant amount of investment goes into the construction, relocation and implementation of a hydroelectric project like the TA3HEP, the life of the project is dependent on the securing slopes, reducing erosion, and halting to the degree possible landslides. All mitigation extended to secure slopes and project construction and other used areas (e.g., rig areas, roads, and labour camps) will directly and indirectly increase security and conservation to natural resources and arable lands in the immediate vicinity of the project. This would foster also well being of local people. All immediate catchment conservation will contribute to watershed stability and maintain ecosystem functioning. The development and formulation of the Immediate Catchment Area Management and Development Plan (ICAMDP) is recommended. This plan spans all programs and is thus also elaborated upon, where specifically necessary, in the thematic sections that follow. In addition, for example, The Forest Plantation Plan and management of felled trees, Endangered Species and Forest Protection Plan, and the set up of a Natural Resource Service Centre will fall under the ICAMDP so that all plans/actions are coordinated under common aims of the ICAMDP. A sub-plan for roads is also proposed under this plan, the framework of which is provided below. The cost of the slope stability mitigation is included in the project costs in the feasibility study. Note that this plan will require detailed development during the pre-construction phase.

Key salient components of the plan follow. See also thematic sections for aspects to be included in this plan:

(i) High Erosion/landslide Risk Area Management.

The ICAMDP will secure the safeguard buffer area and all areas identified as erosion risk areas. In addition, it will include measures to increase landscape stability. Apart from the recommendations of the geological studies presented above forest management, protection and planting should follow established practices based on the experiences of the District Forest Office and the on-going soil conservation work in Dolakha district. Compensatory planting is also included as part of this plan and reforestation as a compensatory mechanism for lost trees is a requirement of the GON.

Presently, there are altogether 13 small and big landslides around the safeguard buffer covering 111 ha area identified as part of the geological studies. These can be considered as high risk areas to TA3HEP as these areas will be included as priority areas. There are planned more extensive studies on the geology of the project area which will further point to site-specific actions. All slope stabilization components in this plan must closely follow the prescriptions of the technical work on geology and mitigation proposed in relation to site specific mitigation recommendations. Coordination with the district forest offices is vital.

The whole catchment area of Tamakoshi River is extensive and spread over 41,171 ha area, and cannot be included in this plan. A separate large-scale plan will have to be developed to deal with the whole catchment and would require all developers and owners of HEPs in the Tamakoshi catchment to collaborate. Such a plan is thus not within the scope of the TA3HEP, which should ideally manage its immediate catchment area as a priority.

(ii) Safeguard Buffer Area (SBA) 'greening'

The concept of a safeguard buffer is to make the area completely vegetated (covered with forest and/or fruit trees) maintaining vegetation at different strata so that it will function to

reduce erosion, and infiltrate sediments before water is discharged into the reservoir. The safeguard buffer area as such constitutes many community forests, leasehold forests, government forests and private lands, and in principal the forested areas will be maintained and other where possible converted into tree covered land. The buffer area covers almost 290 ha area of which 202 ha is forest and 85 ha private land. The forest plantation plan will utilize some of this land for replanting lost forest. The proposed safeguard buffer area is thus proposed as a 'green' belt of the project/reservoir to enhance catchment stability (reduce erosion and landslides) and thus function to provide ecosystem services (e.g., forest products, soil stability, nutrient retention, carbon storage/offsets).

(iii) Road and Transport Sub-plan

A potential impact of the project is expected to be due to road traffic especially that associated with heavy vehicle movement along the transport corridors, which may require widening of roads, strengthening of bridges, special slope stabilization and erosion measures, special warning systems, land acquisition, and fulfillment of GON requirements, and acceptance by and interaction with the GON roads authorities, etc. It is recommended that transport plan be commissioned for the project at the detailed design phase looking at logistic and engineering requirements of the project, and assessing environmental and social impacts as appropriate.

(iv) Forest Plantation Plan and Management of Felled Trees

This will include compensatory plantation in safeguard buffer area, high erosion risk area, community forests and government managed forests in project VDCs and municipality. Almost 1.82 million seedlings will be planted covering about 1140 ha. There will be provision of logistic and technical support to CF nurseries.

All the felled trees and forest vegetation will be handed over to the concerned forest user groups or private owners as well as they will be paid compensatory management cost. Project will support the establishment of Fuel wood Supply Depot managed by user groups.

(v) Endangered Species and Forest Protection Plan

The endangered species and other species of high ecological value will be relocated in safeguard buffer forests and full forest plan will be developed in collaboration with the district offices. Forest protection plan will also foster the nurturing of wildlife habitats.

(vi) Natural Resources Service Center

Natural Resources Service Center will work as resource center for training project affected people in the area of natural resource use and management, nurseries, botanical and zoological center for threatened, protected and ecologically sensitive plant/animal species, and wildlife museum.

2.5.1.2 Environmental, Health and Safety Plan (EHSP)

This plan spans across all programs and sectors of the project. Health and safety is a key issue seen from both an occupational and local public perspective. An Environmental, health and safety plan should be made in compliance with World Bank group and GON requirements. This plan should be formulated during the pre-construction stage.

The plan must include, among others:

(i) setting the HSE policies and requirements for the project covering all components of the project (including project activity areas and workers,

vehicle usage, dam and road safety, waste, visitors and local people in the project area, etc);

(ii) training local persons;

(iii) ensuring subcontractors complete work to international standards;

(iv) develop processes and mechanisms for increasing environmental, health and safety awareness working across the project's programs and plans;

(v) assisting the corporate office with any other environmental, social, health or safety problems and coordinate across other plans of the project (e.g. Sanitation Enhancement Plan, Community Waste Management Plan, etc);

(vi) include or coordinate with the risk/hazard and warning plans, and evacuation planning groups of the project;

(vii) cover all safety measures for the project and

(viii) have regular drills (4 times a year) and provision of information to workers and the public. The project is expected to adopt an Environment Management System (EMS) as part of the EHSP in line with international practice.

2.5.1.3 Awareness and Capacity Building Plan (ACBP)

Capacity can be defined as the ability of individuals and organizations to perform functions effectively, efficiently and sustainably. Capacity building, or rather capacity development, should be a dynamic process building upon an existing capacity base. Human resources and the way in which they are utilized are central to capacity development, as is the overall context within which organizations undertake their functions. All plans proposed in this EIA will require the advise of experts, authorities and the training of the stakeholders, especially those directly involved in a particular mitigation or enhancement measures. The degree to which this will be required will need an assessment when each plan is drawn out. All stakeholders, including those not directly involved in mitigation measures, must be kept aware of measures implemented in the project. More importantly awareness on programs and plans in the EIA has to be done as proposed in the Public Disclosure and Communication Plan (PCDP). Awareness will also include all protocols and guidelines outlined in the EHSP and awareness campaigns will have to be carried out throughout the life of the project, with higher frequency during the construction phase. Such campaigns will include among others, for example: road safety; pollution and sanitation; forest and wildlife conservation; warning systems and drills; etc. Local communities are vulnerable and need to be prioritized in the campaigns through the use of modes of communication that can be easily understood and those that are practical. Where relevant this plan is elaborated upon in the thematic sections.

2.5.2 General Measures and Safeguard Documents

2.5.2.1 Resettlement and Rehabilitation Plan

Nepal is in the process of developing a comprehensive resettlement policy. The development projects since late 1980s have adopted their respective donor's involuntary resettlement policies. Thus, the practice so far has been to develop project specific policies and implement them so as to meet the requirements of donor agencies. The basic principle of resettlement planning is to avoid involuntary resettlement or if unavoidable, minimize acquisition of land and other property as far as possible through consideration of alternate designs in the development projects of public interest. Taking this basic principle of resettlement planning into consideration and the extent of potential loss of land and other property both private and public, a Resettlement and Rehabilitation Plan (RRP) has been prepared for TA3HEP. This plan functions as a framework for the formulation of a full Resettlement Action Plan (RAP). This attempts to highlight the extent of resettlement impact and proposes mitigation measures so that the affected households can improve their living

standard or maintain their living standard to the pre-project status. Since the precise details of land and property acquisition continue to emerge until designs get finalized, the document is based on most recent data available from the survey.

(i) The policy framework.

Land Acquisition Act 2034 (1977) is the main legislation to guide land acquisition in the country so far. It has several limitations. Thus, based on the limitations in the existing legal framework, a project-specific policy for TA3HEP has to be developed. This policy is similar to the resettlement policies developed for some of the ongoing hydropower and water supply projects such as Middle Marsyangdi Hydroelectricity Project and Melamchi Water Supply Project. The resettlement policies and principles of TA3HEP also take into account of the main features of World Bank, Asian Development Bank and International Finance Corporation.

This Project-specific resettlement policy has been prepared with the intention to provide clear information as to what entitlements to compensation, resettlement and rehabilitation assistance are envisaged for certain groups of Project-affected people. In addition to the applicable laws, the provisions of this policy will form the basis for future decisions on individual entitlements, and implementation of group-oriented mitigation or enhancement measures. Application of this policy is aimed at reaching the intended outcomes rather than just sticking to its letters. It should be reviewed regularly in a participatory process and be updated if necessary to account for the actual impacts and the arising mitigation and enhancement needs.

(ii) Resettlement impact

Socioeconomic characteristics of affected households in the inundation zone are provided in the section 2.3.3 Social, Economic and Cultural Environment. A total of 80 houses will be inundated and a number of other structures such as cowshed, firewood store, and water supply points (wells) will be lost. Among the loss of privately owned fruit and fodder trees among surveyed households banana and mangoes are the main fruit trees. Other fruits include guava and fig trees. In terms of the extent of loss of such trees Sunkhani, Jugu, Chhetrapa, Lamidanda and Bhimeshwor come out respectively.

Of the entire land loss, largest amount will be by inundation due to construction of dam and reservoir. This will be a permanent loss. A total of 424 ha will be submerged under water. Of this largest area is forest land and cultivated area comprises 106 ha. See details provided in in earlier sections.

(iii) Consultation, participation and grievance mechanism.

During resettlement survey interviews and focus group discussions have been carried out. The Local Advisory Committee or Local Consultative groups will further ensure participation. In addition to the grievance mechanism as per Land Acquisition Act, TA3 HEP management will set-up a grievance redressal mechanism. The affected persons will have the right to go to the formal Court of Law for appeal.

(vi) Income restoration strategy and institutional framework.

It is understood that Projects that resettle people productively on land and in jobs restore income more effectively, after a transition period, than projects, which hand out compensation only, without institutional assistance for resettlement. Considering this situation TA3HEP will develop two types of livelihood strategies: agriculture based strategy,

and non-agricultural strategy. Other livelihood support provisions such as subsidized inputs for agricultural, fisheries and livestock for the first two to three years or until income levels are restored and special assistance as appropriate to vulnerable groups such as women, indigenous people, the aged and the disabled will be developed and implemented.

The implementation of RRP will be carried out by TA3HEP management within the broad umbrella of Compensation Determination Committee as per Land Acquisition Act 2034 (1977). The Local Consultative Groups will be formed as necessary to facilitate the process and to address the issues of affected people locally.

2.5.2.2 Public Consultation and Disclosure Plan

To guide future consultation and engagement activities a Public Consultation and Disclosure Plan (PCDP) according to the WBG has been written. The PCDP provides details on consultations that have been conducted, stakeholder concerns, policy and regulations, key principles for planned consultations, tasks for an effective PCDP, management organization, and a grievance redressal mechanism.

The PCDP aims to:

- Identify key stakeholders and ensure there are adequate mechanisms for stakeholder feedback and information sharing;
- Carry out *meaningful consultation* for all environmental and social in the project
- Provide a framework for consultation at the local, national and international levels.
- Ensure issues raised by key stakeholders are addressed in the EIA report as well as in the project decision-making and detailed design phase;
- Provide mechanisms that ensure the formulation of the RAP based on the framework RRP prepared as part of the TA3 HEP EIA;
- Provide mechanisms that ensure the full formulation plans of the EMP
- Identify the level of resources required to implement the plan and procedures to monitor implementation;
- Outline a grievance mechanism for local stakeholders.

SNP will also build on their CSR capacity and a strong synergy will be developed between the PCDP and CSR activities. A common communication strategy and program will be developed in lines with this proposed PCDP.

2.5.2.3 Aquatic Ecology and Fisheries

(i) Mitigation during construction and operation phase

Most of the impacts in this project affecting the aquatic environment are impacting the whole freshwater ecosystem. For example increased erosion will affect the water quality, increasing turbidity, visibility and the amounts of nutrients. The increased amounts of sediments can change the habitat quality, impacting both macro invertebrates and fish. Reduced visibility will normally reduce primary production (algae and periphyton) affecting the invertebrates and fish. That which affects the fish negatively will indirectly affect fisheries. A large number of the impacts will be dealt with in the ICAMDP and EHSP.

Mitigation is proposed to reduce impact to the following:

- Erosion due to construction
- Erosion in the reservoir – during the operation phase
- Runoff from tunnel blasting and drilling, and soil and rock deposits
- Sanitary effluents and Oils and chemical spill during construction phase
- Poor water quality in the river

- Measures against accidental water release from the dam
- Loss of fish in the intake of the dam
- Rapid changes in water flow (peaking) (operation phase)
- Loss of fish due to overfishing

(ii) Environmental flow

According to the Hydropower Development Policy 2001 act 6.1.1, provision shall be made to release a quantum of water that is higher or either at least ten per cent of the minimum monthly average discharge of the river/stream, or the minimum required quantum as identified in the environmental impact assessment study report. In TA3HEP there will be a reduced flow during the operation phase downstream the dam reaching approximately 20 km down to the outlet. However, also in Section IV, all the way down to the confluence with Sun Kosi, the lowest water flow will be reduced especially in the low flow season during the 12 hours every day when there is no planned release of water from the power plant. There is low human use and reliance of the river, and the uses are likely to be sustained. Fisheries and fish species/populations will be impacted, however, fish densities are expected to stabilize after a few years as reported in Khimti Khola (tributary of Tamakoshi and site of HEP) and reported by other international studies. The EIA recommends that the TA3HEP release the minimum 10% percent requirement.

The decrease in fisheries that may occur is compensated through the proposal of three fisheries plans. The fish and river use activities as such should be monitored and if the findings reveal that the recommended release is not adequate SNP (or the operator) should be willing to adjust the minimum environmental flow. Thus, an adaptive approach should be taken in the long run. Any adjustment to the environmental flow after 3-5 years of monitoring should reflect the building blocks of a flow regime (low flows, channel flushing, habitat maintenance and spawning/migration freshest).

(iii) Loss of fish due to damming and peaking

Damming will stop up- and down migration, impacting the migrating fish species both up- and downstream the dam. In the reservoir the habitat will change from a river to a lake, and spawning and nursery areas will be lost both in the main river and in the lower part of the tributaries. Daily and yearly water level fluctuations and flushing of the reservoir will degrade the production of fish and aquatic life in general. The fish catches will be reduced due to these changes. In the low flow area the wetted area will be reduced impacting water quality, aquatic life, fish and fishery. Downstream the outlet peaking may impact the river ecosystem. To compensate for the loss of fish three actions are proposed; a fish hatchery, dams for fish production and fish cages in the reservoir (Figure 13).

2.5.2.4 Socio-economics and Culture

The loss of land and properties and the displacement of population from their settlement areas are probably among the major social and cultural impacts of the TA3HEP. Although the optimization process has selected for the locations with the least foreseen impacts the final selected project layout has social and cultural impacts as it shown in the previous chapter. In order to minimize and compensate for these negative impacts a set of compensatory and enhancement measures are described in following sections.

All mitigation and enhancement measures are organized in integral plans. These plans are integral in the sense that they integrate both compensatory and enhancement measures in specific fields aiming to improve living conditions of the population in the project influence

area. The compensatory and enhancement measures are organized into six main areas of intervention: (i) Community Infrastructure Development Plan, (ii) Indigenous Communities Development Plan, (iii) Social Development and Cultural Promotion Plan, (iv) Livelihoods Support and Enhancement Plan, (v) Landscaping and rehabilitation of highly disturbed areas, and (vi) Resettlement and Rehabilitation Plan.

The above main areas of intervention and related plans are placed under three programs: Socio-economic and Cultural program, Agriculture and Livestock Support Program, and the Community Health and Sanitation Program. These are also integrated across program plans, namely the Environmental, Health and Safety Plan (EHSP), Awareness and Capacity Building Plan (ACBP), and the Immediate Catchment Area Management and Development Plan (ICAMDP).

(i) Social and Cultural Features, and Economics

Mitigation and enhancement measures for social and cultural aspects are organized under two main Plans: Social and Cultural Promotion Plan and Indigenous Communities Development Plan. Plans under the Biological Environment Program provide provisions for fisheries enhancement and allocation of community forests.

Mitigation and enhancement measures dealing with the general economic conditions of the households and communities in the project influence area are organized under an integral Plan: Livelihoods Support and Enhancement Plan.

(a) Local Institutions and Social Services

Mitigation and enhancement measures aiming to support and improve the provision of social services and the operation of public institutions in the project influence area are organized under two main plans. These two plans are (i) Community Infrastructure Development Plan and the (ii) Community Health and Sanitation Development Plan

Physical and Community Infrastructure

Mitigation and enhancement measures aiming to support and improve the provision of community infrastructure in the project influence area are also part of the above mentioned Community Infrastructure Development Plan.

Household and Community Assets

Mitigation and rehabilitation measures dealing with directly affected households and their assets are dealt with in the RRP.

(iii) Agriculture and Livestock

The compensatory and enhancement measures are organized into following five main areas of intervention as part of the Agriculture and Livestock Support Program (Figure 14). The Livelihoods Support and Enhancement Plan (LSEP) is part of the Socio-Economic and Cultural Program and essential covers agricultural enhancement measures.

(a) Intensification of Food Crop Production Plan

This is compensatory and enhancement measure to increase food grain production through increasing productivity in the project VDCs and municipality area.

(b) Fruit Tree Production Plan

Farmers will be compensated for replacing annual crops on Bari and Pakho land with fruit trees till they start fruiting. Logistic and technical support will be provided.

(c) Commercial Vegetable and Fruit Production Plan

Farmers in potential areas will be encouraged to grow vegetables and fruits commercially. Logistic and technical support will be provided.

(d) Commercial Poultry and Dairy Farming Plan

Farmers will be encouraged to adopt commercial poultry and dairy farming in potential areas. Logistic and technical support will be provided which would also include veterinary and animal management and small scale milk processing units.

(iv) Public Health and Sanitation

Detailed measures are provided in the EIA, are included in the sections on socio-economic and culture, and are included in the Community Health and Sanitation Program and EHSP. See also plans listed in Figure 14.

2.6 Environmental Management Plan (EMP), Monitoring and Auditing

The application of mitigation measures, monitoring, and environmental audit of the proposed project have been recommended to ensure the validity of impact predication, effectiveness of mitigation measures and sustainable social, economic and cultural development of the local and adjacent community. The measures proposed are expected to be formulated in detail during the pre-construction (design phase) of TA3 HEP. A social and environmental management division has been proposed to manage and implement the proposed environmental management plan (EMP) by forming an environmental management unit under the proponent's management. The EMP will be linked to the social mitigation and enhancement measures undertaken under the same division. An organization structure and program has been proposed for the EMP and other safeguard documents.

Note that the contents of the EIA and mitigation measures may change after the public hearing is held.

2.6.1 Costs of EMP

The costs of mitigation and enhancement measures as well as monitoring in the Environmental Management Plan are estimated at NRs 3.15 billion (US $ 39.5 million). About 68% of the total costs are for socio-economic and cultural program including resettlement and rehabilitation, community infrastructure development and livelihood support and enhancement program followed 10% for forestry, 8% for physical aspects, 6% for fisheries, 4% for agriculture and livestock, 3% for community health and sanitation, and 1% for wildlife. The costs are further broken down for the construction and operation phases, where relevant, and according to plans. Detailed costs will be worked out during the pre-design phase.

2.7 Conclusion

The TA3HEP is planned along a stretch of the Tamakoshi River between Singati Bazaar down to Tamakoshi Bridge at Kirnetar. The technical feasibility of the project has been

performed in the range between 600 MW and 1320 MW. However, the planned project is licensed for 600 MW. The main anticipated impacts of the project include:

(i) the loss of land and assets of project affected people due to land permanently acquired by the project,
(ii) resettlement and social change,
(iii) changes in the river affecting aquatic life and fisheries,
(iv) increase in slope instability and erosion,
(v) loss of forest and habitat fragmentation.

Mitigation and enhancement measures as part of the environmental management plan are proposed to minimize impacts and enhance community well being and economic opportunities through, among others, plans for immediate catchment management, reforestation of a safeguard buffer area bordering the reservoir, health and safety measures, fisheries, and the provision of livelihood enhancement support. The measures will help minimize the ecological footprint of the project. Safeguard documents include a Resettlement and Rehabilitation Plan and an Environmental Management Plan guided by a public consultation and disclosure program. An adaptive management process should be adopted to adjust plans according to findings from monitoring, consultations, and audits. A Social and Environment Division (SEMD) of SNP will administer the EMP through the establishment of an Environmental Management Unit (EMU).