Upper Trishuli-I Hydroelectric Project (216MW)

Environmental Impact Assessment (EIA) Study Report

Volume I: MAIN CHAPTER

Submitted To:
Ministry of Environment
Through
Department of Electricity Development
and
Ministry of Energy
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NEPAL WATER-ENERGY DEVELOPMENT COMPANY

June, 2012

Comments from Ministry of Energy

S.N	Comments from Ministry of Energy/Environment	Response from Developer/ Consultants		
		Where incorporated:	What are the changes made:	Remarks:
1	In the subchapter with heading "Rational of Conducting EIA Study", describe in detail also, about how much land of forest will be acquired for the project: The total forest land requirement shall also encompass land required for overall project access, and project component access, in addition to the forest land requirement for project structures/components/facilities.	Refer Sub chapter 1.6, Paragraph 1, last sentence. Page no 71	The project will require acquisition of 27.20 ha forest for implementation and thus, also attract schedule 2, pertaining to rule 3 of article A of 4 to undergo EIA process	
2	Approval dates of Scoping and ToR by the Ministry of Environment mentioned in subchapters 1.2 and 1.7 are different. So, put the right date. Moreover, mention also about the previous approval of Scoping Document and ToR.	Refer Sub chapter 1.2 of page no 2	The Ministry of Environment had approved the supplementary ToR and Scoping Document for new enhanced project capacity of 216 MW on 2068/6/5. ToR and Scoping documents for 75MW was approved on 2066/12/16	
3	Put an opening paragraph in Study Methodology and discuss/state that study has been carried out based on approved TOR.	Refer Chapter 2, Opening paragraph page no 74	The EIA study of Upper Trishuli -I Hydroelectric Project (216 MW) has been basically carried out by referring approved Terms of Reference	
4	Check whether data are collected as directed by the TOR, as identified in chapter on TOR-Data Requirement.	Refer Chapter 2 page no 74 to 83	The data has been collected as directed by approved ToRs.	
5	Add a section under heading "Time, Cost, and Study Team". Give EIA time schedule in the form of a bar-chart. Provide the Name, Field of Specialization, and Contact number (mobile number is preferred) of the study team members, including team leader/coordinator	Refer Sub Chapter 1.8, 1.9 and 1.10 page no 71 to 73	The time schedule cost of EIA and study team has been provided as per the suggestion.	The mobile number is entirely a personal matter of individual and a matter of privacy and Thus, the mobile number of study team member could not be

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	and subject specialists involved in the study.			provided on this moral view.
6	Write names of VDCs in Nepali font as well, where they first appear in the report.	Refer Sub chapter 1.3, page no 69	Name of project affected VDCs in Nepali script has been incorporated as suggested	
7	If the proponent of this project is building a new access road or just upgrading the existing roads (either Overall Access, or Project Component Access, or Both) and if such road is not located in the VDC/s quoted in the Survey License then the additional VDC/s shall be included in the license. If access roads are part of the project construction, then specific issues and impacts related road construction shall be adequately addressed.	Refer Sub chapter 3.3.1.2-a , page no 92	The project is constructing 12.54 km long access road from Gogane village to headworks and surge shaft.	
8	It shall be explicitly mentioned that the study is valid only for hydropower generation excluding T/L and access road (access road if is part of the study then remove from the statement) components.	Refer Sub chapter 3.3.1.1-o, Paragraph 2 page no 92	It has been written that a separate study 'Initial Environment Examination' is needed for transmission line and this Environmental Impact Assessment study is for hydropower component only	
9	In subchapter 3.1, in a clear and simple manner write the names of VDCs situated in the left and the right banks starting from upstream of the headworks up to where the backwater reaches till the point of tailrace meeting the river.	Refer Sub chapter 3.1, opening paragraph page no 84	It has been written that Dhunche and Ramche VDCs are located at left bank of Trishuli River where as Haku VDC is situated at right bank of Trishuli River. Similarly, the detail of locations of all project structures and facilities has been provided.	
10	Prevailing law requires only IEE for Transmission Line of 132 kV but that described under the heading Transmission Line in page 35 is not correct. Make necessary corrections.	Refer Sub chapter 3.3.1.1-o, Paragraph 2 page no 92	It has been written that a separate study 'Initial Environment Examination' is needed for transmission line and the previous provision of EIA for the study of transmission line has been omitted	

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11	Area of land required given in Tables 4 and 5 are not the same. Correct the mistake and check for such shortcomings elsewhere in the report.	Refer subchapter 3.3.2.1, opening paragraph and Table No 3.2, page no 94 to 98	The query has been corrected. The project will need 104.45 hectares of land for the construction and implementation of the project The acquisition of permanent and temporary land will be 47.58 hectares and 56.88 hectares respectively.	The land requirement has been changed in this revised report. The necessary corrections have been made in other chapters as well.
12	Give presentation on Construction planning which shall cover the following as well:			
	Construction vehicles/equipment to be used (dozers, hauling trucks, excavators, tunneling equipment, service vehicles,) and their parking facilities	Refer subchapter 3.3.2.3 , paragraph one and Table 3.3, page no 99	The suggested comment has been incorporated	
	All the toxic chemicals including acid, petroleum products, batteries - type, tentative amount, storage location, where to use and for what purpose; brief of disposal plan.			
	Explosives – tentative amount to be used and where; storage and handling; management of safety and security; where to use?			
13	In the opening paragraph of chapter 3, it shall be mentioned that "The proponent will abide by any other laws besides those already mentioned in the documents that are attracted due to various activities that will be undertaken during project implementation".	chapter 9, Opening paragraph page no 340	It is written that the proponent will abide by any laws beside those already mentioned in the documents that are attracted due to various activities that will be undertaken during project implementation.	The chapter 3 is now transformed into Chapter 9 as per EPR, Schedule-6 (Pertaining to Rule 7)
14	It is suggested that review of documents (in chapter 3), as applicable, shall cover the presented as follows:	Sub chapter 9.1.1 to 9.5.3 of page no 269-285	All the hydropower related rule & regulation are mentioned in subchapter 9.1.1to 9.5.3 not in chapter 3	
	Legislations/strategies/policies shall be	Subchapter 9.4.1 to	Chronological order has been followed.	

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	presented in chronological order of their enactment.	9.4.9 of page no 280 to 283 page no		
	The order of keeping legislation shall be Constitution; Act; Regulation; Strategy/Plan/Policy; Convention; Guideline, Guide; and Manual.	Subchapter 9.5.1 to 9.5.3 of page no 283 to 285	The order has been corrected according to the comment.	
	Give the year of enactment/promulgation of legislation and policy in BikramSambat. Whereas, corresponding year in A.D shall be given in parentheses.	Subchapter 9.5.1 to 9.5.3 of page no 283 to 285	The year of enactment/promulgation of legislation and policy in BikramSambat and their corresponding year in A.D has be given in parentheses.	
	Very brief discussion on Articles, Clauses, Rules, Chapters, and Sections that are attracted to the study and project/proposal implementation.	Subchapter 9.5.1 to 9.5.3 of page no 283 to 285	A brief discussion on Articles, Clauses, Rules, Chapters, and Sections that are attracted to the study and project/proposal implementation has been incorporated	
	State how the provisions, that are relevant and are mandatory to the study process; and that are relevant and are mandatory to the project implementation, are observed and followed in– the study, mitigation measures/planning, and construction & operation.	Chapter 9 subchapter 9.1.1& 9.2.1 of page no 268 & 273	All the mitigation measures for planning, and construction & operation phases according to environmental sectors have been mentioned.	
	Any provision that hinders the project implementation shall be identified and discussed with possible way out for easement.			There are no provisions that hinder the project implementation.
15	Carry out the following in chapter 1:			
	Identify and state the source of all data and information given in the report. If the source is field surveys, state year and specific methodologies used; and if source is published report or literature then cite it in the main text and include in the reference list. Any statement	Refer all chapters		Source of data of incorporating information has been mentioned simultaneously with given information.

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	and data whose source has not been identified will not be accepted. Presentation shall not imply that everything in the report is the outcome of study conducted by the study team.			
	While discussing about "EXISTING LAND SLIDE AND SLOPE STABILITY CONDITIONS"in and around headworks/settling basin; canal/tunnel, audit-tunnel and portals/fore-bay/surge-tank/penstock, powerhouse, quarry, and disposal sites also, discuss likelihood of triggering instabilities due to construction activities while discussing impact and propose adequate mitigation and avoidance measures with suitable indicators for monitoring.		The impacts associated with existing landslide and slope stability and mitigation and avoidance measures have been discussed in the mentioned chapters as suggested.	
	In subchapter 4.2, add a sub section under the heading of "Mineral occurrences in project area" (if is found applicable). Discuss mineral occurrence in regional context as well as likelihood of finding in project area during construction. Minerals shall be classified in terms of economical and non-economical minerals.			The finding of mineral occurrence is not envisaged in the project area and thus not addressed.
16	In the baseline information on biological environment, present existence and type of vegetation, NTFPs, plants of conservation significance, and ethno-botany in project construction sites, project component access road corridor, camp sites, quarry sites, and disposal sites, and location of other ancillary structures.	Refer chapter 4, Sub chapter 4.2.1.1 , 4.2.1.2, 4.2.1.3, 4.2.1.4, 4.2.1.5, 4.2.1.6, 4.2.1.7 of page no 128 to 147, Annex 4.1, 4.2, 4.3, 4.4, page no	The suggested comment related to the type of vegetations, NTFPs, plants of conservation significance, and ethno-botany in project construction sites, project component access road corridor, camp sites, quarry sites, and disposal sites, and location of other ancillary structures, has now been presented in the mentioned subchapters.	

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17	Description on Wildlife Habitat shall be (at both places where project components are located and surrounding area at least extending to watershed boundary) pertaining to:-			
17.1	Site Description (Water body/holes, Vegetation cover, Ground and soil/rock features),	Sub chapter 4.2.2.1, 4.2.2.2, 4.2.2.3, 4.2.2.4 of page no 148 -166, 4.2.2.5, 4.2.2.6, 4.2.2.7. page no 169-188	The Water body/holes, vegetation cover, ground and soil/rock features, important Habitat Type/Features– Tree/Herb/Shrub/Epiphyte/others, Habitat Use–a) Active/Temporary/Migratory Corridor; b) breeding/feeding or hunting/resting/, and others, Habitat Continuity, Habitat Connectivity, State of habitat in terms of– Degradation/Fragmentation/Human encroachments has been included into the mentioned subchapters.	
17.2	Important Habitat Type/Features– Tree/Herb/Shrub/Epiphyte/others,	"	"	
17.3	Habitat Use–a) Active/Temporary/Migratory Corridor; b) breeding/feeding or hunting/resting/, and others,	"	"	
17.4	Habitat Continuity	"	"	
17.5	Habitat Connectivity	"	"	
17.6	State of habitat in terms of– Degradation/Fragmentation/Human encroachments.	"	"	
18	Discuss in brief, existing and future projects and programmes of [National Park/Buffer Zone] both in the project as well as surrounding area. If there are any, they have to be discussed in sufficient detail to help identify the influence			During interactions with LNP officials during EIA study, there were no programmes as such in the project construction area.

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	from the project.			However LNP has demanded some programmes from UT-I HEP which is addressed in Environmental Enhancement Programmes
19	Since there will be more than 9 km long tunnel built, identify and state existence of water/spring sources and their use (with number of Households and number of people) by the community in the baseline chapter. In impact and mitigation chapters, discuss the likely impacts due to their drying up and propose mitigation/avoidance measures respectively.			There is not existence of water/spring sources along the tunnel alignment; thus, the impact has not been addressed.
20	Subchapter 4.11: Existence of following within the project and in the vicinity shall be given with approximate distance to them from project structures/ancillary-structures/facilities/activities/project component access. For underground project structures like – tunnel, audit tunnel, surge shaft, and power house – vertical as well as horizontal distance shall be given. The information shall be sufficient to help identify impacts.			
20.1	Houses and Settlements	Chapter 4, sub chapter 4.1.20- page 125-126	The horizontal and vertical distance of the settlements, namely; Hakubesi- Phulbari and Gogane is given.	
20.2	Educational institutions: schools colleges.	Chapter 4, sub	The horizontal and vertical distance of the	

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		chapter 4.1.20-page 125-126	settlements, namely; Hakubesi- Phulbari and Gogane is given.	
20.3	Health institutions			No health institutions exist within the project construction site so the impact has not been addressed.
20.4	Sources of – energy(firewood), fodder			The tunnel constructions will not have any impacts on sources of energy (firewood), fodder so has not been addressed.
20.5	NTFP's source and production			The tunnel constructions will not have any impacts on sources of NTFP and production so has not been addressed.
20.6	Local water related infrastructures: source (presentation shall clearly identify use of same source as proposed hydropower project or use of side streams) and infrastructures of – local water supply, irrigation, micro-hydro, water mill	Refer subchapter 4.1.18, page no 125	The mentioned local water related infrastructures will not be affected by the project.	
20.7	Other local infrastructures: communication, transport (foot trails, trekking trail)			Other local infrastructures: communication, transport (foot trails, trekking trail) will not be affected so has not been addressed.
20.8	Cultural/Religious/Archaeological/pilgrimage sites			Cultural/Religious/Archaeological/pilgrimage sites will not be affected so has not

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				been addressed.
20.9	Community services centres, Cremation sites, local market	Refer subchapter 4.1.18, page no 125	A cremation site is practiced by local Dalit of Haku VDC.	
20.10	Village, District, or National Roads			No Village, District, or National Roads exist within the project construction site so the impact has not been addressed. The road to be acquired by the project for switchyard, access road, quarry, spoil & muck disposal sites are the connecting road with the project and preliminary excavation has just started and is related to the project accesss road.Thus, a separate impact is not considered.
20.11	Public/government institutions			Public/government institutions do not exist within the project construction site so has not been addressed.
21	Subchapter 4.14.9: Existence of cremation sites should have been identified with specific location and usage by people in the affected VDCs with reference to the project component. Give the number of HHs and population using the cremation sites.	Refer subchapter 4.1.18 page no 125	It has clearly been mentioned that the cremation site is located the foothill of Hakubesi-Hakubesi-Fulbariand it is being used by 8 households, 50 people.	

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22	Subchapter 4.15.9: Existence of micro-hydros/watermills/irrigation schemes utilizing river water concerned with the proposed project and if they other than concerned with the proposed project as well as their proximity with the project activity and structures. Discuss impacts in chapter on impact, if imparted, (obstruction/hindrance, damage, destabilization, and etc..) to those structures from the project components and construction activities, and propose mitigation/avoidance measures accordingly.	Sub chapter 4.1.18 of page no 125	It has clearly been mentioned that no micro-hydropower, water mills, irrigation schemes utilizing the Trishuli river exists, within the stretch from the headworks to tailrace.	
23	In chapter 5, impacts shall be categorized according to construction phase and operation phase for all three environments: physical, biological, socioeconomic and cultural. Furthermore, impacts shall be classified according to 'magnitude', 'extent', and 'duration', which at present is not followed.	Refer Sub chapter 5.1.1, 5.1.2, 5.1.3 of page no 229 to 281, table no 5.1, 5.11, 5.21	The chapter is categorised according to construction phase and operation phase for all three environments: physical, biological, socioeconomic and cultural. Furthermore, impacts have been classified according to 'magnitude', 'extent', and 'duration'.	
24	Impact discussions are generic in nature and insufficient and by no means to do any justice, in terms of detailing, to the components/features of the proposed project. Mostly they have no bearing on project specific impact and characteristics and sensitivity of existing environment. The whole chapter needs revision to present appropriate measures for all the impacts described.	Refer chapter 5, page no 229- 285	The whole chapter has been revised as per suggestion with present appropriate measures for all the impacts described	
25	Table 137 (page 197) shows land requirement according to temporary and permanent basis,	Refer subchapter 3.3.2.1, Table 3.2	The land requirement for both temporary and permanent basis has been revised	

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	which is also given in Table 5 (page 37), but the results are different in the two tables. Total land requirement should be the same. Clear the confusion.	page no 94 -98		
26	Impact on land use change in subchapter 5.2.12: Agricultural land could be categorized according to khet, bari, and pakho.) for each of the project structures and ancillary facilities. In addition, also account loss of top soil from agricultural land. While accounting the loss give emphasis to – land productivity, top soil quality, nutrient content, and amount of loss.	Sub chapter 5.1.1 point 1, table 5.1; page no 229, subchapter 5.1.3.1 point 1 table 5.12, page no and 5.13; page no 265-266 subchapter 5.1.1.1 point 13, page no 230	The impact on land use is now presented in table 5.1 for each of the project structures and facilities. Similarly, the agricultural land is categorised as (khet, bari and pakho) for both permanent and temporary acquisition of agricultural land in table 5.12 and 5.13. The impact of loss of top soil from agricultural land has been addressed in physical environmental impact.	
27	Loss of top soil, particularly from agricultural land (both in temporary and permanent acquisition) shall be considered as an impact. The impact description shall fully account the loss from permanent and temporarily acquired land separately with – top soil loss area, total volume, loss of fertility, etc. In the mitigation chapter, associated mitigation measures shall be proposed: Mitigation could include – collection of top soil, keeping at safe place (location shall be identified), protection from washout, restoration of temporary land before handover, applying the remaining top soil at places upon request by the local people.	Refer subchapter 5.1.1.1 point 13, page no 229 and subsection 7.1.1 table 7.1 (S.N. 1.13.1 and 1.13.2) page no 291 -304	The impact of loss of top soil from agricultural land has been addressed in physical environmental impact and the mitigation of the same has been addressed.	
28	Muck should not be simply dumped at the river bank for river training. Propose with measures	Sub chapter 7.1.1, Table 7.1 (S.N 1.3.1,	The project has planned appropriate mitigation measures for the proper disposal of spoil and	

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	that ensure disposed muck (could be in river training works) are not eroded with retaining walls, benching, drainage, and plantation. Propose making disposal site green by planting suitable vegetation and where possible handing over to community by proper land development. Work out the required cost.	1.3.2, 1.3.4, 1.3.5, 1.1.3) page no 291-304	muck. For the disposal of spoil and muck near the river, the project has prepared a muck and spoil disposal management plan. The provision of handing over of the spoil and muck disposal sites by proper land development is also mentioned in contract Bid document and project civil cost.	
29	Not all the tables for accounting loss of forest and vegetation (in Appendix 15) are present. Some are missing, and thus, those missing ones shall be included.	Annex 5.1(Forest Resource Data Presentation)	The suggested tables have now been incorporated	
30	Number of trees to be cut down mentioned in subchapters 5.3.1 and 5.3.3 (pages 203 and 205 respectively)and that given in Table 187 are not the same. This value should be equal. Information presented in the report should be consistent. Check the whole report for all the inconsistencies present.	Refer sub chapter 5.1.2.1 point 10 a, table 5.8 page no 252-256	Now, it is written that the project will require clearing of 12001 tree species (seedling -4858, sapling-2346, Pole-3880, tree-917) of about 30 plant species. The necessary corrections related to the same have been done wherever necessary.	
31	In 5.3.9, discuss all possible impacts on Langtang National Park and Buffer Zone due to eased access through dewatered zone. In addition, discuss any influence on the park and buffer zone management activities, both existing and planned ones.	Refer to sub chapter 5.1.2.1. point 6; 269	The envisaged impacts related to Langtang National Park and its buffer zone is presented.	
32	Cary out the following in subchapter 5.4:			
32.1	Agricultural land loss accounted in Table 137 both temporarily and permanently should be reflected in subchapter 5.4.12. Agricultural land loss given in the subchapter does not tally with the figures of Table 137. Differences in data	Subchapter 5.1.2.1 point 1, Table 5.12, , 5.13 page no 265-266 and subchapter 3.3.2.1, Table 3.2	The establishment of project structures and facilities will result in total loss of 21.75 hectares of private agricultural land belonging to 41 households. Of this total acquired land, the permanent and temporary loss of	

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	shall be corrected. Also, it is not necessary to mention here about forest/vegetation land loss.	page no 94-98	agricultural land will be 9.35 ha and 12.40 ha. The land requirement of agricultural land of tables 5.12, 5.13 with respect to Table 3.2 are now similar. Loss of forest / vegetation land has not been mentioned.	
32.2	Loss of agricultural land, loss of agricultural production (regular and/or cash crops) in temporary and permanent acquisition shall be fully accounted for, which is currently lacking in the subchapter. To give full account of impact use data and information from the attached tables.	Refer subchapter 5.1.3.1 point 1, Table 5.12, 5.13, 5.14, 5.15, 5.16, 5.17 pageno 265-267	The loss of agricultural land is presented. Similarly, the loss of agriculture production of commonly grown cereal and cash crops of irrigated and non irrigated land is also presented.	
32.3	Given the content in 4.14.9, there is no impact on cremation sites described. Discussion shall be based on the information that clearly states how the impact is felt–i.e., physical damage, unavailability of water, reduction and prediction of water depth at the sites, etc. Appropriate mitigation and avoidance measures must be identified in respective chapter. If needed, additional water release shall also be proposed.	Refer subchapter 4.1.18, page no 125 sub chapter 5.1.3.2 point 3, sub chapter 7.1.3 (S.N. 2.3.1, 2.3.2, 2.3.3) page no 330	The reduced water flow in operation phase will affect the cremation site of Dalits of Hakubesi-Fulbari. The mitigation measures related to impact on cremation site is now presented.	
32.4	Total land required written in subchapter 5.4.12 is incorrect compared to that calculated in the tables (Table 137 for example).	Refer subchapter 3.3.2.1 Table 3.2 page no 94-98	The land requirement is corrected in all the chapters and subchapters as per Table 3.2	
32.5	Impact-Mitigation matrix shall be presented in table.	Refer chapter 7 page no 291- 331	All the mitigation measures related to all environmental impact is now presented in tabular form.	
32.6	Impacts on houses and settlements above the tunnel alignment/axis: Impacts on houses and settlements above tunnel alignment should	Refer sub chapter 4.1.20, page no 125-126 subchapter	It is clearly written that the tunnel is located more than 150 m. below settlement area.	The tunnel constructing work will not have any impact on house

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	have been discussed in the report; however, that has not been even attempted despite such impact has been identified in the approved TOR. The impact on houses and settlements shall be based on: methodology of tunnel construction, structural and geological features of tunnel, geological characteristics and rock mass characteristics, amount of blasting charge, and vertical as well as horizontal location of tunnel axis with respect to the houses and settlements on the surface. Impacts shall be coherent with related information/discussion in baseline; check earlier comment for baseline.	5.1.1.1 point 2, page no 233, subchapter 7.1.1, Table 7.1 (S.N. 1.2.3 and 1.2.4) page no 293		structures. However, the project has considered impact due to blasting activities to house structures near tunnel adits and has proposed the mitigation for the same.
32.7	Impacts on spring sources lying above and/or around the headrace-tunnel/ audit tunnel/access tunnel/tunnel portals/underground surge shaft and power house: Discuss impacts (likelihood of drying up of sources) by identifying sources of spring used by local people for irrigation and drinking water. The discussion shall be based on location of tunnel axis below such sources considering both lateral and vertical distance. Impacts shall be coherent with related information/discussion in baseline; check earlier comment for baseline.	Refer Sub chapter 4.1.20 page no 125-126		The impact on ground water and spring is not adhered. Thus, any impact related to spring sources by the underground excavation works is not considered.
32.8	Impacts on watermill are not accounted for though baseline information talks about such structures. Impacts shall be coherent with related information/discussion in baseline.	Refer Sub chapter 4.1.18 page no 125	The existing water mills and micro hydropower are operated through the local streams and are not dependent on Trishuli River.	Thus, the impact on water mills is not accounted in the study.
32.9	Cumulative impact not only arises due to many	Refer chapter 5, 7		The suggested impacts

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	projects of similar nature, but also arises from within the project as well. The cumulative impact of this project shall be assessed as a result of impacts from different project structures, components, facilities, activities, at various locations: (For this quantified assessment is required); if it is related to the resources used/lost, then it must be compared with the available resources in the area/region.	and 10 page no 229-285, 291-333, 356-417		resulted from different project structures, components, facilities and activities at various locations are assessed in this revised write-up though not given the name as cumulative impact. The associated impacts related to the same are also addressed in mitigation measures and Environmental Management Plan.
	i) aquatic environment (fish migration, loss of spawning area, loss of habitat);			
	ii) loss of vegetation/forest resources including NTFPs/animal habitat;			
	iii) loss of listed species of flora and fauna;			
	iv) likewise, loss of agricultural land, food/agricultural production, and food security ;			
	v) Degradation of river water quality (due to construction activities, likely sources of pollutants from camp/disposals/support facilities, reduction of river water discharge in the dewatered zone);			
	vi) Possible impacts on Langtang National Park and Buffer Zone due to eased access through dewatered zone.			
33	Carry out the following in chapter 6:			
33.1	In "construction material alternative" discussion should have been based on: use of forest resources as timber and fuel wood, source/"quarry location" of construction materials {cement/aggregates (coarse and fine),	Refer sub chapter 6.7 of page no 289	The suggested alternatives based on use of forest resources as timber and fuel wood, source/"quarry location" of construction materials {cement/aggregates (coarse and fine), steel, and others.} has been presented	

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	steel, and others.}.			
33.2	Also, discuss suitability of either fish pass or fish ladder based on the type of species present in the river, and propose a suitable option as a mitigation measure for barrier effect on migratory fish species.	Refer Sub chapter 7.1.2, Table no 7.2 (S.N. 2.1.1) of page no 314	The fish ladder is proposed for mid distance migratory fishes such as *Schizothorax richardsonii* and *Schizothoraichthys progastus.*	The fish ladder is a illustration of fish pass.
33.3	Discussion should also be made for 'no forest option'.	Refer subchapter 6.6 of page no 289	No forest option is presented	
34	Carry out the following in chapter 7:			
34.1	The content of chapter-7 should reflect commitment from the developer. Do not consider writing in recommendatory tone.	Refer chapter 7 page no 229 -285	All the mitigation measures currently proposed for the environmental impacts reflects commitment from the developer.	
34.2	State in the beginning of the chapter: "Adverse and beneficial impacts that are not identified or pretermitted during the study if later discovered during the construction and operation phases will be mitigated or enhanced by the proponent." and "Proponent will compensate the affected parties for losses of lives or properties due to the implementation of the project as per prevailing law."	Chapter 7, para. 1 page no 291	The mentioned sentence has been included in the opening paragraph.	
34.3	Mitigation measures and enhancement measures shall be presented in the same order as the impacts are presented in chapter 5. Moreover, all the impacts (adverse and beneficial) described in chapter 5 shall be proposed with measures - mitigation and enhancement.	Refer Chapter 7 and 8 page no 291-333, 334-338	The mitigation measures are proposed as the same order of impacts mentioned in chapter 5. However, the enhancement measures proposed in chapter 8 are based on the development aspirations of the local people and community. Moreover, mitigation measures for all the impacts are presented.	
34.4	It is not necessary to describe issues here in the chapter. Furthermore, mitigation measures and	Chapter 7,	Impacts related to environmental issues mentioned in ToR are currently presented.	

S.N	Comments from Ministry of Energy/Environment	Response from Developer/ Consultants		
		Where incorporated:	What are the changes made:	Remarks:
	enhancement measures shall be presented according to construction phase and operation phase for 'Physical Environment', 'Biological Environment', and 'Socioeconomic and Cultural Environment'.		Mitigation measures have been presented as per suggestions. However, the proposed enhancement measures are basically related to socioeconomic and cultural environment thus are not separated into three environments.	
34.5	Presently the mitigation measures and enhancement measures described are all mixed up. Those two shall be presented in separate sections.	Refer chapter 7 and chapter 8 pageno 291-333 & 334-338	The mitigation measures and enhancement measures are now separated and mentioned in separate chapters.	
34.6	Section-7.5.5 does not give any mitigation or measures to reduce impacts/threats/pressure on LNP and Buffer Zone. Consider earlier comment on impacts on National Park. Check allocation of required cost.	Refer sub chapter 7.1.2, Table 7.2, (S.N. 1.2.3, 1.2.4, 1.2.5, 1.2.6, 1.2.7, 1.2.8, 1.2.9, 1.2.13, 1.5.1, 1.5.2, 1.5.3, 1.5.4, 1.6.1,1.6.2, 1.9.1, 1.10.1,2.2.7, 2.2.8, 2.2.9, 2.2.10) page no 305, 307, 308,309, 310, 312, 313, 316	The revised study has tried to incorporate all the mitigation measures related to foreseen impact on LNP and its buffer zone.	
34.7	To overcome any adverse impact by the project, the proposed measures shall be categorized as – i) AVOIDANCE, ii) PREVENTIVE, iii) MITIGATION, AND iv) COMPENSATORY MEASURES. Since, all the impacts may not need all four measures, measures shall be proposed based on the nature of environmental impacts and components of environment that is affected. For avoidance and Preventive measures, propose	Refer Chapter 7 page no 291-333	The proposed measures related to the mentioned comments have been addressed.	

S.N	Comments from Ministry of Energy/Environment	Response from Developer/ Consultants		
		Where incorporated:	What are the changes made:	Remarks:
	how their implementation or compliance will be ensured during project construction and operation.			
34.8	Steps and measures to ensure necessary co-ordination, required in implementing Preventive, Avoidance, and Mitigation Measures with–local, district and central level institutions should be identified and proposed. (in a separate subchapter)	Chapter 7 page no 291- 333	The related institutions for the implementation of mitigation measures has been included such as LNP, district forest office, district police office, local VDCs , DDC, etc.	
34.9	State how Preventive, Avoidance, and Mitigation Measures that are identified in the report which fall under the responsibility of the contractors are incorporated in the tender document and their compliance is assured. (in a separate subchapter)	Refer Chapter 7 , Table 7.1, 7.2 and 7.3 (mitigation costs and remarks) page no 291-333	The responsibility of the contractor is clearly mentioned.	
34.10	Proposed mitigation measures are too generic in nature and insufficient and by no means to any justice, in terms of detailing, to the components/features of the proposed project. Most of the mitigation measures have no bearing on project specific impact and characteristics and sensitivity of existing environment. Please refer observation on impact chapter stated above, and come up with project specific mitigation measures.So, the whole chapter needs revision to present appropriate measures for all the impacts described.	Chapter 7, page no 291-333	The write-up of the whole chapter has been revised as per the mentioned comment. And has been carried out as per the environment impact chapter"(chapter 5)	
34.11	"वन क्षेत्रको जग्गाअन्यप्रयोजनको लागिउपलब्ध गराउने कार्यविधि, २०६३"Shall be followed while	Refer sub Chapter 7.1.2, Table 7.2 (S.N.	The mitigation measures have been proposed as per the mentioned forest guidelines.	

S.N	Comments from Ministry of Energy/Environment	Response from Developer/ Consultants		
		Where incorporated:	What are the changes made:	Remarks:
	proposing mitigation measures regarding impacts on forest and vegetation. In the Work Schedule, there is a requirement, in addition to the plantation for the lost trees/poles in the ratio of 1:25, by the developer, on the area equivalent to the one that is occupied by the project's physical infrastructure and facilities on the land designated by the concerned district forest office; managed for five years and handed over to the concerned district forest office. Cost for such plantation and management for five years shall be determined and presented. Ensure that the additional cost figures are adjusted in all the chapters/sections/tables including Executive Summaries.	1.1.1 to 1.1.5) page no 305		
34.12	Mitigation Cost of loss of vegetation and forest resources in either of government, community, or leasehold forest shall encompass– i) growing/nursery development/purchase of seedlings; ii) plantation cost; iii) nurturing cost for five years; iv) tagging, cutting, chipping, collecting, and stacking; and iv) compensation to loss of trees.	Refer sub Chapter 7.1.2, Table 7.2 (S.N. 1.10.2) page no 313	The mitigation cost is proposed as per the suggested comment.	
34.13	Mitigation/avoidance measures for impacts on fishes shall at least cover the following since that explained in subchapter 7.2.4 is inadequate and insufficient:			
	– Mitigation, protection, and avoidance measures for protection and restoration of spawning grounds	subchapter 7.1.2, Table no 7.2 (S.N. 1.3.2 and 1.3.3) page	The mitigation measures for protection and restoration of spawning ground is proposed.	

S.N	Comments from Ministry of Energy/Environment	Response from Developer/ Consultants		
		Where incorporated:	What are the changes made:	Remarks:
		no 307		
	– Protection and avoidance measures from likely release of toxic and other materials during construction from various sites and activities.	Sub chapter 7.1.1, Table no 7.1 (S.N. 1.6.1, to 1.6.14) page no 298-300	The mitigation measures to avoid or mitigate any pollution of Trishuli River have been proposed.	
	– proposal for provisions at the headworks structure(s) to allow safe movement of fishes (provision of either fish pass or fish ladder)	Refer Sub chapter 7.1.2, Table no 7.2 (S.N. 2.1.1) of page no 314	The fish ladder is proposed for mid distance migratory fishes such as *Schizothorax richardsonii* and *Schizothoraichthys progastus.*	
	– Proposal for provisions at the headworks structure(s) to allow stipulated/required environmental flow downstream. Clearly explain how such environmental release will be ensured.	Refer Subchapter 7.1.2, Table 7.2 (S.N.2.1.2)m page no 314	The environmental flow equivalent to 10% of monthly flow at all times will be ensured.	
	– Amount of downstream release shall be determined based on the requirement to: allow fishes species (considering their growth/size/shape/weight/other characters) have safe movement as well as migration in the river. Please note that, 10 % of minimum monthly average flow as stated in Hydropower Development Policy, 2001, is the absolute minimum environmental flow to be released downstream.	Refer Subchapter 7.1.2, Table 7.2 (S.N.2.1.1, 2.1.2, 2.1.3)page no 314	The proposed release of 10% of the monthly flow will be sufficient for safe movement and migration of fish in the dewatered zone.	
	– Give amount of downstream release discharge.		The environmental flow equivalent to 10% of monthly flow (Table 5.2) all at times will be ensured.	
34.14	Awareness and training programmes, which are mentioned, shall be elaborated in more detail giving information such as to whom, how many	Refer Subchapter 7.1.2, Table 7.2 (S.N. 1.2.5, 1.2.12, 1.7.5,	Different awareness programmes has been proposed as per the requirement of the people related to the project and the associated costs	

S.N	Comments from Ministry of Energy/Environment	Response from Developer/ Consultants		
		Where incorporated:	What are the changes made:	Remarks:
	times, who will conduct such programmes, and priority setting criteria of training recipients. Make sure associated cost are calculated and given in the report.	page no 293, 294, 2.2.2) page no 303 and 7.1.3. Table 7.3 (S.N. 1.3.3, 1.15.5, 1.17.5) page no 321,328	have also been calculated and given in the report.	
34.15	In impact section - Socio-economic and Cultural Environment-construction phase, identify purpose or use of the houses, which are said to be displaced; give total plinth area per storey and number of stories. Discuss mitigation measures regarding acquisition and relocation of houses: check the cost has been worked for that purpose. Also, state how far the houses are to be relocated. Ensure the cost includes-relocation cost, allowance for hardships faced because of relocation, refurbishment cost.	Refer subchapter 5.1.2.1 point 5 table 5.20 of page no 269 and subchapter 7.1.3, table 7.3 (S.N. 1.5.1 to 1.5.4) page no 321	It is written that two structures are residential houses and two are cow sheds. The plinth area, number of storeys has also been presented. The mitigation measures along with mitigation cost are given.	
34.16	Mitigation for loss of land, loss of agricultural land, loss of agricultural production (regular and/or cash crops) in temporary and permanent acquisition shall be fully accounted for, which is currently lacking in the report. (If tables are provided in the appendix or annex they shall be referred).	Refer subchapter 5.1.2.1 point 1, Table 5.12, 5.13, 5.14, 5.15, 5.16, 5.17 of page no 265,266 & 267	The loss of agricultural land is presented. Similarly, the loss of agriculture production of commonly grown cereal and cash crops of irrigated and non-irrigated land is also presented.	
34.17	Mitigation for loss of top soil, discuss about the ways of protecting loss of top soil from agriculture land (both temporary and permanently acquired land). For loss of top soil, mitigation could be – collection of top soil during construction, storage at safe place, and	Refer subchapter 5.1.1.1 point 13 of page no 238 and subsection 7.1.1 table 7.1 (S.N. 1.13.1 and 1.13.2) page no	The impact of loss of top soil from agricultural land has been addressed in physical environmental impact and the mitigation of the same has been addressed.	

S.N	Comments from Ministry of Energy/Environment	Response from Developer/ Consultants		
		Where incorporated:	What are the changes made:	Remarks:
	back filling on temporarily acquired land before handover: Remaining top soil shall be placed on the other land as requested by the local people/community.	302		
34.18	It is obvious that some of the mitigation/avoidance options can be provisioned in the contract document with mandatory provision, while some can be incorporated in project design and construction methodologies and rest are to be planned and implemented by the developer. Identify those; and clearly state how it could be achieved. It is appreciated that table-159 has covered most of the part. However, propose necessary safeguarding measures to be observed by the project developer to ensure: i) incorporation in the detailed design, ii) mandatory obligation to the contractor through contract document for effective implementation, iii) supervision and monitoring for effective implementation, iv) implementation of measures that are not under contractor's obligation and are to be implemented by the developer, and v) and steps to ensure corrective actions in case of noncompliance shall be categorically proposed.	Refer Chapter 7, Table 7.1, 7.2, 7.3, of page no 291-333 Chapter 10, Table 10.8, 10.9, 10.10 and 10.11 and 10.12 of page no 364-404	The suggested comments have been incorporated in the mentioned chapters and tables wherever necessary.	
34.19	Mitigation and enhancement measures cost shall be presented separately in the mitigation chapter. The cost shall be broken down and given separately differentiating into “Physical Environment”, “Biological Environment” and	Refer chapter 7 and 8, Table 7.2, 7.3, 7.4 of page no 291-333 and 8.1 of page no 334	A separate cost for mitigation and enhancement measures has been proposed, and the mitigation has been broken down and given separately differentiating into “Physical Environment”, “Biological Environment” and	

S.N	Comments from Ministry of Energy/Environment	Response from Developer/ Consultants		
		Where incorporated:	What are the changes made:	Remarks:
	"Socio-economic and cultural Environment" and further according to "Operation Phase" and "Construction Phase". Give detail cost calculation, with break down as required, including unit costs. The revised cost figures shall be adjusted in all chapters and sections in the report including both executive summaries.		"Socio-economic and cultural Environment" and further according to "Operation Phase" and "Construction Phase" with detail cost calculation including unit cost wherever possible.The revised cost id corrected wherever necessary including executive summaries.	
35	Check 'Social and Environmental Management Plan'(chapter 9) shall include the following (it is not required to reproduce what is already mentioned in earlier or forthcoming chapters; cross referencing could be a better option):			
35.1	EMP shall give:			
	Target- what is aimed to achieved through management plan	Refer subchapter 10.1, para. 1&2 of page no 356	The key objectives of EMP has been presented.	
	Actions	Refer Fig 10.1 and 10.2, page no 361 Table 10.8, 10.9, 10.10, 10.11, 10.12, 10.13, 10.14, 10.15 of page no 364- 414	The Actions to be followed by construction contractors and proponent has been presented.	
	- Elements of actions that construction contractor/or other assigned to follow	"	"	
	- Examples of specific Actions to be included	"	"	
	Monitoring & reporting:	subchapter 10.5,10.5.1, 10.5.2, 10.5.3, page no405 - 409 Tables 10.13, 10.14, 10.15 page no	The suggested comment has been incorporated.	

S.N	Comments from Ministry of Energy/Environment	Response from Developer/ Consultants		
		Where incorporated:	What are the changes made:	Remarks:
		406-414		
	– List of Activities that require measurement and reporting	"	"	
	– Identification of – parameters, indicators, methods, location, frequency	"	"	
	– Identification of reporting authority to whom contractor shall report; reporting interval	"	"	
	Corrective Actions and Reporting	"	"	
	– Identification of incidences noncompliance	"	"	
	– In case of noncompliance, identification of responsible person of the contractor to take necessary corrective actions	"	"	
	Reporting in case of noncompliance	"	"	
	o Causes of noncompliance	"	"	
	o Actions taken for re-compliance	"	"	
	o Mechanism and necessary actions to ensure compliance	"	"	
	Relevant Legislation and Standard to observe and follow	Refer subchapter 10.2 page no 356-357	The relevant legislations, environmental standard and approvals has been provided.	
	Cost Estimates	Refer subchapter10.3, Para 2 page no and 3. and Tables 10.14 and 10.15 page no 407-414	The cost estimates for environmental mitigation management plan has been included in the project cost, whereas, the outsourcing of human resource and other costs associated with baseline monitoring management plan, compliance monitoring management plan, impact monitoring management plan has been provided.	
35.2	Social Management Plan shall cover:			The Social management

S.N	Comments from Ministry of Energy/Environment	Response from Developer/ Consultants		
		Where incorporated:	What are the changes made:	Remarks:
				plan has been provided in environmental management plan (chapter 10)
	§ Permits and Approval Plan	Refer Table 10.7 of page no 360	The permit and approval from the concerned authority related to various issues has been provided.	
	§ Resettlement and Rehabilitation Plan	Refer Table10.10 (S.N. 1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.5, 1.3.4, 1.6.1, 1.6.2, 1.6.3, 1.6.4 and 1.6.5) page no 369, 370, 371	The given clauses has addressed the rehabilitation measures related to the affected familes loosing both oand and houses.	A separate Resettlement and Rehabilitation Plan has not been provided in this report. However, the suggested comments are incorporated in tables 10.10. mitigation management plan for socioeconomic and cultural environment adverse impact.
	Environmental Enhancement Plan	Refer Table 10.12 page no 404	The mitigation management plan for environment enhancement plan has been provide.	
	Vulnerable Community Development Plan	Refer Table 10.10 (S.N. 1.6.4, 1.6.5, 1.17.1, 1.17.2, 1.17.3, 1.17.4, 1.17.5, 1.17.6, 1.17.8, 1.17.9, 1.17.10, 1.17.11) page no391, 392, 398, 399	The clauses of the plan has addressed vulnerable groups such as women children and dalit groups of the project construction site.	

S.N	Comments from Ministry of Energy/Environment	Response from Developer/ Consultants		
		Where incorporated:	What are the changes made:	Remarks:
	Public Health Safety Management Plan	Refer Table 10.10 (S.N. 1.7.2, 1.7.3, 1.7.5, 1.9.7, 1.15.4,) and page no 393-394 Table 10.12 (S.N 2 S.N. 4) page no 405	The clauses of the plan has addressed public health safety management plan related to the proposed project.	
	Project Information Management plan	Refer Table 10.10 (1.3.4, 1.8.1) page no 391& 394	The project information will be providd by ESMC under PCMO to the local people	
	Public Grievances Redress Management Plan	Refer Table 10.10 (1.3.4) page no 391	The ESMC under PCMO will make necessary arrangement to address greviences of local communities of the project.	
	§ Institutional Capacity Strengthening Plan	Refer Table 10.10 (S.N. 1.8.4, 1.11.1), page no 394 & 397 Table 10.12 (S.N. 1 to 12, 14, 16, 17) page no 405	The project has proposed necessary programmesfor strengthening institutional capacity.	
	Interagency/stakeholder Co-ordination plan	Refer Table 10.10 (S.N. 1.3.4, 1.6.4,1.8.1) page no 380, 382, 384	The project has proposed the necessary measures in EMP to address the coordination with stakeholders.	
35.3	Physical and Biological Management Plan shall cover:			
	§ Erosion Abatement and Watershed Management Plan	Refer Table 10.8 (S.N. 1.3.1 to 1.3.5, 1.3.13, 1.3.14,1.3.15,1.3.18 to 1.3.23,1.9.1) page no 367,369, 370, 373	These clauses has addressed the Erosion Abatement and Watershed Management.	

S.N	Comments from Ministry of Energy/Environment	Response from Developer/ Consultants		
		Where incorporated:	What are the changes made:	Remarks:
	Muck/Spoil Site Management Plan	Refer Table 10.8 (S.N. 1.3.1 to 1.3.5)page no 367	The clauses have addressed Muck/Spoil Site Management Plan	
	Top Soil Saving Management Plan	Refer Table 10.8 (S.N. 1.13.1 and 1.13.2) page no 375	The clauses have addressed Top Soil Saving Management Plan	
	§ Pollution Abatement Plan (Pertaining to – Water quality; Air quality; and Solid Waste)	Refer Table 10.8 (S.N. 1.2.5 to 1.2.10, 1.4.1 to 1.4.8, 1.6.1 to 1.6.9 and 1.6.13, 1.6.14) page no 366, 370, 371, 373	These clauses has addressed Pollution Abatement Plan (Pertaining to – Water quality; Air quality; and Solid Waste)	
	Toxic and Hazardous Chemical Handling and Management Plan	Refer Table 10.8 (S.N 1.6.10 to 1.6.12) page no 372-373	The Toxic and Hazardous Chemical Handling and Management Plan has been addressed in these clauses	
	§ Demobilization and Rehabilitation Management Plan	Refer Table 10.10 (S.N. 1.1.1 to 1.1.6, 1.5.1 to 1.5.5, 1.6.1 to 1.6.3) page no 390,392	Demobilization and Rehabilitation Management Plan has been addressed in these clauses.	
	§ Terrestrial Ecology Management Plan	Refer Table 10.9 page no377 -389	Terrestrial Ecology Management Plan has been specifically presented in the mentioned table.	
	Wildlife Protection and Conservation Plan	Refer Table 10.9 (S.N. 1.2.1 to 1.2.14, 1.6.1 to 1.6.8, 2.2.6, 2.2.9 to 2.2.11, 2.3.1, 2.3.2, 2.7.1, 2.8.2, 2.8.3) page no 378, 380, 382,383, 387, 389	These clauses have addressed the Wildlife Protection and Conservation Plan	

S.N	Comments from Ministry of Energy/Environment	Response from Developer/ Consultants		
		Where incorporated:	What are the changes made:	Remarks:
	§ Aquatic Ecology Management Plan	Refer Table 10.9 (S.N. 1.3.1 to 1.3.4, 1.4.1 to 1.4.3, 1.8.1, 1.8.2, 2.1.1 to 2.1.3 page no 380-381,384-386	Theses clause have addressed the Aquatic Ecology Management Plan	
	Environmental Training Plan to project staff and construction staff	Refer Table 10.9 (S.N. 1.2.5, 1.2.12, 1.5.7, 2.2.2) Table 10.10 (S.N. 1.8.1, 1.15.4, 1.17.5,) page no 378-379,381-386, page no 394,399	These clauses have addressed Environmental Training Plan to project staff and construction staff	The environmental training programmes of both biological and socioeconomic and cultural environment has been presented.
	Occupational Health and Safety Management Plan	Refer Table 10.10 (S.N. 1.9.1 to 1.9.7) page no 395-396	These clauses have addressed the Occupational Health and Safety Management Plan	
	§ Construction Camps Management Plan	Refer Table 10.8 (S.N. 1.9.9, 1.9.10, 1.6.3 to 1.6.9) page no 374, 371, 372	These clauses have addressed the Construction Camps Management Plan	
	§ Construction Traffic Management Plan	Refer Table 10.10 (S.N. 1.9.5)page no 396	These clause has addressed the Construction Traffic Management Plan	
	§ Emergency Preparedness and Management Plan	Refer Table 10.10 (S.N. 1.9.5)page no 396	These clause has addressed the Emergency Preparedness and Management Plan	
	Construction Related Management Plan shall cover:			
	Occupational Health and Safety Management Plan	Refer Table 10.10 (S.N. 1.9.1 to	These clauses have addressed the Occupational Health and Safety Management Plan	

S.N	Comments from Ministry of Energy/Environment	Response from Developer/ Consultants		
		Where incorporated:	What are the changes made:	Remarks:
		1.9.7)page no 395-396		
	Emergency Preparedness and Management Plan	Refer Table 10.10 (S.N. 1.9.5) page no 396	These clause has addressed the Emergency Preparedness and Management Plan	
	Construction Camp Management Plan	Refer Table 10.8 (S.N. 1.9.9, 1.9.10, 1.6.3 to 1.6.9) page no 371, 372, 374	These clauses have addressed the Construction Camps Management Plan	
	Construction Traffic Management Plan	Refer Table 10.10 (S.N. 1.9.5)page no 396	These clause has addressed the Construction Traffic Management Plan	
	Environmental training Plan to Project and Construction Staff	Refer Table 10.9 (S.N. 1.2.5, 1.2.12, 1.5.7, 2.2.2) Table 10.10 (S.N. 1.8.1, 1.15.4, 1.17.5,) page no 378, 379,381,386, & 394, 399	These clauses have addressed Environmental Training Plan to project staff and construction staff	The environmental training programmes of both biological and socioeconomic and cultural environment has been presented.
	Demobilization and Rehabilitation Management Plan	Refer Table 10.10 (S.N. 1.1.1 to 1.1.6, 1.5.1 to 1.5.5, 1.6.1 to 1.6.3) page no 390, 392	Demobilization and Rehabilitation Management Plan has been addressed in these clauses.	
36	Carry out the following in chapter 10:			
	Workout the detail breakdown of monitoring cost. While giving breakdown also consider the cost of field sampling and laboratory analysis those that are proposed.	Refer Table 10.13, 10.14 and 10.15, page no 407, 408, 415	The detail breakdown cost related to baseline monitoring, compliance monitoring and impact monitoring has been provided.	
	Propose an organogram for carrying out	Refer subchapter		It is clearly written that the

S.N	Comments from Ministry of Energy/Environment	Response from Developer/ Consultants		
		Where incorporated:	What are the changes made:	Remarks:
	monitoring (as internal monitoring by the project) with clearly assigned/identified roles and responsibilities. The organogram shall also exhibit different agencies to be consulted during implementation of mitigation/enhancement measures and monitoring activities.	10.3, Figure 10.1 and 10.2, para 2 and 3 page no 362 &363		environmental monitoring works of the project will be executed under, ESMC related to construction and operation. Thus a separate organogram has not been provided for monitoring.
	Field test/sampling and laboratory testing proposed shall also be included for pre-construction, construction, and operation phases. Allocate adequate costs for them.	Refer Table 10.13, 10.14 and 10.15, page no 407-415	Field test/sampling and laboratory testing has been included.	
37	Give "Summary of Cost Benefit assessment" which shall include the following in chapter 12:	Refer chapter 11 page no 419		Former chapter 12 has been shifted to chapter 11.
	cost for Environmental Mitigation Measures	Refer Table 11.1 page no 419	The table has been prepared as per the suggested comment.	
	cost for Enhancement Measures,			
	cost for Other Social Support Programmes and Corporate Social Responsibility (CSR),			
	cost for Environmental Monitoring,			
	Total Project Cost; and Total Project Benefit, and			
	Percentage of total Environmental Cost to the Total Project Cost; and			
	Percentage of total Environmental Cost to the Total Project Benefit			
38	Carry out the following in chapter 13:	Refer chapter 12 page no 421		Former chapter 13 has been shifted to chapter 12.
	Try to limit the content of this chapter in two pages.	Refer chapter 12 page no 421	The chapter has been prepared as per the suggested comment.	
	Drop "and Recommendation" from the title of			

xxx

S.N	Comments from Ministry of Energy/Environment	Response from Developer/ Consultants		
		Where incorporated:	What are the changes made:	Remarks:
	chapter Content of this chapter shall be limited to conclusion.			
	Do the same in both executive summaries. Also check table of contents.			
	This chapter shall give VERY BRIEF OVERVIEWof the following (if it is not described):			
	Project and its development concept			
	Significant findings from baseline study that needs special attention			
	Major impacts			
	Major Mitigation Measures,			
	Specific precaution and avoidance measures to be followed by developer.			
	Statement about overall impact on environment and benefit accrued from the project.			
	The chapter shall state findings; and language be such that it shows commitments from the developer.			
39	Carry out the following in chapter 14:			
	Never ever, put "List of Reference" if all the contents are never to be cited in the main text. If the content is not to be referred, other heading can be used.			A reference list has been provided separately and is not enlisted as a chapter.
	Either change the title of chapteror else refer all the materials in main text that have been listed under the "Reference list".			
	Check all the referenced material to ensure that they are adequately referred in the main text or change the title of the list.			

S.N	Comments from Ministry of Energy/Environment	Response from Developer/ Consultants		
		Where incorporated:	What are the changes made:	Remarks:
	EDITING AND OTHERS			
40	आयोजनाको अस्थाई संरचनाहरुको प्रयोजनकालागिगरिने जग्गाअधिग्रहणलिजमालिने गरी प्रस्तावगर्ने । त्यस्ताजग्गाहरु निर्माणकार्य सम्पन्नभएपश्चात् सम्बन्धितव्यक्ति, सस्था, वानिकायलाई पुरानै अवस्थामाहस्तान्तरणगर्नकालागिआवश्यकव्यवस्थासहित प्रस्तावगर्ने ।	Refer table 7.3 (S.N. 1.1.3, 1.1.4 and 1.1.5) page no 320	The project plan of leasing land has been enlisted.	
41	Recommendation Letters from the Community Forest User Groups affected by the project developmentare not present.	Refer annex 2.10		
42	Concurrence/Agreement letter from the owner of affected - Micro hydro projects/Water Mills, Irrigation Water Users Association (whichever is applicable) shall be obtained".			The construction of proposed project will not affect any Micro hydro projects/Water Mills, Irrigation structures thus the concurrence/ agreement letter is not needed.
43	Fill up the attached tables for "Land/property losses", "Power and Energy Production", "Environmental Release and Water Balance", and "Inflows from side streams". Use them in the main text to discuss the impact from the project. Mitigation measures shall be based on the impact discussed on the information provided by those tables.	Refer Annex 3.1, 3.2, 3.3	The related attached tables as per the comments are presented. Impact and mitigations written in this report are basically related to these tables.	
44	Following DRAWINGS, MAPS, and EXHIBITS shall			

S.N	Comments from Ministry of Energy/Environment	Response from Developer/ Consultants		
		Where incorporated:	What are the changes made:	Remarks:
	be given in the report:			
	Following shall be over laid on complete project layout map, as a background, on topographical map			
	Location of sampling sites for collecting baseline information			The location of inclusion of the suggested site could not be explicated due to large scale of GIS map, if included the size would not be clearified through them map
	Water Quality, terrestrial vegetation, terrestrial habitat (if required); aquatic habitat and fish sampling. Habitat of listed species (if found in the area) shall be distinctly exhibited.			
	Extent of contiguous forest beyond core project area. Extent of contiguous terrestrial animal habitat.			
	Location of habitat in the project impact zones and contiguous forest if Rare/ Endangered/Threatened and Endemic Species of wild life (terrestrial/avian/aquatic) are found in project impact zones/area.			
	Location of social infrastructures– schools/colleges, health posts, religious sites (temples, churches, mosques, and cremation sites), public buildings, and foot trails.			
	Existing irrigation system, water mill, micro hydro, – with their structures/ components/ facilities			
	Geological map at local and regional level			
	Provide engineering drawing (plan view) exhibiting - headworks, powerhouse, and tailrace. Also give a typical section view (engineering drawing) of headworks,	Refer Fig. 4.11, 4.12, 4.13 and 4.14	The suggested drawings have been incorporated.	

S.N	Comments from Ministry of Energy/Environment	Response from Developer/ Consultants		
		Where incorporated:	What are the changes made:	Remarks:
	powerhouse, and tailrace; in orthogonal directions.			
	All the project details exhibiting project layout together with all the support facilities shall be presented in the GOOGLE- 'kmz' file format. The details of project layout shall be same as in engineering drawing, plan view, prepared for the project in the feasibility study.			
45	All the corrections in the report based on the comments shall be adequately addressed in all relevant chapters, sections, and tables including Executive Summaries. In addition, all the changes in cost figures shall be adequately adjusted in all relevant chapters, sections and tables including Executive Summaries. Make sure that this is seriously considered, many reports have been found not adjusting all the chapters/sections/tables in the report despite of claiming in the answer sheets.	Refer all chapters, subchapters and tables including executive summaries	The suggested comment has been incorporated.	
46	The final report shall be printed on both sides. Provide an electronic copy of the final EIA report.		The report has been printed on both sides and an electronic copy is provided.	
47	NOTE: The response should be submitted from the developer / consultants, in the following table, about the incorporation of comments and suggestions on the report reviewed.		The response has been submitted in tabloe format as suggested.	

Executive Summary (Nepali)

संक्षिप्त साराँश

१. प्रतिवेदनको नाम, प्रस्तावकको ठेगाना र प्रतिवेदन तयार पार्न संस्थाको जिम्मेबारी ।

"माथिल्लो त्रिशुली -१ जल विद्युत आयोजना" भौगोलिक समसंख्यक अक्षांश २८° ०४' २७.५" उत्तर देखि २८° ०७' ४२" उत्तर र देशानतर ८५° १२' ४०" पूर्व देखि ८५° १८' ०३" रसुवा जिल्लाको हाँकु, धुन्चे र राम्चे गा.वि.सको सिमाना भएर बग्ने त्रिशुली नदीमा अवस्थित छ । यस मुख्य उद्येश्य त्रिशुली नदीको पानीलाई उपभोग गर्दै "माथिल्लो त्रिशुली -१ जल विद्युत आयोजना" विकास गर्ने रहेको छ । माथिल्लो त्रिशुली-१ जलविद्युत आयोजनाको प्रस्तावित नेपाल वाटर एण्ड इनर्जि डेभलपमेन्ट कम्पनि प्रा.लि. रहेको छ । जुन नेपाल सरकार अन्तरगत वि.स. २०६० बैशाख १० गतेका दिन स्थापना गरी दर्ता गरिएको थियो।

प्रस्तावकको विस्तृत ठेगाना:

नेपाल वाटर एण्ड इनर्जि डेभलपमेन्ट कम्पनि प्रा.लि.
थापाथली, काठमाडौं, नेपाल
पोष्ट बक्स नं: ७४६
फोन नं: ४२४७२३७
फ्याक्स नं: ४२३२१७१

नेपाल वाटर एण्ड इनर्जि डेभलपमेन्ट कम्पनि प्रा.लि. ले वातावरणीय प्रभाव मुल्यांकन अध्ययन तथा प्रतिवेदन तयारी सम्बन्धी कार्यका लागि जेड कन्सल्ट प्रा.लि.लाई जिम्मेवारी दिइएको थियो ।

परामर्शदाताको ठेगाना:

जेड कन्सल्ट प्रा.लि.
काविलमार्ग, थापाथली, काठमाडौं, नेपाल
फोन नं: ४२२२२०२

२.वातावरणीय प्रभाव मुल्यांकन अध्ययन गर्नुको औचित्य:

हरेक ५० मेगावाट भन्दा माथि जडित क्षमता भएका जल विद्युत आयोजनाको वातावरणीय प्रभाव मुल्यांकन प्रतिवेदन वातावरण संरक्षण ऐन २०५३ र नियमावली २०५४ अन्तरगत स्वीकृत गराई आयोजना लागु गर्नुपर्ने छ । वातावरण संरक्षण ऐन २०५३ (२) अनुसार कानुनी प्रक्रिया अनुसार यो आयोजनाको वातावरणीय प्रभाव मुल्यांकन अध्ययन गर्नुपर्ने हुन्छ । यसका साथै आयोजना लाडटाङ्ग राष्ट्रिय निकुञ्जको मध्यवर्ती क्षेत्रमा पर्नका साथै २७.२० हेक्टर वनक्षेत्रको अधिग्रहण गर्नुपर्ने भएकोले वातावरण संरक्षण ऐन २०५३ (२), उपदफा ३ को के अन्तरगतको वातावरणिय प्रभाव मुल्याङ्कन प्रक्रिया भित्र पनि पर्न जान्छ ।

३.प्रस्तावित आयोजना:

२१६ मेगावाट जडित क्षमताको माथिल्लो त्रिशुली-१ जलविद्युत आयोजना रन अफ रिभर प्रकृतिको आयोजना हो । यो परियोजना त्रिशुली नदीमा प्रस्ताव गरिएको छ । आयोजनाको डिजाइन प्रवाह७४ घनमिटर प्रति सेकेण्ड, ग्रसहेड ३५० मीटर र वार्षिक उत्पादन क्षमता १५५७ गिगावाट घण्टा

रहेको छ । बाँध स्थल धुन्चे र हाँकु गा.वि.स.को फुलबारीको नजिकमा र विद्युत गृह हाँकु गा.वि.स.को बालुवाफाँटमा रहेको छ । त्यस्तै बाँध संरचना, डिसेन्डर, हेड्रेस टनेल, अडिट, पेनस्टेक, टेलरेस, स्वीचयार्ड र आयोजनाका बाँकी पुर्वाधारहरु पनि त्रिशुली नदीको दाहिनेपट्टी हाँकु गा.वि.स.मा रहेका छन । वर्तमानमा आयोजनाको बाँध स्थलसम्म पुग्न सक्ने मोटरेवल बाटोको व्यवस्था छैन । तापनि वेत्रावती देखि आयोजनाको विद्युत गृहसम्मको १३ किलोमिटर पहुँचमार्ग निर्माण गरिएको छ । आयोजना सञ्चालनका लागी ४७.५८ हेक्टर जग्गा स्थायी र ५६.८८ हेक्टर जग्गा अस्थायी गरी जम्मा १०४.४५ हेक्टर जग्गा आवश्यक पर्ने छ ।

४. उपल्बध बातावरणीय अवस्था

भौतिक वातावरण:

आयोजना नेपालको मध्यमाञ्चल विकास क्षेत्रको रसुवा जिल्लाको उच्च हिमाली क्षेत्रको माथ्लिो क्षेत्रमा पर्दछ र त्रिशुली नदीको माथिल्लो भागमा पर्दछ । यस क्षेत्रको जमीन केहीहदसम्म नाङ्गा चटाने भीर र भीरालो जग्गाहरुको साथै रेस्युडियल माटो र कडा चट्टानले भरिएको छ । आयोजना क्षेत्रको बैशाखको बार्षिक अधिकतम तापक्रम् १८ डिग्री सेन्टीग्रेड देखि 20 डिग्री सेन्टीग्रेड रेक्ड गरिएको छ भने पुष र माघको बार्षिक न्युतम् तापक्रम् ० डिग्री सेन्टीग्रेड देखि ५ डिग्री सेन्टीग्रेडसम्म रेक्ड गरिएको छ । आयोजना क्षेत्रमा बार्षिक औसत बर्षा २००० मिमि देखि २५०० मिमि रहेकोछ भने बार्षिक ८० प्रतिशत बर्ष सनसुन समयमा हुनेगरेको छ । आयोजनाको समग्र ड्रेनेज प्याटरन डेनड्राईट प्रकृतिको पाईन्छ ।

आयोजना क्षेत्र निर्मात्र क्षेत्रमा वायु जल र ध्वनिको गुणस्तर स्वच्छ रहनको साथै प्रषणका स्रोतहरु अवस्थित छैन्न र त्रिशुली नदीका प्रमुख समस्या सेडिमेन्टेशन रहेकोछ । भुगर्भिक हिसाबले आयोजान क्षेत्र मध्य नेपालको लेसर हिमाली भेगमा पर्दछ । यहाको चट्टान बिषेश गरी फिलाइटिक सिस्ट हो तर केहि क्षेत्रको फिलाइटिक क्वार्जाइट पनि भेटिन्छन् । आयोजना क्षेत्रको सतहमा विशेष गरी कोलोभियम र आलुभियम डिपोजिट पाईन्छन । आयोजना क्षेत्रभित्र उच्च, मध्यम् र न्युन प्रकृतिको भिराला जमीन पाईन्छ । राम्चे, ठाडे, हाँकु र सरघाङ्ग आयोजना क्षेत्रका मुख्य पैरोहरु हुन । आयोजनाको विद्युतगृह र बाँध स्थलको बीचमा हाँकु गा.वि.स.का दलित परिवारले मशानघाटको रुपमा प्रयोग गर्नु बाहेक त्रिशुली नदी अरु कुनै प्रयोगमा आएको पाईदैन । आयोजना निर्माण स्थलभित्र जमीन प्रयोगका हिसाबले बगर ३०.३१ प्रतिशत, जंगल २६.०५ प्रतिशत, खेतियोग्य जमीन १९.८३ प्रतिशत, भिरालो जमीन १३.७१ प्रतिशत, झाडी ७.१४ प्रतिशत, खेतबारी १ प्रतिशत, नदी ०.९प्रतिशत र उपल्बध सडक १.०७ प्रतिशत देखियो ।

जैविक वातावरण:

आयोजना क्षेत्र लामटाङ्ग राष्ट्रिय निकुञ्ज नजीकमा पर्दछ । बाँध स्थलको बाँया भाग लाङटाङ्ग राष्ट्रिय निकुञ्जको मध्यवर्ती क्षेत्रमा पर्दछ भने आयोजनाका धेरैजस्ता संरचनाहरु सुविधाहरु त्रिशुली नदीको दाहिनेपट्टी हाँकु गा.वि.स.को सामुदायिक तथा निजी वनभित्र पर्दछन । आयोजना क्षेत्र जैविक विविधता हिसाबले धनी भएतापनि आयोजना क्षेत्रको त्रिशुली नदीको दुवैपट्टीका भिरहरु ठाडो भिरालो भएकाले वनस्पतिको उपस्थिति नजिकैको क्षेत्र भन्दा कम रहेको छ । भौगोलिक कारणले गर्दा नदीका दुवैतिर भएका जैविक विविधता अन्यत्रको भन्दा केही फरक रहेको पाईन्छ । आयोजनाको जलविद्युत निर्माण क्षेत्र ९०५मीटर देखि १२३५ मीटरको रेन्जको उचाइमा रहेकाले उचाईको आधारमा यो क्षेत्र माथिल्लो उष्ण (५००मी देखि १०००मी) र तल्लो उष्ण (१०००मी देखि १५००मी) भित्र पर्दछ । साल सल्लो र उतिस वन आयोजना क्षेत्रका मुख्य वनहरुमा पर्दछन । वातावरणीय प्रभाव मुल्यांकन अध्ययनको क्रममा क्षेत्रिय तथा स्थानीय स्तरमा जम्मा २४३ प्रकारका बोटविरुवा पहिचानमा आएका छन । त्यस्तै आयोजना निर्माण क्षेत्र भित्र साल, दार र खोटे सल्ला

गरी जम्मा ३० वटा बोटविरुवा रेर्कड गरिएका छन । हाँकु गा.वि.स.मा रहेका १५ वटा सामुदायिक वनहरु मध्ये ६ वटा सामुदायिक वनहरु आयोजना निर्माणको क्रममा प्रभावित पर्ने देखिन्छन । आयोजना क्षेत्र भित्र घरायसी उपभोगका लागी दाउरा संकलन गर्नु, जंगली फलफुल र तरकारी जस्ता चलन चल्तीका कार्यहरु हुन । धान, मकै, गहुँ, दाल, तोरी जस्ता अन्न बाली र तरकारीका साथै फलफुल, अन्नबाली घरायसी प्रयोजनका लागी खेती गरिएको पाईन्छ ।सिमल तथा साल निर्माण क्षेत्रका प्रमुख संरक्षित बिरुवाहरु हुन । आयोजना क्षेत्रमा जम्मा गरी २३ प्रजातिका स्तनधारी जनावरहरु, ६२ प्रजातिका चराहरु, २० प्रजातिका घिस्रीने जीवहरु, ४ प्रजातिका माछाहरु त्था ४० प्रजातिका पुतलीहरु पाईएका छन । जसमध्ये ७ प्रजातिका स्तनधारी जनावर, १० प्रजातिका चराहरु र १ प्रजातिका घिस्रीने जीव संरक्षित सुचीमा रहेका छन आयोजना क्षेत्रभित्र नमुना अध्ययनमा बुच्चे असला, चुच्चे असला माछाहरु रेर्कड गरिएका थिए भने काभ्रे तथा गडेला माछाका प्रजातिहरु त्रिशुली नदीमा रहेको कुरा पहिचानमा आएका छन ।

सामाजिक आर्थिक र सास्कृतिक वातावरण:

नेपालको कुल भुभाग मध्ये रसुवा जिल्लाको १५४४ वर्गकिलोमिटरले १.०५ प्रतिशत भुभाग ओगटेको छ । हाँकु, धुन्चे र राम्चे गा.वि.स. आयोजनाका संरचना र अन्य पुर्वाधारका हिसाबले प्रभाावित क्षेत्रभित्र पर्दछन यी गा.वि.सहरुलाई प्रभावित गा.वि.सको सुचिकृत गरिएकोछ । यी गा.वि.सहरुको जम्मा जनसंख्या ६९८६ (पुरुष ५३.६३ प्रतिशत र महिला४६.३७ प्रतिशत) संगै जम्मा घरधुरी संख्या १४२६ र परिवार आकार ५ रहेको छ । जातिय हिसाबले तामाङ ७९.७३ प्रतिशत, गुरुङ ६.०१ प्रतिशत, ब्राम्हण ४.०९ प्रतिशत रहेका छन । मुख्य धर्म बौद्ध ८७.४५ प्रतिशत रहेको छ । तामाङ भाषा (८६.२२ प्रतिशत) मुख्य भाषाको रुपमा रहेको छ । उपल्बध तथ्याङ्क अनुसार ६० प्रतिशत असाक्षर जनसंख्या र साक्षर जनसंख्या मध्ये केवल २.१३ प्रतिशतले मात्र एस.एल. सी. भन्दा माथि पास गरेको पाईन्छ । आयोजना प्रभावित क्षेत्रभित्र रहेका जम्मा १५ वटा शैक्षिक संस्थाहरु मध्ये १३ प्राथमिक, १ निम्न माध्यमिक, १ माध्यमिक र १ उच्च माध्यमिक रहेका छन । धुन्चे गा.वि.स.मा एउटा जिल्ला अस्पताल र एउटा स्वास्थ्य चौकीका साथै बाँकी दुबै गा.वि.समा एउटा एउटा उप स्वास्थ्य चौकी रहेका छन । औषधी, उपचार प्रविधि र स्वास्थ्य जन शक्तिको अभावमा राम्चे र हाँकु गा.वि.सको स्वास्थ्य अवस्था एकदम न्युन रहेको छ । मुख्य रोगहरुमा जनडीस्, रुघाखोकी, टी.बी, यौन रोग, पाठेघर खस्नु आदी पर्दछन । आयोजना प्रभावित क्षेत्रमा ५५ प्रतिशत भन्दा बढी घरधुरीहरुलाई शुद्ध पिउनेपानीको व्यवस्था छैन भने ६४.८१ प्रतिशत घरधुरीहरुमा चर्पीको व्यवस्था छैन । आयोजना प्रभावित गा.वि.स मध्ये राम्चे र धुन्चेमा राष्ट्रिय प्रशारण लाईनबाट बिजुलीको व्यवस्था गरिएको छ भने हाँकु गा.वि.समा मट्टीतेल र सौर्य उर्जाको प्रयोग भएको पाईन्छ । ९३.६२ प्रतिशतले खाना पकाउनका लागी प्रमुख रुपमा दाउराको प्रयोग गर्ने गरिन्छ ।

अधिकाँश जनसंख्या जीवकोपार्जनका लागी कृषिमा आस्रित रहेको पाईन्छ । हाँकुवेसी फुलबारी, गोाने र मैलुङमा आयोजना निर्माण पक्षहरुका हिसाबले प्रभावित क्षेत्र पर्नजान्छ । आयोजना प्रभावित क्षेत्रको जम्मा जनसंख्या १०६६, जम्मा घरधुरी १३२ संगै घर परिवारको आकार ८.१४ रहेको छ । यहाँको मुख्य जातीमा तामाङ जाती पाईन्छ । प्रभावित क्षेत्रभित्र आज पनि धेरै जसो घरधुरीहरु आधुनिक उपभचारमा (स्वास्थ्य संस्थाहरु) भन्दा परम्परागत उपचारमा बढी विशवास गर्दछन ।

आयोजनाको जग्गा अधिक्रमणले गर्दा लगभग ४१ घरधुरीहरुले आफ्नो घरजमीन गुमाउने छन । जसमध्ये ३९ घरधुरीले आफ्नो जग्गा गुमाउने छन भने २ घरधुरीले आफ्नो जग्गा र बासस्थान दुवै गुमाउने छन । आयोजना प्रभावित जम्मा जनसंख्या ३१३ मध्ये पुरुष ५१.४४ प्रतिशत र महिला ४८.५६ प्रतिशत रहेका छन । औसत घरधुरी आकार ७.६३ मध्ये सबै तामाङ जाति पर्दछन र

लगभग सबले (८७.८० प्रतिशत) हिन्दुधर्म मान्दछन । प्रभावित जनसंख्या मध्ये ३४.८२ प्रतिशतले प्राथमिक तथा निम्न माध्यमिक स्तरसम्मको शैक्षिक गुणस्तर हासिल गरिसकेका छन । आयोजनाद्धारा विस्तापित गरिएका सबै घरधुरीले क्षतिपुर्तिको रुपमा नगद नै रुचाएका छन । ल्होसार, दशैं, तिहार, रामनवमी, माघेसंक्रान्ती, साउनेसंक्रान्ती, तिज, जनैपुर्णिमा, कृष्णजन्माष्मी, बुद्धपुर्णिमा जस्ता चलनचल्तीका चाडपर्व मनाउने गर्दछन । हाँकु गा.वि.सका केही दलित परिवारले त्रिशुली नदीको किनारा हाँकुवेशीको फेदीलाई मसानघाटको रुपमा प्रयोग गर्ने गर्दछन ।

५. वातावणीय प्रभाव

५.१. भौतिक नकारात्मक वातावणीय प्रभाव

निर्माण चरण

- आयोजनाका विभिन्न संरचना तथा पुर्वाधार स्थापनाका कारणले २१.३९ हेक्टर जंगल स्थायी रुपमा परिवर्तन आउनेछ ।
- आयोजनाका विभिन्न संरचना तथा पुर्वाधार स्थापनाका कारणले ९.३५ हेक्टर खेती योग्य जमीन स्थायी रुपमा परिवर्तन आउनेछ ।
- आयोजनाका विभिन्न संरचना तथा पुर्वाधार स्थापनाका कारणले १२.४० हेक्टर खेती योग्य जमीन अस्थायी रुपमा परिवर्तन आउनेछ ।
- पहुँच मार्ग र अडिट १ नजीक रहेका हाँकुबेसीका केही घर तथा गोठमा क्षति पुग्न जानेछ ।
- निर्माण चरणमा पहुँच मार्ग र अडिट हिस्साले कोलाहलको स्तर बढाउने छ ।
- मक र स्पाइलमा भुक्षय हुने तथा जमीनका स्थिरतालाई घटाउने ।
- निर्माण कार्यबाट उत्पादित विभिन्न रसायनका साथै धुवा धुलोले कारणले हावाको गुणस्तर घटाउनेछ ।
- मक र स्पाइलको उचित व्यवस्थापनको अभावमा पानीको गुणस्तरमा ह्रास आउनेछ ।
- आयोजनाका लेबर क्याम्प र ईजनियरिङ्ग क्याम्प बाट निस्केको ढलले पानीको गुणस्तरमा ह्रास आउनेछ ।
- आयोजनामा प्रयोगमा आएका विभिन्न मेशिन तथा अन्य उपकरणहरुबाट निष्केको पेट्रोलियम पदार्थ र अन्य रसायनको चुहावटले पानीको गुणस्तरमा ह्रास आउनेछ ।
- माटो उर्बरा शक्तिमा ह्रास आउनेछ ।

संचालन चरण

- बाँधबाट निष्कासित हुने *sediments* को कारणले बाँधभन्दा तल नदी किनारमा भुक्षय हुने
- डयाम भन्दा तल पानीको मात्रा कम हुनु र नदीको क्षेत्र चौडा हुनु
- टनेलका अडिटमा स्लोप फेलर हुनसक्ने

५.२ जैविक नकारात्मक वातावणीय प्रभाव

निर्माण चरण

- स्थायी रुपमा १८.२९ हेक्टर सामुदायिक जंगल नोक्सान हुने
- स्थायी रुपमा २.६१ हेक्टर सरकारी जंगल नोक्सान हुने (लमटाङ्ग राष्ट्रिय निकुञ्जको मध्यवर्ती क्षेत्र)
- अस्थायी रुपमा ४.७२ हेक्टर सामुदायिक जंगल नोक्सान हुने
- लामटाङ्ग राष्ट्रिय निकुञ्जको मध्यवर्ती क्षेत्रमा निर्माण कार्यमा काम गर्ने कामदारद्धारा गैह्रकानुनी रुपमा दाउरा तथा अन्य बहुमुल्य प्रजाति संकलन गर्ने
- निर्माण कार्यमा काम गर्ने कामदारद्धारा खाना पकाउने दाउरा तथा अन्य गैह्रकाष्ट बस्तुहरुको हाँकु गा.वि.सको सामुदायिक वनमा गैह्रकानुनी रुपमा उपभोग गर्ने ।
- लाडटाङ्ग राष्ट्रिय निकुञ्जको तटष्थ क्षेत्र भित्र जंगली जनावरहरुको गैह्रकानुनी रुपमा चोरी शिकारी हुनु
- हाँकु गा.वि.सको सामुदायिक वनमा जंगली जनावरहरुको गैह्रकानुनी रुपमा चोरी शिकारी हुनु
- कोलाहलका कारणले जमीनमा बसोबास गर्ने जनावरहरु टाढा भाग्नु
- सामुदायिक, सरकारी र व्यक्तिगत वनका गरी जम्मा १२००१ प्रजातीका रुखहरु (Seedling-4858, Sapling-2346, Pole-3880 and Tree-917) नोक्सान हुने

संचालन चरण

- त्रिशुली नदीको बाँधका कारणले छोटोदुरीका प्रवासी माछाको आवातजावतमा रुकावट गर्ने
- पहुचमार्गका कारणले हाँकु गा.वि.सका वन पैदावारहरुको अवैध संकलनमा हुने
- लाडटाङ्ग राष्ट्रिय निकुञ्जको मध्यवर्ती क्षेत्रमा गैह्र कानुनी रुपले वनपैदावारहरु संकलन र प्रयोग हुनु
- आगन्तुकहरुद्धारा हाँकु गा.वि.सभित्र जंगली जनावरहरुको गैह्रकानुनी चोरी शिकारी हुनु
- आगन्तुकहरुद्धारा लामटाङ्ग राष्ट्रिय निकुञ्जको मध्यवर्ती क्षेत्र भित्र जंगली जनावरहरुका गैह्रकानुनी चेारी शिकारी हुनु
- निरन्तर रुपले दाउरा तथा अन्य वन पैदावार संकल्नले गर्दा हाँकु गा.वि.सभित्र रहेको वन क्षेत्र पात्लिने
- हाँकु गा.वि.सभित्र वन अतिक्रमण हुनु
- लाडटाङ्ग राष्ट्रिय निकुञ्जको मध्यवर्ती क्षेत्र भित्र वन अतिक्रमण हुनु
- आयोजनाको बाँधबाट अचानक पानी छोडने कारणले जंगली जनावरहरुको बगेर र डुबेर दुर्घटना हुनु
- सुख्खायाममा नदीमा पानीको प्रभाव कम हुने र नदीको पानीको गहिराई घटनुले माछाको बासस्थानमा असर पर्ने

५.३ सामाजि आर्थिक र सास्कृतिक नकारात्मक वातावणीय प्रभाव

निर्माण चरण

- थायी रुपमा ९.३५ हेक्टर कृषि योग्य जमीनको नोक्सानले जम्मा १४ घरधुरीहरु प्रभावित हुने
- स्थायी रुपमा कृषि उत्पादनमा नोक्सान हुनु
- अस्थायी रुपमा १२.४० हेक्टर कृषि योग्य जमीनको नोक्सानले जम्मा २७ घरधुरीहरु प्रभावित हुने
- अस्थायी रुपमा कृषि उत्पादनमा नोक्सान हुनु
- हाँकु बेसी फुलबारी, गोगने र मैलुङ्ग क्षेत्रमा स्थानिय र बाहिरका कामदारहरु बीच सास्कृतिक द्धन्द हुनु
- स्थायी रुपमा दुई परिवारको दुईघर तथा दुई गोठ अधिग्रहण हुने
- आयोजना प्रभाावित परिवारका पुरुष घरमुलीद्धारा क्षतिपुतिको रकम जथाभावी खर्च गर्नु
- शैक्षिक संस्थाहरुमा चाप बढने
- स्वास्थ्य संस्थाहरुमा चाप बढने
- पानी वितरणमा समस्या हुने
- वातावरणीय व्यवस्थापनमा ह्रास र सरसफाईको समस्या बढनु
- स्थानीय स्तरमा चोरी डकैती जस्ता घटनाहरु हुनु
- रक्सी, जुवातास र झगडा जस्ता गैर सामाजिक गतिविधिहरु हुनु
- स्थानिय स्तरमा विद्धमान नियम कानुनको अवस्थामा खल्ल पुग्नु
- निर्माणका कामदारहरुमा चोटपटक र दुर्घटना हुन जानु
- यौन रोगहरु सर्ने तथा फैलिन सक्ने
- मजदुर क्यामपहरुमा कमसल खानाका कारणले विभिन्न किसिमका रोगहरु उब्जीनु
- दैनिक मजदुरी ज्यालामा लैङ्गिक विविधता आउनु
- मजदुरहरु बीच यौनदुर्व्यवहार हुनु
- आयोजना क्षेत्रभित्र बाल मजदुरको प्रयोग हुनु
- आयोजना क्षेत्रभित्र दलितलाई आयोजनाको कार्यममा विवेध गरिनु

संचालन चरण

- बाँध स्थल भन्दा मुनिको भागमा रहेको दलितहरुले प्रयोग गर्दै आएको मसानघाटलाई पानीको बहावले प्रभाव पार्ने
- अचानक पानी छोडनाले बाँध स्थल भन्दा मुनितिरका मान्छेहरु डुब्न सकने वा बग्न सक्ने
- सडक दुर्घटना हुन सक्ने

५.२ सकारात्मक प्रभाव

निर्माण चरण

- आयोजनाद्धारा सृजित रोजगारीका माध्यमले स्थानिय बासिन्दाहरुको आर्थिक अवस्था सुधारोन्नुमुख हुनु
- स्थानिय उत्पादन बस्तुहरुको व्यवसायमा वृद्धि हुनु
- स्थानिय स्तरमा विभिन्न खालका चिया पसल, होटेल, रेष्टुरेन्ट खोल्नुले स्थानीय स्तरमा विभिन्न प्रकारका व्यवसायिक अवरहरु सृजना हुने ।

संचालन चरण

- १४४० गीगावाट उत्पादन गर्दै आवश्यक उर्जा माग र उर्जा संकट कम गर्ने
- विद्युत आयोजना संञ्चालनद्धारा स्थानिय क्षेत्रको राजश्वमा वृद्धि हुने
- आयोजनाद्धारा सृजित रोजगारीका माध्यमले स्थानिय बासिन्दाहरुको आर्थिक अवस्था सुधारोन्नुमुख हुनु

६. वैकल्पिक विश्लेषण:

वैकल्पिक विश्लेषण अन्तरगत विना आयोजना विकल्प, आयोजनाको विकल्प, आयोजनाको डिजाइनको विकल्प (आयोजनाको उत्पादन शक्ति), आयोजनाको स्थानको विकल्प, आयोजनाको लागी आवश्यक पर्ने उर्जाको विकल्प, विना वन विकल्प, निर्माण सामग्रीको विकल्प र , वातावरणीय व्यवस्थापन प्रणाली रहेका छन ।

७. वातावणीय न्युनीकरण उपायहरु

७.१. भौतिक नकारात्मक वातावणीय प्रभाव

निर्माण चरण

आयोजनाद्धारा प्रयोग गरिएको जमीनमा आउने परिवर्तन दीर्धकालसम्म रहनेछ । आयोजना निर्माण अवधिमा विभिन्न विष्फोटक गतिविधिले क्षति भएका संरचनाहरुका लागी क्षतिपुर्ति उपल्बध गराईनेछ । आयोजना निर्माणका लागी प्रयोग गरिएका निर्माण यातायातकका साधन, मेशिनरी र औजारहरुमा मर्मत संभारद्धारा कोलाहल रहित वातावरणको व्यवस्था गरिनेछ । आयोजानसंग सम्बन्धीत आयोजना प्रस्तावक, ठेकदार र परामर्षदाता सहितका सम्पुर्ण यातायातका साधनहरुमा नेपाल सरकार वातावरण मन्त्रालयद्धारा जारी गरिएका हरियो स्टीकर अनिवार्य रुपमा प्रयोग गरी प्रदुषण माापदण्ड तोकिनेछ । यसरी निष्कासित मक तथा स्पाइललाई आयोजनाद्धारा तोकिएको आधिकारिक स्थानमा व्यवस्थापन गरिनेछ । आयोजनासंग सम्बद्ध विभिन्न जनशक्तिहरुका लागी निर्माण गरिने क्यामपहरुमा (फुलबारी, बजेटफाट, गुम्चेत, बालुवाफाट र मैलुङ्ग दोभान) आवश्यक पर्ने संरचनागत सुविधाहरु (चर्पी र स्नानगृह) को व्यवस्था गरिनुका साथै आयोजना निर्माणको क्रममा निष्केका विकार पानी तथा अन्य काम नलाग्ने पदार्थको व्यवस्थापनको योजना गरिनेछ । तरल खेर गएका पदार्थहरु मोविल, कलर, रसायनका साथै अन्य तेलयुक्त सामग्रीहरुको व्यवस्थापनका लागी आयोजनाद्धारा तोकिएको अधिकारीको सल्लाह बमोजिम छुट्टै संकलन केन्द्र तथा भचित किसिमको व्यवस्थापन गरिनेछ । कृषियोग्य (खेत र बारी) जमीनको माटोको माथिल्लो सतहको पुनः प्रयोगका लागी १० देखि ३० से.मी.को माटा संकलन गर्न माटो संरक्षण योजना तयार गरिनेछ ।

संचालन चरण

बाँध मुनिको भाग नदीको किनारा भुक्षय हुने जोखिमहरुलाई कम गर्नका लागी नदी नियन्त्रणका उपायहरु लागु गरिने छन । नदीमा बाँध भन्दा मुनि पानी कम हुनु आयोजनाको दीर्घकालिन प्रभाव हो । आयोजना सुरुङ्ग मार्ग (अडिट) बार्षिक २ पटक जाँच गर्नु र आवश्यक्ता अनुसार भिरालो भागलाई मजबुत गर्ने, बायोईजिनियरिङ्ग जस्ता कामहरु लागु गरिनेछ । यसरी निर्माण तथा संञ्चालनको अवस्थामा पर्न जाने भौतिक नकारात्मक वातावणीय प्रभावका न्युनीकरणका उपायका लागी अन्दाजी नेपाली लागत रु. ५,२००,०००। प्रस्ताव गरिएको छ ।

७.२ जैविक नकारात्मक वातावणीय प्रभाव

निर्माण चरण

आयोजनाले भौतिक पुर्वाधारका लागी प्रयोगमा ल्याएको २७.२० हेक्टर वन क्षेत्रलाई वन निर्देशिका अनुसार वृक्षरोपण गरी ५ वर्ष सम्म संरक्षित गरी सम्बन्धीत निकायलाई हस्तातरण गरिनेछ । यसरी वृक्षारोपण पर्ने वन क्षेत्र सम्बन्धीत जिल्ला वन कार्यालय र लाडटाङ्ग राष्ट्रिय निकुञ्जले निर्धारण गर्नेछ । आयोजना निर्माण क्षेत्र नजीक रहेको लाडटाङ्ग राष्ट्रिय निकुञ्जको मध्यवर्ती क्षेत्र र लाडटाङ्ग राष्ट्रिय निकुञ्जको अनुगमन तथा निरिक्षण जस्ता कामका लागी लाडटाङ्ग राष्ट्रिय निकुञ्जलाई थप कर्मचारी खटाउन सहयोग गरिनेछ । त्यस्तै वन र जंगली जनावरहरुको अनुगमन तथा निरिक्षण जस्ता कामका लागी स्थानिय सामुदायिक वन उपभोक्ता समुहहरुलेपनि सहयोग गरिनेछ । वन निर्देशिका अनुसार जम्मा क्षति भएका ४७९७ रुखहरुको सट्टामा हरेक रुख क्षति भएको स्थानमा १:२५का दरले हुनआउने जम्मा ११९९२५ वटा बिरुवाहरुका वृक्षरोपण गरिनेछ रवृक्षारोपण गरिने क्षेत्र जिल्ला वन कार्यालयले निर्देशित हुनेछ ।

संचालन चरण

बाँध स्थलमा माछा चढने सिडीको व्यवस्था गरिनेछ । अनाधिकृत व्यक्तिलाई वनको प्रवेशमा निषेधित गरिनेछ । वन र जंगली जनावरको सुरक्षाका लागी स्थानिय सामुदायिक वन उपभोक्ता समुहहरुको सहयोग तथा सहकार्यमा अनाधिकृत व्यक्तिहरुलाई अनावश्यक रुपमा वन क्षेत्रभित्र प्रवेशमा रोक लगाईनेछ । आयोजना निर्माण क्षेत्र नजीक रहेको लामटाङ्ग राष्ट्रिय निकुञ्जको मध्यवर्ती क्षेत्रको अनुगमन तथा निरिक्षण जस्ता कामका लागी लाडटाङ्ग राष्ट्रिय निकुञ्जले थप कर्मचारी खटाउन सहयोग गर्नेछ । सम्भव भएसम्म डयामबाट अचानक पानी छोडने समय दिनमा सिमित गरिनेछ । डयामबाट उललेखित निरन्तर पानीको बहावको लागी आयोजनाका अपरेटलाई आवश्यक निर्देशन दिईनेछ । यसरी निर्माण तथा संञ्चालनको अवस्थामा पर्न जाने जैविक नकारात्मक वातावणीय प्रभावका न्युनीकरणका उपायका लागी अन्दाजी नेपाली लागत रु. 46,650,000। प्रस्ताव गरिएको छ ।

७.३ सामाजिक आर्थिक तथा सास्कृतिक नकारात्मक वातावणीय प्रभाव

निर्माण चरण

जग्गा धनीको सहमति अनुसार स्थायी रुपमा अधिग्रहण गरिएको कृषि योग्य जग्गाको प्रचलित बजार मुल्य अनुसार क्षतिपुर्ति उपल्बध गराईनेछ । अस्थायी रुपमा लिने जग्गाको हकमा जग्गा धनीको सहमति अनुसार निश्चित अवधिका लागी क्षतिपुर्ति स्वरुप जग्गाको भाडा उपल्बध गराईनेछ । आयोजना प्रभावित घरधुरीहरुलाई सम्बन्धीत जमीनमा लगाएको एक बर्षको अन्न बालीको मुल्य क्षतिपुर्ति स्वरुप दिईनेछ । आायोजना निर्माण कार्यका लागी आवशयक पर्ने कामदारका लागी स्थानिय व्यक्तिहरुलाई पहिलो प्राथमिकता दिईनेछ । जनचेतना मुलक कार्यक्रमको माध्यमबाट बाहिरीया मजदुरहरुलाई स्थानियको प्राचीन संस्कृति तथा स.स्कारहरुको आदरका लागी जानकारी

गराईनेछ । विशेष आयोजना प्रभावित घरपरिवारलाई अधिग्रहण गरिएको घर तथा बासस्थानको क्षतिपुर्ति उपल्बध गराईनेछ ।

आयोजनाले आयोजना प्रभावित घरपरिवारलाई उपल्बध गराएको क्षतिपुर्ति रकमको सही सद्उपयोग सम्बन्धी परामर्ष सेवासञ्चालन गरिनेछ । आयोजनाले आयोजनाका कर्मचारी तथा मजदुरका केटाकेटीहरुलाई शैक्षिक सुविधा उपल्बध गराउनका लागी हाँकु गा.वि.सको स्कुललाई सहयोग गरिनेछ । आयोजना ठेकदारले आयोजनाको निर्माण काममा आवद्ध रहेका मजदुरहरुलाई व्यक्तिगत रुपमा स्वास्थ्य सेवा उपल्बध गराई डाक्टर, नर्स र अन्य कर्मचारीहरु भएको एउटा सुविधा सम्पन्न स्वास्थ्य संस्थाको व्यवस्था गर्नेछ र यसका साथै आफ्ना मजदुरहरुका लागी सबै क्यामपहरुमा नियमित पानीको व्यवस्थापन गर्नेछ । आयोजना निर्माण ठेकदारले निर्माण स्थलका प्रत्येक क्यामपमा एउटा सरसफाई इंकाइको व्यवस्था गर्नेछ । हाँकु गा.वि.स.क्षेत्र भित्र कानुनी अवस्थाको सुधारका लागी रसुवा जिल्ला प्रहरी कार्यालयले स्थानिय प्रहरीमा थप जनशक्तिका लागी अनुरोध गरिनेछ र साथै आवशयक पर्ने भौतिक पुर्वाधारका लागी आर्थिक सहयोग उपल्बध गराईनेछ । कामको प्कृतिको आधारमा हेल्मेट, पञ्जा, बुट, मास्क, इअर प्लगस र सेफ्टी वेल्ट जस्ता व्यक्तिगत सुरक्षाका औजारहरु प्रत्येक मजदुरलाई उपल्बध गराईनेछ । आयोजनाका मजदुरहरुलाई यौन सरुवा रोगहरुको हकमा सामुदायिक जनचेतना कार्यक्मका साथै नियमित स्वास्थ्य जाच जस्ता कार्यक्म सञ्चालन गरिनेछ । दुवै महिला तथा पुरुषलाई रोजगारीमा समान अवसरहरु उपल्बध गराईनेछ । केटाकेटीहरुलाई निर्माण कार्यमा सहभागी गराईने छैन । दलितहरुलाई तिनको योग्यता र क्षमताका आधारमा काममा प्राथमिकता दिईनेछ ।

संचालन चरण

बाँध स्थल भन्दा मुनिको विभिन्न स्थानमा साईरन नेटवर्कको व्यवस्था गरिनेछ । बाँध स्थलबाट अचानक पानी छोडदा कम्तीमा आधा घण्टा पुर्व तीनपटकसम्म साईरन बजाईनेछ । सडक दुर्घटना न्युनीकरणका लागी बस्ती नजीक गतिरोधक ट्राफिक सिगनलको स्थापना गरिनेछ । यसरी निर्माण तथा संञ्चालनको अवस्थामा पर्न जाने सामाजिक आर्थिक तथा सास्कृतिक नकारात्मक वातावणीय प्रभावका न्युनीकरणका उपायका लागी अन्दाजी नेपाली लागत रु २५३,२९८,६३७। प्रस्ताव गरिएको छ ।

८.वातावणीय सुधार कार्यक्म:

समुदाय र समुदायका मानिसहरुलाई विकासको अनुभुति गराउन आयोजना प्रस्तावकले आयोजना क्षेत्र भित्र शैक्षिक तथा शैक्षिक सुविधा सहयोग कार्यक्म, स्वास्थ्य संस्था सहयोग कार्यक्म, सडक विकास सहयोग कार्यक्म, सरसफाई सुधार र व्यवस्थापन सहयोग कार्यक्म, पानी वितरण सहयोग कार्यक्म, सिचाई व्यवस्थापन सहयोग कार्यक्म, कृषि सुधार सहयोग कार्यक्म, पशुपालन तथा कुखुरा पालन सुधार सहयोग कार्यक्म, महिला विकास कार्यक्म, प्राविधिक शिक्षा सहयोग कार्यक्म, कार्यालय सहयोगी तालीम कार्यक्म, जनजाति समुह सहयोग, लाडटाङ्ग राष्ट्रिय निकुञ्ज सहयोग कार्यक्म, स्थानीय संस्था सहयोग कार्यक्म, धार्मिक संस्था सहयोग कार्यक्म, माईसिंखोला लघु जल विद्युत सहयोग तथा ग्रामीण विद्युतीकरण सहयोग जस्ता सामुयिक विकासका कार्यक्महरु सञ्चालनमा ल्याउनेछ जसका लागी आयोजनाले नेपाली लागत रु.६४,०५०,०००। प्रस्ताव गरिएको छ ।

९. ऐन, नियम, निर्देशिका, निति, सम्मेलन र अन्य सम्बन्धीत संस्थाहरुको पुर्न अध्ययन

वातावणीय प्रभाव मुल्याङ्कनले नेपाल सरकारका विभिन्न संविधान, ऐन, कानुन, नियम, योजना, निर्देशिका, नितिहरु, र रणनितिहरु पुर्न अध्ययन गर्नुका साथै विभिन्न अन्तराष्ट्रिय सम्मेलन लगायतका प्रावधानहरु पुनः अध्ययन गरिएको छ । जुन यस प्रकार छन - नेपालको आन्तरिम संविधान २०६३, (2006), वातावरणीय संरक्षण ऐन, वि.स.२०५३ (1997), जग्गा अधिग्रहण ऐन वि.स.२०३४(1977), विष्फोटक ऐन वि.स.२०१८ (1961), वन ऐन वि.स.२०४९ (1993), भुमि सुधार ऐन वि.स.२०२१ (1964), स्थानिय स्वायत ऐन वि.स.२०५५ (1998), विद्युत ऐन वि.स.२०४९ (1992), पानी स्रोत ऐन वि.स.२०४९ (1992), जंगली जानवर संरक्षण ऐन वि.स.२०१५ (1958), राष्ट्रिय निकुञ्ज र जंगली जनावर संरक्षण ऐन वि.स.२०२९ (1973), जलचर संरक्षण ऐन वि.स.२०१६ (1961), माटो र पानी संरक्षण ऐन वि.स.२०३९ (1982), मजदुर ऐन वि.स.२०४९ (1992), वातावरणीय संरक्षण नियमावली वि.स.२०५४ (1998), वन नियम वि.स.२०५१ (1995), स्थानिय स्वायत नियम वि.स.२०५६ (1999), विद्युत नियम वि.स.२०५० (1993), राष्ट्रिय निकुञ्ज र जंगली जनावर संरक्षण नियम वि.स.२०३० (1974), संरक्षण क्षेत्र व्यवस्थापन नियम वि.स.२०५३ (1996), राष्ट्रिय वातावरणीय प्रभाव मुल्याङ्कन निर्देशिका, वि.स.२०५० (1993), राष्ट्रिय वातावरणीय प्रभाव मुल्याङ्कन वन निर्देशिका, वि.स.२०५२ (1995), सामुदायिक वन निर्देशिका, वि.स.२०५८ (2001), सामुदायिक वन सुची निर्देशिका वि.स.२०६२ (2005), राष्ट्रिय स्वास्थ्य सुरक्षा र फोहोर मैला व्यवस्थापन निर्देशिका वि.स.२०५९ (2002), वातावरणीय व्यवस्थापन निर्देशिका (रोड) वि.स.२०५४ (1997), मध्यवर्ती क्षेत्र व्यवस्थापन निर्देशिका वि.स.२०५६ (1999), तीन बर्षे अन्तरिम योजना वि.स.२०६४(2007), राष्ट्रिय वातावरणीय निति र कार्ययोजना १ र २, वि.स.२०५० (1993) र वि.स.२०५५(1998), कृषि दृष्टिकोण योजना, वि.स.२०५२ (1995), वन क्षेत्रको गुरु योजना वि.स.२०४५ (1988), नेपाल जैविक विविधता सञ्चालन योजना वि.स.२०६० (2003), परिमार्जित वन निति, वि.स.२०५८ (2000), राष्ट्रिय सुरक्षा रणनिति वि.स.२०४५ (1998), गरिबी निवारण रणनिति वि.स.२०५९ (2002), जलस्रोत रणनिति वि.स.२०५९ (2002), अन्तराष्ट्रिय संकटग्रस्त प्रजाति व्यापार सम्मेलन, जैविक विविधता सम्मेलन 1992, र अन्तराष्ट्रिय मजदुर संगठन सम्मेलन 196

१०. वातावरणीय व्यवस्थापन योजना

माथिल्लो त्रिशुली -१ ले प्रस्तावित गरेको वातावरणीय व्यवस्थापन आवश्यक्ता र विकास प्रक्रियाको निश्चित्ताका लागी सबै न्युनीकरण प्रक्रिया र अनुगमनको आवश्यक्तालाई वातावरणीय प्रभाव मुल्याङ्कन प्रतिवेदन अनुसार आयोजनाको विकासको चरणमा लागु गरिनेछ । वातावरणीय व्यवस्थापन योजनाका चारवटा महत्तवपुर्ण अंगहरुमा वातारणीय व्यवस्थापन संरचना, वातारणीय अनुगमन व्यवस्थापन योजना, वातारणीय न्युनीकरण व्यवस्थापन योजना र वातारणीय निरिक्षण व्यवस्थापन योजना हुन । आयोजनाको मुख्य दायित्व अन्य निकायहरुसंगको सहकार्यमा वातावरणीय व्यवस्थापन योजना पुरा गर्नु रहनेछ । आयोजनाको वातावरणीय व्यवस्थापन योजना र वातावरणीय अनुगमन व्यवस्थापन योजनालाई निरन्तर रुपमा अघि बढाउनका लागी आयोजनाको आयोजना निर्माण व्यवस्थापन कार्यालय र आयोजना सञ्चालन व्यवस्थापन कार्यालय अन्तरगत एउटा छुट्टै वातावरणीय तथा सामाजिक व्यवस्थापन सेल स्थापना गरिनेछ । साथै प्रस्तावित लेखापरिक्षणका लागी पनि आयोजनाका प्रस्तावक नै विशेषतः जिम्मेबार रहनेछन जसका निम्ति प्रस्तावकले वातावरणीय लेखापरिक्षणका लागी सरकारी अथवा चुनिएका वातावरणीय लेखापरिक्षकको नियुक्ति गर्नेछ । यसरी वातावरणीय व्यवस्थापन अनुगमन योजनाका लागी ने. रु ११७६०००० छुट्याएको छ भने वातावरणीय लेखापरिक्षणका लागी ने.रु. ८००,००० व्यवस्था गरेको छ ।

११. आयोजनाको लागत र आम्दानी

आयोजनाले उत्पादन अवस्थामा बार्षिक १४४० गिगावाट घण्टा विद्युत उत्पादन गरी ने.रु ६,४८०,०००,०००। बराबरको उर्जाको बिक्री गर्नेछ । आयोजनाको वातावरणीय न्युनीकरण, वातावरणीय अनुगमन, वातावरणीय लेखा परिक्षण र बढोत्तरीका कार्यक्रमका लागी जम्मा लागत ने.रु ३८,१७५८,६३७। रहेको छ जुन आयोजनाको लागतको १.०४६ प्रतिशत हुने छ ।

निर्स्कष

सम्पन्न गरिएको वातावरणीय प्रभाव मुल्याङ्कन अध्ययन अनुसार प्रस्तावित माथिल्लो त्रिशुली-१ जलविद्युत आयोजना वातावरणीय दृष्किोणले उपयुक्त रहेको पाईएकोछ किनकि यस आयोजनाले वरपरको वातावरण तथा समाजमा कम प्रभाव पुरयाउनेछ । आयोजनाको आकार अनुसार यसबाट पर्ने प्रभावहरु क्म तथा मध्यम प्रकृतिका छन । आयोजानका मुख्य वातावरणीय प्रभावहरुलाई आवश्यक अनुसार न्युनीकरण गर्न सकिनेछ । यस बाहेक प्रस्तावि आयोजना प्राविधिक, वातावरणीय र आर्थिक दृष्किोणले पनि सक्ष्यम रहेकोछ । यस आयोजनाको विकासले स्थानीय क्षेत्रको विकासका साथै राष्ट्रको आर्थिक वृद्धिमा सकारात्मक योगदान पुरयाउनेछ ।

Executive Summary

Name of the Proposal, Address of the Proponent and Organization Responsible for Preparation of the Report

The name of the Proposal is "Upper Trishuli-I Hydroelectric Project (216 MW) " which is one of the hydropower projects identified in Trishuli River. The purpose of the proposal is to develop Upper Trishuli-I Hydroelectric Project (UT-I HEP) by utilizing the water of Trishuli River located in Haku, Dhunche and Ramche VDCs of Rasuwa district within the geographical boundary of latitudes 280 04' 27.5" and 280 07' 42" North and longitudes 850 12' 40" and 850 18' 03" East.

The proponent of Upper Trishuli-I Hydroelectric Project (216 MW) is Nepal Water and Energy Development Company (P) Ltd (NWEDC) which is a private company established and registered under GoN in the year 10th of Baisakh, 2059 B.S. The detail address of the Proponent is as under:

Nepal Water and Energy Development Company (P) Ltd.

P.O.Box: 746, Kathmandu, Nepal

Telephone: 00977-1-4247237, Fax: 00977-1-42321

The proponent has appointed Jade Consult Pvt. Ltd. (formerly known as NEPDC) to carry out the EIA Study of the proposed project. The detail address of the organization is as under:

Jade Consult Pvt. Ltd.
Kabilmarg, Thapathali, Kathmandu, Nepal
Tel: 00977- 1- 4222202
Web: www.jadeconsult.com.np

Rationality for Conducting EIA Study

The Environment Protection Act (EPA) 1997 and the Environment Protection Rules (EPR) 1998 provide details on provisions to prepare and approve the EIA report of each hydropower project exceeding above 50 MW of installed capacity before implementation. As per the Schedule 2 of the EPR 1997, this project should undergo EIA process legally. Furthermore the area falls within the Buffer zone of Langtang National park and hence required EIA (EPR 1997 schedule 2, pertaining to rule 3 of article K of 3 as a part of the EIA process. The project will require acquisition of 27.20 ha forest for implementation and thus, also attract schedule 2, pertaining to rule 3 of article A of 4 to undergo EIA process.

The Proposed Project

The proposed Upper Trishuli-I Hydroelectric Project (216 MW) is a run-of-river type project identified in Trishuli River. The project has installed capacity of 216 MW with an average annual energy generation of 1557 GWh utilizing the design discharge of 74m^3/s and a gross

head of 350m. The weir site is situated in Dhunche and Haku VDCs near Hakubesi-Hakubesi-Fulbariand powerhouse is situated in Baluwa Phant of Haku VDC. Similarly, the intake structure, desander, headrace tunnel, adits, penstock tailrace, switchyard and remaining project facilities are located on the right side of Trishuli River in Haku VDC. At present, there is no passable access for wheeled transport to headworks. However, the powerhouse site of proposed project is accessible by vehicles through 13 kilometer long seasonal road from Betrawati. The project will need 104.45 hectares of land (47.58 ha permanently and 56.88 ha temporarily) for the construction and implementation of the project.

Existing Environmental Condition

Physical Environment

The project area lies in the upper stream of Trishuli River in Rasuwa District in Higher Himalayan zone of central Nepal. The land surface is somewhat rugged and with steep slopes to vertical cliff containing residual soil and exposing hard rock. The annual maximum temperature in the project area occurs generally in the month of May and ranges from 18˚C to 20˚C. Likewise, the minimum temperature generally occurs in February and January ranging from 0˚C to 5˚C. The average annual basin precipitation of the project site is between 2000 to 2500mm and 80% of the annual rainfall occurs in monsoon season. The overall drainage pattern of the project area is dendrite. The air, water and noise quality of the project construction area is found to be in pristine condition with no polluting sources. The sedimentation is a major problem in the river as of its tremendous carrying capacity due to high velocity of flow caused by high gradient and yearly effects of snow melting upstream in the valley. Geologically, the project area belongs to the Lesser Himalayan Zone of Central Nepal. The predominant rock type of the project area is Phyllitic schist with metasandstone but in some area phyllitc quartzite can also be found inter bedded with Ulleri gneiss rock. The surface deposit in the project area mainly consists of colluviums and alluvium. The project area shows diverse nature of slopes from medium to high slope angle. Ramche, Thade, Haku and Sarghang are the major landslides of the project area. The stretch of Trishuli River between headworks and powerhouse sites is not used for any purpose except a cremation site practiced by local Dalit of Haku VDC. The land uses of project construction site are Bagar (30.31%), forest (26.05%), cultivated land (19.83%), cliff (13.71%), Bushes (7.14%), Khar Bari (1.00%), river (0.90%) and existing road (1.07%).

Biological Environment

The project area mainly lies adjacent to the Langtang National Park. The left side of the weir site falls on the buffer zone of the Langtang National Park where as various structures and facilities on right bank is situated in community and private forest of Haku VDC . The project area is rich in terms of plant bio-diversity consisting distinct bands of vegetation. However, due to steep topography, on both sides of the river, the flora and vegetation of the project site itself is found less gregarious in comparison to the surrounding vegetation of the region. The sites for the hydropower construction fall within the range of 905m to 1235m in altitude and it represents upper tropical (500-1000m) and lower sub-tropical (from 1000-1500m) zone. Hill sal, chirpine and alder comprise the main forest component of the project area. About 243 plant species are identified in regional and local context of EIA study. Likewise, about 30 tree species are recorded in project construction site with Sal, Daar and

Khote Sallo as common tree species. There are altogether 15 community forests in Haku VDCs of which 6 community forests will be affected by the construction. The collection of firewood, wild fruits and vegetables for own consumption is the common practice in the area. Farmers cultivate grow some cereals like maize, millets, wheat, various pulses, mustard, vegetables etc. and some perennial crops like fruits, fodder and timber species mostly for home consumption under rain-fed conditions. Bombax ceiba and Shorea robusta are the protected plant species of the project construction site.
A total of 23 species of mammals, 62 species of birds, 20 species of herpetofauna, 4 species of fishes and 40 species of butterflies were reported from the project area with 7 mammals, 10 birds and 1 hepetofauna listed in protected category. Only 2 species of fish species i.e Schizothorax richardsonii and Schizothoraichthys progastus are recorded in fish sampling study and Pseudecheneis sulcatus and Noemacheilus botia are the fish species reported in the Trishuli River.

Socioeconomic and Cultural Environment

Rasuwa district comprises an area of 1544 Sq. Kms covering 1.05% of total area of Nepal. The total population of Rasuwa district is 44,731 (52.21% male and 47.79% female) with 8696 households and average household size of 5.14.

The project structures and facilities are located in Haku, Dhunche and Ramche VDCs and are termed as project affected VDCs. The total population of project affected VDCs is 6986 (53.63% male and 46.37% female) with 1426 households and average household size of 5.00. Tamang (79.73%) is the major ethnic group followed by Gurung (6.01%) and Brahmin (4.09%). Buddhism (87.45%) is the major religion. Tamang (86.22%) is the dominant language. The literacy and educational status is poor with figure showing more than 60% of illiterate population and population with education level above SLC is extremely low (2.13%). There are altogether 15 educational institutions (13 primary, 1 lower secondary, 1 secondary and 1 higher secondary). Dhunche VDC is facilitated with 1 district level hospital and 1 health post and both Haku and Ramche VDCs are facilitated with 1 sub-health post each. The available treatment facilities of both Haku and Ramche VDC are exceptionally poor due to lack of proper health personnel, treatment technology and medicines. The major diseases of the three VDCs are Jaundice, Cold/cough, Tuberculosis, STD, uterus prolapsed, etc. More than 55% households have no access to safe drinking water. Similarly, 64.81% households have not toilet facility. Ramche and Dhunche VDCs have been facilitated with electricity supplied from National grid where as In Haku VDC, Peltric set and Solar panel is the only source of light. Fuel wood (93.62%) is the major fuel used for cooking purpose. Majority of the population follow agriculture for their subsistence.

Hakubesi-Fulbari, Gogane and Mailun are the settlements located within the project construction sites and are considered as project affected settlement. The project affected settlements have 1066 population residing in 132 households with an average household size of about 8.14. Tamang are major ethnic group in the settlements. Many households in the settlement still believe in traditional healer i.e. Dhhami and Dhakri and prefer for treatment before going to the health institution.

41 households will lose their land and assets due to acquisition of land by the project. Out of these 41 PAFs, 39 PAFs (95.12%) will lose their land while 2 families (4.88%) lose their

both land and residential structures. The total populations of PAFs are 313 (51.44% male and 48.56% female). The average household size is 7.63. All the PAFs (100%) belong to Tamang ethnic group. Majorities of the PAFs (87.80%) follow Hinduism as their main religions. 34.82% of the total population of PAFs had education of primary and lower secondary level. Almost all PAFs preferred cash compensation for land and property in case of compulsory displacement.

Lhochar, Dashain, Tihar, Ram Nawami, Maghe Sakranti, Saune Sakranti, Tij, Janai purnima, Krishnna Janmastami, Buddha Purnima are the common festivals of project VDCs. In Haku VDC, the riverbanks at foothill of Hakubesi are used as cremation area by few Dalits of Haku VDC.

Environmental Impact

Physical Environmental Adverse Impact

Construction Phase

- Permanent change of forest land use (21.39 hectares) by the establishment of various project structures and facilities.
- Permanent change of agricultural land use (9.35 hectares) by the establishment of various project structures and facilities.
- Temporary change of agricultural land use (12.40 hectares) by the establishment of project facilities
- Damage of structures (mud/ mortar houses and sheds) located nearby access road and Adit 1 at Hakubesi due to development of crack
- Changes in Noise level within the construction site of Adit Portals and Access Road
- Land instability and erosion of deposited spoil and muck
- Degradation of air quality due to release of carbon monoxide, sulphur oxide, hydrocarbons, hydrogen sulphides, $PM_{10,}$ etc
- Degradation of river water quality by inappropriate disposal of muck & spoil
- Degradation of water quality by sewage discharged from construction camp (labour camp and engineering camps)
- Degradation of water quality by liquid waste such as lubricants, paints, cleaning, chemical and other aqueous oil based materials
- Degradation of fertility of soil

Operation Phase

- Erosion of river bank downstream of weir by the release of sediments
- Reduction of water in dewatered zone and widening of dewatered zone
- Slope failure of tunnel portal (adit)

Biological Environmental Adverse Impact

Construction Phase

- Permanent loss of 18.29 hectares of community forest
- Permanent loss of 2.61 hectares of government forest (forest of buffer zone of LNP)
- Temporary loss of 4.72 hectares of community forest
- Illegal collection of firewood, NTFPs, valuable floral species, etc. by construction workers from the buffer zone areas of LNP
- Illegal harvesting of forest product for fuel wood, timber and NTFPs by construction workers in local community forest of Haku VDC.
- Illegal hunting and poaching of wild animal in buffer zone area of LNP
- Illegal hunting and poaching of wild animal in community forest of Haku VDC
- Driving away of terrestrial wildlife due to increment of noise level
- Loss of 12001 tree species (Seedling-48.58, Sapling-2346, Pole-3880 and Tree-917) of community, government and private forest

Operation Phase

- Obstruction of the route of mid distant Snow Trout by the placement of weir in Trishuli river
- Exploitation of forest products within access road of Haku VDC
- Illegal collection and harvesting of forest products from Buffer zone of LNP
- Illegal hunting and poaching of wild animal by the visitor in Haku VDC
- Illegal hunting and poaching of wild animal by the visitor in Buffer zone area of LNP
- Degradation and fragmentation of the forest due to unregulated collection of the forest products of local forest of Haku VDC
- Encroachment of forest land of Haku VDC
- Encroachment of forest land in buffer zone of LNP
- Accidental washout or drowning of wild animals by sudden release of water from weir
- Reduction in discharge of water and decrease river depth in dry month affecting river ecology including habitat of fish of LNP area

Socioeconomic and Cultural Environmental Adverse Impact

Construction Phase

- Permanent loss of 9.35 ha of agricultural land affecting 14 households
- Permanent loss of agricultural production
- Temporary loss of 12.40 ha of agricultural land affecting 27 households
- Temporary loss of agricultural production
- Conflict due to clash of culture and rituals between outside and local work force near settlements such as Hakubesi-Fulbari, Gogane and Mailun
- Permanent acquisition of 2 residential structures resulting in the loss of shelter of 2 families
- Misuse of compensation by male members of PAFs resulting lifelong poverty and impoverishment

- Pressure on educational Institution
- Pressure on health institution
- Pressure on water supply
- Pressure on management of sanitation condition and consequence of environmental degradation
- Occurrence of theft and burglary
- Incidence of anti-social activities like alcohol consumption, gambling, quarrel, etc
- Deterioration of local law and order condition
- Occurrence of accident and injuries to project personnel
- Transfer and spreading of diseases such as STDs, HIV/AIDS
- Gender discrimination in project employment and payment of daily wages
- Exploitation of women sexually and physically
- Employment of underage children in project works
- Discrimination of disadvantaged group (Dalit) in project works

Operation Phase

- Sudden release of water resulting drowning of people in dewatered stretch
- Occurrence of road accidents

Beneficial Physical Environmental Impact

Construction Phase

- Economic upliftment of local people by generation of income through employment in the project
- Increase in business due to supply of commodity and locally produced goods
- Establishment of tea stalls, grocery shops, restaurants, hotels, etc creating business opportunities for local people

Operation Phase

- Generation of 1440 GWh of clean and renewable energy fulfilling energy demand and minimizing energy crisis
- Increment in revenue of local area by the operation of proposed hydropower plant
- Economic upliftment of local people by generation of income through employment in the project

Alternative Analysis

Alternative analysis is carried out for no action alternative, project alternative, alternative design options (power generation), alternative location, alternative energy to be used, no forest alternative, construction material alternative and environmental management system.

Environmental Mitigation Measures

Physical Environmental Impact

Construction Phase

The change in land use will remain as the residual impact of the project. Compensation will be provided to structures if reported to be damaged by blasting activities during construction period. Maintenance of construction vehicles, machineries and equipments will be carried out to control mechanical noise. All vehicles belonging to the Project i.e., proponent, contractors, consultants will comply with the national emission standards of the Ministry of Environment, Nepal (with Green Sticker). The generated spoil and muck will be disposed behind the gabion structures of required size and capacity for the protection of spoil/muck disposal toe. The generated muck and spoil will be disposed at authorized site only. Separate washing, bathing, urination and toilet facilities will be provided at the labor camps and engineering camps of Hakubesi-Fulbari, Buchet Phant, Gumchet, Baluwa Phant and Mailun Dovan along with appropriate sewage network to drain the waste water in waste water treatment plan. Proper solid waste management system will be established in the construction camp for collection, segregation and disposal of solid waste. The liquid waste generated from construction sites such as lubricants, paints, cleaning, chemical and other aqueous oil based materials will be collected separately and stored in suitable storage tank for final management with the advice of the authorized officer. The top soil preservation plan will be prepared to collect top soil (10 to 30cm) of agricultural land (both khet and bari) to reuse.

Operation Phase

The erosion of river bank will be minimized by implementing river bank protection measures in susceptible site downstream of weir. The reduction of water in dewatered zone is residual impact of the project. The structural rigidness of tunnel portals (adits) will be checked annually (twice a year) and repair works such as slope stabilization works, bioengineering, etc will be implemented as per the requirement.

The total cost of mitigation of physical adverse environmental impact for both construction and operation phase of the proposed project is estimated as **NRs.5,200,000/-**

Biological Environmental Impact

Construction Phase

The area equivalent to occupied forest area (27.20 hectares) for project physical infrastructures will be afforested by the project and protected for 5 years and handed over to related stakeholders as per the Forest Guideline for the Allocation of the Forest land to other Development Projects. The afforestation area will be as per the area designated by the respective district forest office and LNP. LNP will be supported in recruiting additional staffs to increase monitoring and surveillance activities in buffer zone of LNP at weir site as well as LNP area nearby project construction site. Similarly, local forest user group will be supported in surveillance activities for conservation of forest and wildlife. The compensatory plantation of 4797 felled trees at a ratio of 25 seedlings for each lost tree

equivalent to 119925 numbers as per the Forest Guideline, 2006 in an area as directed by the District Forest office of Rasuwa district will be carried out.

Operation Phase

Fish ladder is provided in weir structure. The roaming of unauthorized people in local forest will be prohibited by coordinating and supporting local forest user group committee in surveillance activities for protection of forest and wildlife. LNP will be supported in recruiting additional staff to increase monitoring and surveillance activities in buffer zone of LNP at weir site as well as LNP area nearby project construction site. The sudden release of water from dam will be limited to day hour as far as possible. The project operators will be instructed to release environmental flow at all times of project operation.

The total cost of mitigation of biological adverse environmental impact for both construction and operation phase of the proposed project is estimated as **NRs.46,650,000/-**

Socioeconomic and Cultural Environmental Impact

Construction Phase

The loss of permanently acquired agricultural land will be compensated at the current market price and with the consent of land owner. The loss of temporarily acquired agricultural land will be compensated through land rental and with the consent of land owner. The loss of standing crops of one year will be provided to PAFs. Local people will be prioritized for employment in project construction works. The outside work force will be instructed to respect the local tradition, culture and riots by conducting awareness programme. The house owners or SPAFs will be compensated of acquired residential structures. The project will provide counseling service to PAFs for the effective utilization of the compensation amount. The project will assist the school of the Haku VDC to provide education to the children of project staff and workers. The project contractor will set up its own heath institution manned by doctors, nurses and staffs within the construction camps to provide health services to the work personnel. The project contractor will set up its own persistent water supply system for workforce in all camps. The project contractor will set up sanitation management unit in each of the construction sites. The District Police Office, Rasuwa district will be requested to increase the security personnel in Haku VDC to improve the law & order and the existing police post will be provided with financial assistance for required infrastructures and facilities. Personal protective equipments such as helmets, gloves, boots, mask, ear plugs, safety belts etc. will be provided to all workers as per the nature of their work. Community awareness programme on sexually transmitted disease and ways to prevent such disease will be conducted as well as regular health checkups of construction workers will be conducted. Both women and men will be provided with equal opportunity in project works. Children will not be involved in construction works. Dalit will be prioritized in project works as per their skills and capacities.

Operation Phase

Siren network will be installed at different locations in the dewatered zone and siren will be blown (3 times) half an hour prior to sudden release. The traffic signal showing restriction on speed will be installed near settlements to prevent road accident.

The total cost of mitigation of socioeconomic and cultural adverse environmental impact for both construction and operation phase of the proposed project is estimated as **NRs.253,298,637/-**

Environmental Enhancement Programme

To address the development aspiration of the local people and community, the proponent has planed various environmental enhancement programmes such as Education and education facility support programme, Health institution support programme, Road development support programme, Sanitation improvement and management support programme, Water supply support programme, Irrigation management support programme, Agricultural enhancement support programme, Animal husbandry and poultry enhancement support programme, Women development programme, Technical education support programme, Office and secretarial training programme, Ethnic group support programme, Langtang national park (LNP) support programme, Local organization support programme.

Religious institution support programme, support to Misyung khola micro hydropower (peltric set system) and Rural electrification support programme. The project has allocated **NRs. 64050000/-** for the programme..

Review of Acts, Regulations, Guidelines, Policies, Convention and other Related Institution

The EIA study has reviewed various constitution, laws, acts, rules, regulations, guidelines, plans, policies, strategies of Government of Nepal along with international conventions related to UT-I HEP that include Interim Constitution of Nepal, 2063 (2006), Environmental Protection Act, 2053 B.S (1997 A.D), Land Acquisition Act, 2034 B.S (1977 A.D), Explosive Act, 2018 B.S (1961 A.D), Forest Act, 2049 B.S (1993 A.D), Land Reform Act, 2021 B.S (1964 A.D), Local Self Governance Act, 2055 B.S (1998 A.D), Electricity Act, 2049 B.S (1992 A.D), Water Resource Act, 2049 B.S (1992 A.D), Wildlife Protection Act, 2015 B.S (1958 A.D), National Park and Wildlife Conservation Act, 2029 B.S (1973 A.D), Aquatic Life Protection Act, 2016 B.S (1961 A.D), Soil and Watershed Protection Act, 2039 B.S (1982 A.D), Labor Act, 2049 B.S (1992 A.D), Environmental Protection Rules, 2054 B.S (1998 A.D), Forest Rule, 2051 B.S (1995 A.D), Local Self Governance Regulation, 2056 B.S (1999 A.D), Electricity Rules, 2050 B.S (1993 A.D), National Park and Wildlife Conservation Rule, 2030 B.S (1974 A.D), Conservation Area Management Rule, 2053 B.S (1996 A.D), National EIA Guideline, 2050 B.S (1993 A.D), EIA Guideline for Forest Sector, 2052 B.S (1995 A.D), Community Forest Guideline, 2058 B.S (2001 A.D), Community Forest Inventory Guideline, 2062 B.S (2005), National Health Care and Waste Management Guideline, 2059 B.S (2002 A.D), Environmental Management Guidelines (Road), 2054 (1997), Buffer Zone Management Guideline, 1999 B.S (2056 A.D), Three Years Interim Plan, 2064 B.S (2007 A.D), National Environmental Policy and Action Plan I & II, 2050 B.S (1993 A.D) and 2055 B.S (1998), Agricultural Perspective Plan, 2052 B.S (1995 A.D), Forest Sector Master Plan, 2045 B.S (1988 A.D), Nepal Biodiversity Implementation Plan, 2060 B.S (2003 A.D), Revised Forest Policy, 2058 B.S (2000 A.D), National Conservation Strategy, 2045 B.S (1988 A.D), Poverty

Reduction Strategy, 2059 B.S (2002 A.D), Water Resources Strategy, 2059 B.S (2002 A.D), Convention on International Trade of Endangered Species (CITES), Convention on Biological Diversity (CBD), 1992 and ILO Convention, 169.

Environmental Management Plan

EMP for UT-I HEP (216 MW) has been proposed to set out environmental management requirements and development of procedures to ensure that all mitigation measures and monitoring requirements specified in this EIA study report will be carried out in subsequent stages of project development. The Environmental Management Plan (EMP) of the project includes 4 essential components namely (a) Environmental Management Structure (b) Environmental Mitigation Management Plan (c) Environmental Monitoring Management Plan and (d) Environmental Auditing Plan. The project has the key responsibility for the implementation of the environmental management plan in co-ordination with the other project stakeholders. A separate environmental and social management cell (ESMC) will be established under Project Construction Management Office (PCMO) and Project Operation Management Office (POMO) in both construction and operation phase for the appropriate implementation of environmental requirements that includes both environmental mitigation management plan and environmental monitoring management plan of the project. In addition, the project proponent will be primarily responsible for carrying out all the proposed audit activities and will make necessary arrangements for environmental audit through GoN or its nominated auditor. The project has estimated NRs.**11,760,000/-** for implementation of Environmental Monitoring Management Plan and NRs.800,000/0- for Environmental auditing.

Project Cost and Benefit

The operation of project will generate 1440 GWh of clean and renewable energy with annual sale of energy of NRs.6480000000/-. The total cost for environmental mitigation, monitoring, audit and enhancement cost is **NRs.381758637/-** which is 1.046 % of the project costs

Conclusion

The proposed Upper Trishuli-I Hydroelectric Project (216 MW) as indicated in the present level of the study is found to be feasible from environmental perspective as it causes minimal impacts to the surrounding environment and society. Most of the impacts are low and moderate, as compared to the project scale and the key environmental impacts of the project could be mitigated to acceptable levels. Furthermore, the project is viable from technical, environmental and economical aspects. The development of this project will have positive contribution to the development of the locality as well as economic growth of nation.

ABBREVIATIONS AND ACRONYMS

AD	Annodomini
AIDS	Acquired Immune Deficiency Syndrome
°C	degree centigrade
BA	Basal Area
BMCC	Biodiversity Monitoring and Coordination Committee
BOD	Biological Oxygen Demand
cft	Cubic Feet
CBD	Convention on Biological Diversity
CBH	Circumference above Breast Height
CBO	Community Based Organization
CDO	Chief District Officer
CF	Community Forest
CFUGs	Community Forest Users Groups
CHDP	Community Health and Development Programme
CITES	Convention on International Trade on Endangered Species
COL	Collinear level 2,500 to 3,000m
CR	Critically Endangered
D	Diameter
DBH	Diameter at Breast Height
DDC	District Development Committee
DEVA	Development Associates for Rural and Regional Development
DO	Dissolve Oxygen
DoED	Department of Electricity Development
DFO	District Forest Office
DoF	Department of Forest
DNPWC	Department of National Park and Wildlife Conservation
eNd	Isotopic Sequence value
EIA	Environmental Impact Assessment
EPA	Environmental Protection Act
EPR	Environmental Protection Regulation
FUGs	Forest Users Group
GLOF	Glacier Lake Outburst Flood
GoN	Government of Nepal
GWh	Giga Watt Hour
H	Height
Ha	hectare
HH	Household
HIV	Human Immunodeficiency Virus
HPP	Hydropower Project
HRT	Headrace Tunnel
IEE	Initial Environmental Examination
IUCN	International Union for Conservation of Nature
IVI	Importance Value Index
Kg	Kilo Gram
Km	Kilo metre
KW	Kilo Watt
kWh	Kilo Watt Hour
Lat	Latitude

LC	Least Concern
LDO	Local Development Officer
LNP	Langtang National Park
Long	Longitude
LR	Low Risk
LRMP	Land Resource Mapping Project
m	Metre
m2	Meter Square
m3	Meter Cube
mm	Millimetre
masl	Mean Average Sea Level
MBT	Main Boundary Thrust
MCT	Main Central Thrust
mg/L.	Milligram per Litre
MHT	Main Himalayan Thrust
MT	Metric Ton
MoE	Ministry of Environment
MoFSC	Ministry of Forest and Soil Conservation
MoEn	Ministry of Energy
mpa	Mega Pascal
Msl	Mean Sea Level
MT	Metric Tonnes
NDWQS	National Drinking Water Quality Standards
NE	Northeast
NEA	Nepal Electricity Authority
NEPAP	Nepal Environmental Policy and Action Plan
NGOs	Non-Governmental Organizations
No	Number
NRs	Nepali Rupees
NTFPs	Non-Timber Forest Products
NTU	Nephelometric Turbidity Unit
NW	Northwest
PAF	Project Affected Family
PIC	Public Information Centre
PPE	Personal Protective Equipment
Q	Tunnel Quality Index
RMR	Rock Mass Rating
SCP	Safe Construction Practices
SE	Southeast
Sp	Species
SPAF	Seriously Project Affected Family
STD	Sexually Transmitted Disease
STM	Synchronous Transport Module
SW	Southwest
TDS	Total Dissolved Solid
ToR	Terms of Reference
TSP	Total Suspended Particulates
TSS	Total Suspended Solid
UGs	User Groups
UT-I	Upper Trishuli-I
UT-I HEP	Upper Trishuli-I Hydroelectric Project

V	Volume
VDC	Village Development Committee
µS/cm	microsiemens per centimetre

TABLE OF CONTENTS

COMMENTS FROM MINISTRY OF ENERGY I

EXECUTIVE SUMMARY (NEPALI) XXXV

EXECUTIVE SUMMARY XLVI

1 INTRODUCTION 68

1.1 BACKGROUND 68
1.2 NAME OF THE PROPOSAL 69
1.3 PURPOSE OF THE PROPOSAL 70
1.4 NAME AND ADDRESS OF THE PROPONENT 70
1.5 ORGANIZATION RESPONSIBLE FOR PREPARATION OF THE REPORT 70
1.6 RATIONALITY FOR CONDUCTING EIA STUDY 72
1.7 OBJECTIVE OF EIA STUDY 72
1.8 STUDY TEAM 72
1.9 WORK SCHEDULE OF EIA 73
1.10 EIA BUDGET 74
1.11 PROJECT AREA DELINEATION 74
1.11.1 Category A: High Impact Area 74
1.11.2 Category B: Moderate Impact Area 74
1.11.3 Category C: Low Impact Area 74

2 METHODOLOGY 75

2.1 DESK STUDY AND LITERATURE REVIEW 75
2.2 FIELD STUDY 75
2.2.1 Physical Environment 75
2.2.2 Biological Environment 79
2.2.2.1 Flora and Vegetation 79
2.2.2.2 Mammals, Birds, Herpetofauna and Butterflies 80
2.2.2.3 Fish 81
2.2.2.4 Plankton 81
2.2.3 Socio-Economic and Cultural Environment 81
2.2.3.1 Household Questionnaires 82
2.2.3.2 Focus Group Discussion (FGD) 82
2.2.3.3 Consultation Meeting 82
2.2.3.4 Key Informant Interviews 82
2.3 IDENTIFICATION, PREDICTION AND EVALUATION OF ENVIRONMENTAL IMPACTS 82
2.4 PUBLIC CONSULTATIONS AND PUBLIC HEARING 83
2.5 LIMITATION OF STUDY 83

3 PROJECT DESCRIPTION 85

3.1 PROJECT LOCATION 85
3.2 PROJECT ACCESSIBILITY 86
3.3 PROJECT FEATURES 87
3.3.1 Project Structures and Facilities 89
3.3.1.1 Project Structures 89
3.3.1.2 Project Facilities 93
3.3.2 Project Requirement 95
3.3.2.1 Land 95
3.3.2.2 Human Resource 100
3.3.2.3 Construction Material 100
3.3.2.4 Construction and Implementation Schedule 100
3.3.3 Construction Cost 101
3.3.4 Project Operation Mode 101

4 EXISTING ENVIRONMENTAL CONDITION 103

4.1 PHYSICAL ENVIRONMENT 103
4.1.1 *Physiography* 103
4.1.2 *Topography* 104
4.1.3 *Climate* 105
4.1.4 *Precipitation* 106
4.1.5 *Drainage and Hydrology* 108
4.1.6 *Water Quality* 109
4.1.7 *Air Quality* 111
4.1.8 *Noise Level* 112
4.1.9 *Soil Quality* 112
4.1.10 *Sediments and Sedimentation* 112
4.1.11 *Geomorphology* 113
4.1.12 *General Geology* 114
4.1.13 *Geology of Project Area* 115
4.1.14 *Quaternary Deposit* 118
4.1.15 *Seismic Hazard Risk* 119
4.1.16 *Landslide* 120
4.1.17 *GLOF* 124
4.1.18 *Existing Water Use* 126
4.1.19 *Tributaries of Trishuli River within the Project Stretch* 126
4.1.20 *Groundwater and spring* 126
4.1.21 *Land Use* 127
4.2 BIOLOGICAL ENVIRONMENT 127
4.2.1 *Flora and Vegetation* 128
4.2.1.1 Regional Bio-diversity 129
4.2.1.2 Local Biodiversity and Surrounding Vegetation 130
4.2.1.3 Ethno-Botany 131
4.2.1.4 Agro-Diversity 132
4.2.1.5 Description of Vegetation of Project Structures, Facilities and Monitoring Plots 132
4.2.1.6 Description of Sample Plots 139
4.2.1.7 Plants under Different Threat Categories 148
4.2.1.8 Ecological Significance of Forest and Vegetation 148
4.2.2 *Wild Animal* 149
4.2.2.1 Mammals 149
4.2.2.2 Avi-fauna 154
4.2.2.3 Herpeto-fauna 163
4.2.2.4 Habitat Condition for Terrestrial Wild Animals 167
4.2.2.5 Fish Species 170
4.2.2.6 Plankton 185
4.2.2.7 Butterfly 188
4.2.2.8 Concluding Remark on wildlife 190
4.3 SOCIO-ECONOMIC AND CULTURAL ENVIRONMENT 190
4.3.1 *Project Affected District - Rasuwa* 190
4.3.1.1 Demography 191
4.3.1.2 Health and Education Institution 194
4.3.1.3 Infrastructure (Road/Bridge) 194
4.3.1.4 Communication 194
4.3.1.5 Energy 195
4.3.1.6 Economy 195
4.3.1.7 Migration 196
4.3.2 *Project Affected VDCs* 196
4.3.2.1 Demography 197
4.3.2.2 Literacy and Educational Status 199
4.3.2.3 Educational Institution and Educational Scenario 200
4.3.2.4 Health Status 203
4.3.2.5 Water Supply and Sanitation 205
4.3.2.6 Energy 207
4.3.2.7 Economy 207
4.3.2.8 Gender 213
4.3.2.9 Migration 214

4.3.2.10 Communication 214
4.3.2.11 Other Physical, Social and Cultural Infrastructures and Facilities 215
4.3.2.12 Local Institutions INGOs and CBOs 216
4.3.2.13 Places of Historical, Archaeological and Tourism Importance 217
4.3.3 *Project Affected Settlement* 219
4.3.3.1 Demography 219
4.3.3.2 Mode of livelihood 220
4.3.3.3 Access to Facility 220
4.3.3.4 Pattern of Energy Used 220
4.3.3.5 Status of Women 221
4.3.4 *Project Affected People* 221
4.3.4.1 Demography 222
4.3.4.2 Education 223
4.3.4.3 Health 223
4.3.4.4 Water Supply and Sanitation 224
4.3.4.5 Energy 224
4.3.4.6 Economy 224
4.3.4.7 Housing Structures 226
4.3.4.8 Communication 226
4.3.4.9 Gender Aspects 226
4.3.4.10 Perception about the Project 226
4.3.4.11 Desired Compensation Modality 227
4.3.5 *Cultural Environment* 227

5 ENVIRONMENTAL IMPACT 230

5.1 Adverse Impact 230
5.1.1 *Physical Environmental Issues* 230
5.1.1.1 Construction Phase 230
5.1.1.2 Operation Phase 239
5.1.1.3 Construction Phase 248
5.1.1.4 Operation Phase 259
5.1.2 *Socioeconomic and Cultural Environmental Issues* 266
5.1.2.1 Construction Phase 266
5.1.2.2 Operation Phase 275
5.2 Beneficial Impact 283
5.2.1 *Construction Phase* 283
5.2.2 *Operation Phase* 283

6 ANALYSIS OF ALTERNATIVES 287

6.1 No Action Alternative 287
6.2 Project Alternative 287
6.3 Alternative Design Options (Power Generation Options) 288
6.4 Alternative Location 289
6.5 Alternative Energy to be used 290
6.6 No Forest Alternative 290
6.7 Construction Material Alternative 290
6.8 Environmental Management System 290

7 ENVIRONMENTAL MITIGATION MEASURES 292

7.1 Adverse Impact 292
7.1.1 *Physical Environment* 292
7.1.2 *Biological Environment* 306
7.1.3 *Socioeconomic and Cultural Environmental* 320
7.2 Beneficial Impact 333

8 ENVIRONMENTAL ENHANCEMENT PROGRAMME 335

8.1 Education and Education Facility Support Programme 335
8.2 Health Institution Support Programme 336
8.3 Road Development Support Programme 336

8.4 Sanitation Improvement and Management Support Programme 336
8.5 Water Supply Support Programme 336
8.6 Irrigation Management Support Programme 337
8.7 Agricultural Enhancement Support Programme 337
8.8 Animal Husbandry and Poultry Enhancement Support Programme 337
8.9 Women Development Programme 337
8.10 Technical Education Support Programme 338
8.11 Office and Secretarial Training Programmes 338
8.12 Etiinic Group Support Programme 338
8.13 Langtang National Park (LNP) Support Programme 338
8.14 Local Organization Support Programme 338
8.15 Religious Institution Support Programme 339
8.16 Support to Misyung Khola Micro Hydropower Project 339
8.17 Rural Electrification Extension Programme 339

9 REVIEW OF ACTS, REGULATIONS, GUIDELINES, POLICIES, CONVENTION AND OTHER RELATED INSTITUTION 340

9.1 Constitution of Nepal 340
9.1.1 *Interim Constitution of Nepal, 2063 (2006)* 340
9.2 Laws and Acts 340
9.2.1 *Environmental Protection Act, 2053 B.S (1997 A.D)* 340
9.2.2 *Land Acquisition Act, 2034 B.S (1977 A.D)* 341
9.2.3 *Explosive Act, 2018 B.S (1961 A.D)* 341
9.2.4 *Forest Act, 2049 B.S (1993 A.D)* 342
9.2.5 *Land Reform Act, 2021 B.S (1964 A.D)* 342
9.2.6 *Local Self Governance Act, 2055 B.S (1998 A.D)* 343
9.2.7 *Electricity Act, 2049 B.S (1992 A.D)* 343
9.2.8 *Water Resource Act, 2049 B.S (1992 A.D)* 343
9.2.9 *Wildlife Protection Act, 2015 B.S (1958 A.D)* 344
9.2.10 *National Park and Wildlife Conservation Act, 2029 B.S (1973 A.D)* 344
9.2.11 *Aquatic Life Protection Act, 2016 B.S (1961 A.D)* 344
9.2.12 *Soil and Watershed Protection Act, 2039 B.S (1982 A.D)* 344
9.2.13 *Act, 2049 B.S (1992 A.D)* 345
9.3 Rules and Regulations 346
9.3.1 *Environmental Protection Rules, 2054 B.S (1998 A.D)* 346
9.3.2 *Forest Rule, 2051 B.S (1995 A.D)* 347
9.3.3 *Local Self Governance Regulation, 2056 B.S (1999 A.D)* 347
9.3.4 *Electricity Rules, 2050 B.S (1993 A.D)* 347
9.3.5 *National Park and Wildlife Conservation Rule, 2030 B.S (1974 A.D)* 348
9.3.6 *Conservation Area Management Rule, 2053 B.S (1996 A.D)* 348
9.4 Plans/Policies/Strategies 348
9.4.1 *Three Years Interim Plan, 2064 B.S (2007 A.D)* 348
9.4.2 *National Environmental Policy and Action Plan I & II, 2050 B.S (1993 A.D) and 2055 B.S (1998)* 348
9.4.3 *Agricultural Perspective Plan, 2052 B.S (1995 A.D)* 349
9.4.4 *Forest Sector Master Plan, 2045 B.S (1988 A.D)* 349
9.4.5 *Nepal Biodiversity Implementation Plan, 2060 B.S (2003 A.D)* 350
9.4.6 *Revised Forest Policy, 2058 B.S (2000 A.D)* 350
9.4.7 *National Conservation Strategy, 2045 B.S (1988 A.D)* 351
9.4.8 *Poverty Reduction Strategy, 2059 B.S (2002 A.D)* 351
9.4.9 *Water Resources Strategy, 2059 B.S (2002 A.D)* 351
9.5 Convention 351
9.5.1 *Convention on International Trade of Endangered Species (CITES)* 351
9.5.2 *Convention on Biological Diversity (CBD), 1992* 352
9.5.3 *ILO Convention, 169* 353
9.6 Guidelines 353
9.6.1 *National EIA Guideline, 2050 B.S (1993 A.D)* 353
9.6.2 *EIA Guideline for Forest Sector, 2052 B.S (1995 A.D)* 355

9.6.3 *Community Forest Guideline, 2058 B.S (2001 A.D)* 355
9.6.4 *Community Forest Inventory Guideline, 2062 B.S (2005)* 355
9.6.5 *National Health Care and Waste Management Guideline, 2059 B.S (2002 A.D)* 355
9.6.6 *Environmental Management Guidelines (Road), 2054 (1997)* 356
9.6.7 *Buffer Zone Management Guideline, 1999 B.S (2056 A.D)* 356

10 ENVIRONMENT MANAGEMENT PLAN 357

10.1 INTRODUCTION 357
10.2 RELEVANT LEGISLATION, ENVIRONMENTAL STANDARD AND PERMIT & APPROVALS 357
10.2.1 Legislation 357
10.2.2 Environmental Standard 358
10.3 ENVIRONMENTAL MANAGEMENT STRUCTURE 362
10.4 ENVIRONMENTAL MITIGATION MANAGEMENT PLAN 364
10.5 ENVIRONMENTAL MONITORING MANAGEMENT PLAN 406
10.5.1 Baseline Monitoring Management Plan 406
10.5.2 Compliance Monitoring Management Plan 408
10.5.3 Impact Monitoring Management Plan 410
10.6 ENVIRONMENTAL AUDITING 416
10.6.1 Environmental Audit Framework 416

11 PROJECT COST 419

11.1 PROJECT COST 419
11.2 RESOURCE LOSS 419
11.3 PRODUCTION LOSS 419
11.4 ECONOMIC BENEFIT 419
11.5 EMPLOYMENT GENERATION 419

12 CONCLUSION 421

REFERENCES 422

LIST OF TABLES

TABLE 1.1: WORK SCHEDULE FOR EIA REPORT PREPARATION 73
TABLE 3.1: SALIENT FEATURES OF UPPER TRISHULI-I HYDROELECTRIC PROJECT 88
TABLE 3.2: LAND REQUIREMENT OF UT-1 HPP FOR ESTABLISHMENT OF PROJECT STRUCTURES AND FACILITIES 95
TABLE 3.3: REQUIREMENT OF CONSTRUCTION MATERIAL 100
TABLE 3.4: TENTATIVE SCHEDULE PROJECT IMPLEMENTATION 101
TABLE 3.5: MONTH WISE WATER AVAILABLE 101
TABLE 3.6: WATER AND ITS MAJOR ROLE IN THE PROJECT COMPONENT 102
TABLE 4.1: LAND AREA DISTRIBUTION OF PROJECT AFFECTED VDCS 103
TABLE 4.2: MEAN MONTHLY RAINFALL AT PROJECT AREA 107
TABLE 4.3: TRISHULI RIVER BASIN - CLIMATIC CONDITION 108
TABLE 4.4: SAMPLING STATIONS 109
TABLE 4.5: WATER QUALITY OF TRISHULI RIVER AND ITS TRIBUTARIES 111
TABLE 4.6: SOIL SAMPLING SITE 112
TABLE 4.7: PH VALUE OF SOIL OF PROJECT CONSTRUCTION SITE 112
TABLE 4.8: MAJOR TRIBUTARIES IN THE PROJECT AREA 126
TABLE 4.9: COMMUNITY FOREST OF HAKU VDCS 131
TABLE 4.10: PLANTS UNDER DIFFERENT PROTECTION CATEGORIES 148
TABLE 4.11: MAMMALS RECORDED IN PROJECT SITES (PARTICIPATORY INFORMATION FROM LOCAL PEOPLE) 151
TABLE 4.12: DISTRIBUTION OF MAMMALS IN PROJECT SITES (PARTICIPATORY INFORMATION FROM LOCAL PEOPLE) 152
TABLE 4.13:STATUS OF MAMMALS RECORDED IN PROJECT SITES 154
TABLE 4.14: AVI-FAUNA RECORDED FOR PROJECT SITES (PARTICIPATORY INFORMATION FROM LOCAL PEOPLE) 155
TABLE 4.15: AVI-FAUNA RECORDED IN PROJECT SITES 159
TABLE 4.16: STATUS OF AVIFAUNA RECORDED IN PROJECT SITES 163
TABLE 4.17: HERPETOFAUNA RECORDED IN PROJECT SITES (PARTICIPATORY INFORMATION FROM LOCAL PEOPLE) 164
TABLE 4.18: HERPETOFAUNA RECORDED IN PROJECT SITES AND THEIR ECONOMIC VALUE AS PER LOCAL PEOPLE 166
TABLE 4.19: STATUS OF HERPETOFAUNA RECORDED IN PROJECT SITES 167
TABLE 4.20: DESCRIPTION OF SAMPLING STATIONS OF UPPER TRISHULI-I HYDROELECTRIC PROJECT AFFECTED SITES 170
TABLE 4.21: AQUATIC HABITAT CHARACTERIZATION OF TRISHULI RIVER IN THE DIRECTLY PROJECT AFFECTED AREA 172
TABLE 4.22: FISH SPECIES OBSERVED AND RECORDED IN SAMPLING STATIONS 173
TABLE 4.23: NUMBER OF FISH SPECIES RECORDED AND OBSERVED IN THE SAMPLING STATIONS 173
TABLE 4.24: SPECIES COMPOSITION AND DIVERSITY OBSERVED DURING FIELD VISIT 176
TABLE 4.25: PERCENTAGE ABUNDANCE AT SAMPLING STATIONS (CAUGHT BY CAST NET) 176
TABLE 4.26: CATCH PER UNIT EFFORT (CPUE) AT DIFFERENT SAMPLING STATIONS 177
TABLE 4.27: AVERAGE FISH LENGTH AND WEIGHT IN THE STUDY AREA 178
TABLE 4.28: MIGRATORY PATTERN OF FISH SPECIES 178
TABLE 4.29:MIGRATION PATHWAYS OF MIGRATORY FISH SPECIES IN DIFFERENT SEASONS 179
TABLE 4.30: CONSERVATION STATUS OF THE FISH SPECIES OF PROJECT AREA 179
TABLE 4.31: FISH HABITAT PREFERENCE AND FEEDING 180
TABLE 4.32: SPAWNING ECOLOGY OF THE REPORTED FISH SPECIES OF THE PROJECT AREA 180
TABLE 4.33: LIST OF PEOPLE PRACTICING FISHING IN THE PROJECT AREA 181
TABLE 4.34: ECONOMIC IMPORTANCE OF THE FISH OF THE PROJECT AREA 184
TABLE 4.35: SAMPLING SITES FOR THE ANALYSIS OF PLANKTONS IN TRISHULI RIVER 185
TABLE 4.36: PHYTOPLANKTON'S RECORDED AT DIFFERENT SAMPLING SITES OF TRISHULI RIVER 186
TABLE 4.37: ZOOPLANKTON'S RECORDED AT DIFFERENT SAMPLING SITES OF TRISHULI RIVER 187
TABLE 4.38: BUTTERFLY OF PROJECT AREA 188
TABLE 4.39: LAND USE OF RASUWA DISTRICT (HA) 191
TABLE 4.40: DEMOGRAPHY OF RASUWA DISTRICT 191
TABLE 4.41: ETHNIC COMPOSITION OF RASUWA DISTRICT 192
TABLE 4.42: RELIGION COMPOSITION OF RASUWA DISTRICT 193
TABLE 4.43: LINGUISTIC STATUS OF RASUWA DISTRICT 194
TABLE 4.44: OCCUPATIONAL STATUS OF RASUWA DISTRICT 196
TABLE 4.45: POPULATION DISTRIBUTION OF PROJECT AFFECTED VDCS 197
TABLE 4.46: AGE AND SEX COMPOSITION OF PROJECT AFFECTED VDCS 197
TABLE 4.47: ETHNIC COMPOSITION OF PROJECT AFFECTED VDCS 198
TABLE 4.48: RELIGION OF PROJECT AFFECTED VDCS 199

Table 4.49: Linguistic Status of Project Affected VDCs 199
Table 4.50: Educational Status of Project Affected VDCs 199
Table 4.51: Educational Institution of Project Affected VDCs 200
Table 4.52: Status of School of Project Affected VDCs 201
Table 4.53: Overall Educational Scenario of Project Affected VDCs 202
Table 4.54: School Enrolment Status in Project Affected VDCs 202
Table 4.55: Health Institution of Project Affected VDCs 204
Table 4.56: Average Health Status of Project affected VDCs 204
Table 4.57: Treatment Practice in Project Affected VDCs 205
Table 4.58: Drinking Water Status of Project Affected VDCs 206
Table 4.59: Sanitation Status of Project Affected VDCs 206
Table 4.60: Status of Lighting of Project Affected VDCs 207
Table 4.61: Energy Used for Cooking 207
Table 4.62: Economically Active Population of Project Affected VDCs 208
Table 4.63: Occupational Priority in Project Affected VDC 209
Table 4.64: Land Possession 209
Table 4.65: Average Production of Common Cereal Crops in Project Affected VDCs 210
Table 4.66: Average Production of Vegetables in Project Affected VDCs 210
Table 4.67: Average Price of Agricultural Items 211
Table 4.68: Food Sufficiency Status of Households in Project affected VDCs 211
Table 4.69: Average Livestock and Poultry in the Project area 212
Table 4.70: Average Monthly Production from Livestock and Poultry in the Project Affected VDCs 213
Table 4.71: Average Income, Expenditure and Saving Trend in Project affected VDCs (HH) 213
Table 4.72: Decision Making Process within Project Affected VDCs 214
Table 4.73: Migration Trend of Project Affected VDCs 214
Table 4.74: Access of Communication in Project Affected VDCs 214
Table 4.75: Physical, Social and Cultural Infrastructures and Facilities in the Project Affected VDCs 215
Table 4.76: Bridge, River and Trail within the Project Affected VDCs 216
Table 4.77: Local Institutions in the Project Affected VDCs 216
Table 4.78: Comparative Study of Socio-Economic Condition of Project Affected Settlement 221
Table 4.79Table 4.76: Population and Household of PAFs 222
Table 4.80: Age Group Population and Sex Composition of Project Affected VDCs 222
Table 4.81: Ethnicity of PAFS 223
Table 4.82: Religion of PAFs 223
Table 4.83: Education Level of PAFs 223
Table 4.84: Sanitation Status of PAFs 224
Table 4.85: Agricultural Production of Non-Irrigated Land (Bari) 225
Table 4.86: Agricultural Production of Irrigated Land (Khet) 225
Table 4.87: Food Sufficiency Status of PAFs 226
Table 5.1: Expected Change in Land Use 231
Table 5.2: Downstream Release from Weir 240
Table 5.3: Summary of Physical Environmental Adverse Impact 243
Table 5.4: Permanent Acquisition of Forest Land 248
Table 5.5: Temporary Acquisition of Forest Land 249
Table 5.6: Loss of Protected Plant Species 249
Table 5.7: Land Use of Access Road to Surge Shaft and Gogane Village to Headworks 251
Table 5.8: Loss of Vegetations in Various Project Structures and Facilities 254
Table 5.9: Loss of Wood Volume and Biomass in terms of Plant Species 255
Table 5.10: Valuation of Forest Product Loss (in terms of Plant Species) 257
Table 5.11: Summary of Biological Environmental Adverse Impact 262
Table 5.12: Permanent Acquisition of Agricultural Land 266
Table 5.13: Temporary Acquisition of Agricultural Land 267
Table 5.14: Permanent Loss of Agricultural Production from Irrigated Land (Khet) 267
Table 5.15: Temporary Loss of Agricultural Production from Irrigated Land (Khet) 268
Table 5.16: Permanent Loss of Agricultural Production from Non-irrigated Land (Bari) 268
Table 5.17: Temporary Loss of Agricultural Production from non-irrigated Land (Bari) 268
Table 5.18: Permanent Loss of Other Category of Land 268

TABLE 5.19: TEMPORARY LOSS OF OTHER CATEGORY OF LAND 269
TABLE 5.20: DETAIL OF HOUSE AND OTHER STRUCTURES OF SPAF 270
TABLE 5.21: SUMMARY OF SOCIOECONOMIC AND CULTURAL ADVERSE ENVIRONMENTAL IMPACT 278
TABLE 5.22: SUMMARY OF SOCIOECONOMIC AND CULTURAL BENEFICIAL ENVIRONMENTAL IMPACT 285
TABLE 6.1: POWER GENERATION OPTIONS FOR DIFFERENT INSTALLED CAPACITIES 288
TABLE 7.1: MITIGATION MEASURES FOR PHYSICAL ENVIRONMENTAL IMPACT 293
TABLE 7.2: MITIGATION MEASURES FOR BIOLOGICAL ENVIRONMENTAL IMPACT 306
TABLE 7.3: MITIGATION MEASURES FOR SOCIOECONOMIC AND CULTURAL ENVIRONMENTAL IMPACT 320
TABLE 7.4: MITIGATION MEASURES FOR BENEFICIAL IMPACT 333
TABLE 8.1: SUMMARY OF ENVIRONMENTAL ENHANCEMENT PROGRAMME 339
TABLE 10.1: STANDARDS FOR EFFLUENTS DISCHARGED INTO INLAND WATER FROM THE CONSTRUCTION SITES AND CAMPS 358
TABLE 10.2: DRINKING WATER QUALITY STANDARDS FOR CONSTRUCTION CAMPS AND CONSTRUCTION SITES 359
TABLE 10.3: AMBIENT AIR QUALITY STANDARDS IN THE PROJECT AREA 360
TABLE 10.4: EMISSIONS STANDARDS FOR 'IN-USE' VEHICLES 360
TABLE 10.5 PROPOSED NOISE EXPOSURE LIMITS FOR THE WORK ENVIRONMENT 361
TABLE 10.6: PROPOSED AVERAGE EQUIVALENT SOUND LEVELS RECOMMENDED FOR PUBLIC HEALTH AND WELFARE 361
TABLE 10.7: PERMIT AND APPROVAL 361
TABLE 10.8: MITIGATION MANAGEMENT PLAN FOR PHYSICAL ENVIRONMENTAL ADVERSE IMPACT 365
TABLE 10.9: MITIGATION MANAGEMENT PLAN FOR BIOLOGICAL ENVIRONMENTAL ADVERSE IMPACT 377
TABLE 10.10: MITIGATION MANAGEMENT PLAN FOR SOCIOECONOMIC AND CULTURAL ENVIRONMENTAL ADVERSE IMPACT 390
TABLE 10.11: MITIGATION MANAGEMENT PLAN FOR BENEFICIAL IMPACT 403
TABLE 10.12: MITIGATION MANAGEMENT PLAN FOR ENVIRONMENTAL ENHANCEMENT PROGRAMMES 405
TABLE 10.13: BASELINE MONITORING MANAGEMENT PLAN 407
TABLE 10.14: COMPLIANCE MONITORING MANAGEMENT 408
TABLE 10.15: ENVIRONMENTAL AUDIT FRAMEWORK 416
TABLE 11.1: COST ESTIMATES OF ENVIRONMENTAL MITIGATION, MONITORING AND ENVIRONMENTAL ENHANCEMENT 419

LIST OF FIGURES

FIGURE 1-1: LOCATION MAP OF ISSUED LICENSE FOR SURVEY OF ABOVE 1 MW (SOURCE: DOED) 69
FIGURE 2-1: ENGINEERING GEOLOGICAL MAP OF THE WEIR SITE 78
FIGURE 2-2: MEASUREMENT OF CBH OF TREES 80
FIGURE 3-1: LOCATION MAP OF THE PROJECT AREA 85
FIGURE 3-2: LOCATION OF HEADWORKS AND POWERHOUSE OF UT-1 HEP 86
FIGURE 3-3: PROJECT STRUCTURE AND FACILITIES IN TOPOGRAPHIC MAP OF GON (1:50,000 SCALE) 87
FIGURE 3-4: DOWNSTREAM FROM WEIR SITE OF TRISHULI RIVER FROM NEARBY SANO BHARKHU 89
FIGURE 3-5: TRISHULI RIVER SECTION AT WEIR SITE 90
FIGURE 3-6: TRISHULI RIVER WEIR SITE, TUNNEL ALIGNMENT AND HAKU VDC (ON THE WAY DOWN TO WEIR SITE) 91
FIGURE 3-7: POWER HOUSE, SURGE TANK, PART OF TUNNEL ALIGNMENT (VIEW FROM GRAN) 92
FIGURE 3-8: POWER HOUSE AREA 92
FIGURE 4-1: TERRAIN MAP OF PROJECT AREA (DS: DAM OR WEIR, PH: POWERHOUSE, LS: HAKU LANDSLIDE) 104
FIGURE 4-2: TOPOGRAPHICAL AND ACCESS MAP OF THE PROJECT AREA 104
FIGURE 4-3: LOCATION OF POWER HOUSE AREA 105
FIGURE 4-4: PRECIPITATION MAP OF NEPAL 105
FIGURE 4-5: AVERAGE MAXIMUM AND MINIMUM TEMPERATURE AND RAINFALL IN RASUWA DISTRICT 106
FIGURE 4-6: AVERAGE MONTHLY TEMPERATURE (°C) AND RAINFALL (MM) RECORDED AT DHUNCHE STATION BETWEEN 1999 AND 2008 106
FIGURE 4-7: DAILY RAINFALL RECORDED AT THE DHUNCHE STATION IN THE YEAR, 2009 107
FIGURE 4-8: DRAINAGE MAP OF RASUWA DISTRICT 109
FIGURE 4-9: EIA TEAM MEMBER COLLECTING WATER SAMPLE 110
FIGURE 4-10: SOIL MAP OF THE PROJECT AREA (*SOURCE: ACHARYA, 2003*) 113
FIGURE 4-11: GEOLOGICAL MAP OF LANGTANG REGION 114
FIGURE 4-12: GEOLOGY OF THE PROJECT AREA 115
FIGURE 4-13: GEOLOGY OF WEIR SITE AREA 116
FIGURE 4-14: TUNNEL ALIGNMENT 117
FIGURE 4-15: TUNNEL ALIGNMENT 117
FIGURE 4-16: POWERHOUSE AREA 118
FIGURE 4-17: SIMPLIFIED SEISMIC RISK MAP OF NEPAL (BAJRACHARYA, 1994) 120
FIGURE 4-18: LANDSLIDE OF RAMCHE 121
FIGURE 4-19: LANDSLIDE OF THADE 122
FIGURE 4-20: HAKU LANDSLIDE 122
FIGURE 4-21:SARGHANG LANDSLIDE 123
FIGURE 4-22: DIFFERENT STABILITY ZONES IN THE PROJECT AREA AT DIFFERENT WATER CONDITION 124
FIGURE 4-23: LANGTANG GLACIER AND LAKE NEAR UT -1 HEADWORK 125
FIGURE 4-24: GOSAIKUNDA LAKE 126
FIGURE 4-25: BIOGRAPHICAL ZONATION OF THE PROJECT AREA 128
FIGURE 4-26: *RHODODENDRON ARBORETUM* 130
FIGURE 4-27: VEGETATION AT WEIR SITE, LEFT BANK 133
FIGURE 4-28: LOCAL PEOPLE PARTICIPATING IN WILDLIFE SURVEY 150
FIGURE 4-29: FAECAL MATTER OF GOLDEN JACKAL (CANIS AUREUS) 150
FIGURE 4-30: YELLOW-THROATED MARTEN (*MARTES FLAVIGULA*) AT RIGHT BANK OF TRISHULI AT WEIR SITE 150
FIGURE 4-31: PLANKTON SAMPLING AT WEIR SITE 171
FIGURE 4-32: BAMBOO BASKET (DHADIYA)- FISHING GEAR 171
FIGURE 4-33: CAST NET -FISHING GEAR 171
FIGURE 4-34: GHORLANG- FISHING GEAR 172
FIGURE 4-35:GILL NET (MAHAJAL)- FISHING GEAR 172
FIGURE 4-36: DRY SPECIMEN OF KABRE (PSEUDECHENEIS SULCATUS), DORSAL VIEW 174
FIGURE 4-37: DRY SPECIMEN OF KABRE (PSEUDECHENEIS SULCATUS), VENTRAL VIEW 174
FIGURE 4-38: SNOW TROUT IN COLLECTION 174
FIGURE 4-39: SNOW TROUT -SCHIZOTHORAX RICHARDSONII ABOVE AND SCHIZOTHORAICHTHYS PROGASTUS BELOW 174
FIGURE 4-40: TAMANG WOMEN WITH TRADITIONAL OUTFIT 192
FIGURE 4-41: MAJOR LANGUAGES OF PROJECT DISTRICT 193
FIGURE 4-42: ETHNIC COMPOSITION OF PROJECT AFFECTED VDC 198
FIGURE 4-43: TWO CLASSES OF GRADE 4 AND 5 IN A SINGLE ROOM IN HAKUBESI PRIMARY SCHOOL, HAKU VDC 200

FIGURE 4-44: CHILDREN COLLECTING FODDER AND FIREWOOD, HAKU VDC 203
FIGURE 4-45: STUDENT OF LOWER SECONDARY SCHOOL IN HAKU VDC 203
FIGURE 4-46: TOILET FACILITIES IN RASUWA DISTRICT 206
FIGURE 4-47: WOMEN INVOLVE IN POTATO FARMING 210
FIGURE 4-48: LIVESTOCK REARING 212
FIGURE 4-49: WATER MILL OF THE PROJECT AREA 215
FIGURE 4-50: LANGTANG NATIONAL PARK WITH BUFFER ZONE 219
FIGURE 4-51: PROJECT AFFECTED RESIDENTIAL STRUCTURES, BALUWA PHANT 222
FIGURE 4-52: GUMBA IN HAKU VDC 227
FIGURE 10-1: ENVIRONMENTAL MANAGEMENT STRUCTURE, PRE- CONSTRUCTION/CONSTRUCTION PHASE 362
FIGURE 10-2: ENVIRONMENTAL MANAGEMENT STRUCTURE, OPERATION PHASE 363

1 INTRODUCTION

1.1 Background

Nepal has an enormous potential of generating electric energy from its water resources. On the global scenario, it ranks second in terms of water resources after Brazil. About 200 billion cubic meters of water is being discharged every year through 6000 large and small rivers of Nepal. Nepal is endowed with economically exploitable hydroelectric potential to the tune of 42000 MW of installed capacity out of total hydro potential of 83000 MW and half of which is economically feasible for development. Nepal's immense hydroelectric potential needs to be exploited in broadening the market that is developing in the domestic and regional areas. Yet, less than 1% of this capacity has been developed. Furthermore, Energy consumption is one of the main indicators of development of a country and hydroelectric is one of the cleanest and most reliable sources of energy.

Power shortages in the region continue to constrain economic development. The domestic as well regional market for the electricity is vast and rapidly growing. Demand for power in Nepal is outstripping supply by 10% per year[1]. India's energy deficit is expected to reach 20,000 MW, and China's deficit will reach 330,000 MW by 2015[2]. If the hydroelectric potential of Nepal is utilized, it could become one of the largest exporters of power to both of its neighbours. Thus, for a developing country like Nepal, its immense water resource presents many opportunities towards economic and social prosperity.

In the present domestic energy consumption scenario, so far only 14 per cent of the total populations have access to electric energy, most of whom are urban dwellers. Currently, the available electricity fulfils only one per cent of total domestic energy demand. The larger portion of the energy demand is being supplied by the traditional sources such as fuel wood, agricultural residues, and animal dung. The contribution of petroleum fuel to energy supply could be considered after those of traditional sources. Although the power generation, especially hydroelectric power generation capacity of the country has increased substantially and in Chaitra 2068, the total of 1474 MW of awarded IPP license (above

[1] NEA Fiscal Year 2002/03 – A Year in Review.
[2] Third United Nations Conference on the Least Developed Countries, Brussels, 14-20 May 2001

1MW) are either in operation or in different stages of study (Figure 1.1), It has to be admitted that the achievement in this area has always lagged far behind the power generation targets specified by the periodic plans. At the same time, it also has to be recognized that the gaps between the specified targets and the actual achievements have narrowed down progressively over the years. Looking at the supply situation of power, inability to increase the supply was affecting adversely the developments of the industrial, agriculture, commercial and domestic sectors. Hence, the government invited independent power producers (IPPs) from the private sector, who are now influential players for hydropower generation in Nepal with total installed capacity of 180.85MW (27.73%). Besides, over a dozen small hydropower projects that are in different stages of progress have been cleared to interconnect with the NEA grid and sell all their generation to NEA. In 1992, GoN introduced Electricity Development Policy (2049), along with endorsement of Water Resource Legislation (2049), Electricity Act (2049) and Electricity Regulation (2050), which paved the way for private sectors in developing hydroelectric projects in Nepal. The objective behind such a move of the government is to rationally maximize harvesting of the water resource for electricity production. Furthermore, it has become necessary to reduce, to the extent possible, the outlays involved in the production of electric-power, its transmission and distribution.

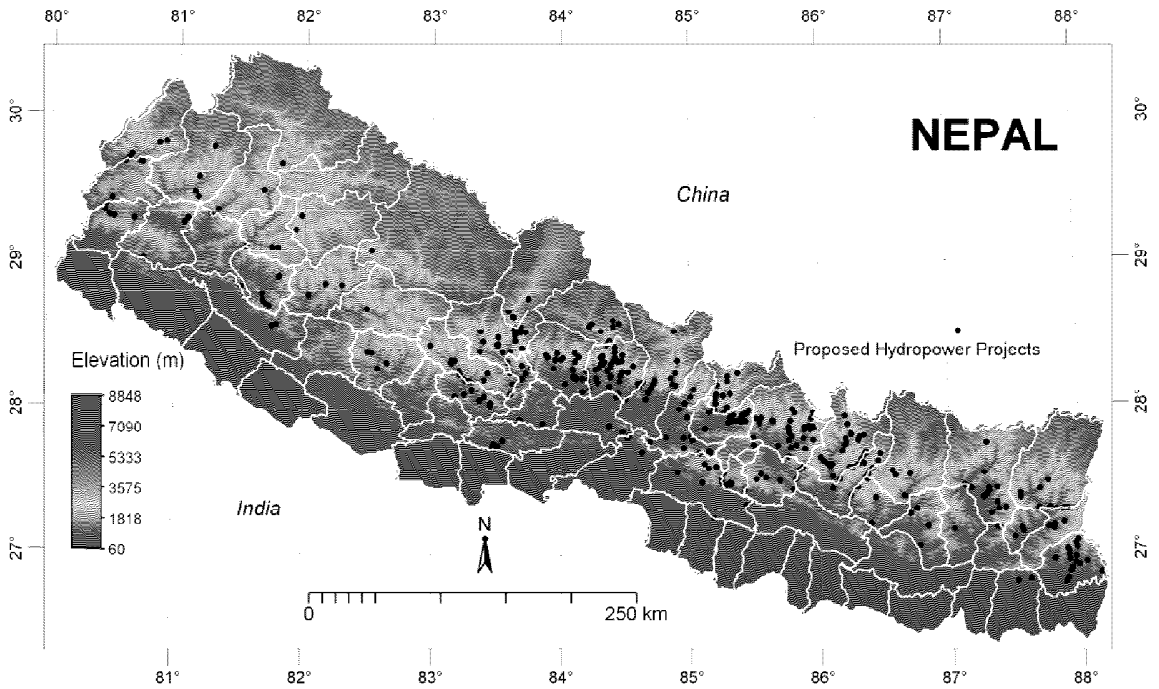


Figure 1-1: Location Map of Issued License for Survey of above 1 MW (Source: DoED)

In this regard, Nepal Water and Energy Development Company (P) Ltd (NWEDC) has proposed Upper Trishuli-I Hydroelectric Project of 216 MW installed capacity, which is one of the hydropower projects identified in Trishuli River.

1.2 Name of the Proposal

The name of the Proposal under this EIA study is "Upper Trishuli-I Hydroelectric Project (216 MW)". The proposed project is situated in Rasuwa District, Bagmati Zone in the Central

Development Region of Nepal. The company has got survey license of the proposed project from the by then Ministry of Water Resource. The survey license for 75MW had been issued on Nepali date 2063/09/24, which was valid and extended until 2067/03/23. The Ministry of Environment had approved the ToR and Scoping Document for 75MW on 2066/12/16. The license was further renewed with extended project boundaries and installed capacity of 216 MW on 2067/11/19, which is valid until 2068/09/23. The Ministry of Environment approved the supplementary ToR and Scoping Document for new enhanced project capacity of 216 MW on 2068/06/05. The survey licenses for 75 MW and 216 MW of Upper Trishuli-I Hydroelectric Project is presented in Annex 1.1. Similarly, the approved Terms of Reference for both 75 MW capacity and 216 MW capacities of proposed project are presented in Annex 1.2. The study is carried out only for hydroelectric generation excluding transmission line components.

1.3 Purpose of the Proposal

The purpose of the proposal is to develop Upper Trishuli-I Hydroelectric Project (216 MW) Hydroelectric Project by utilizing the water of Trishuli River located in Haku (हाकु गा.वि.स), Dhunche (धुन्चे गा.वि.स) and Ramche (राम्चे गा.वि.स) VDCs of Rasuwa district within the geographical boundary of latitudes 28^0 04' 27.5" and 28^0 07' 42" North and longitudes 85^0 12' 40" and 85^0 18' 03" East. The electrical energy generated from the proposed project will reduce the current pressure on power supply and demand and will help to promote clean energy for the sustainable development of the country.

1.4 Name and Address of the Proponent

The proponent of Upper Trishuli-I HEP (216 MW), in line with the Hydropower Development Policy 2003 of Government of Nepal (GoN) to promote private sector participation in the development of hydropower projects, established Nepal Water and Energy Development Company (P) Ltd (NWEDC) as a private sector company for the project development. NWEDC is a company established and registered under GoN in the year 10th of Baisakh, 2059 B.S. i.e. 23rd of April, 2002 A.D.

The contact address of the Proponent is as under:
Nepal Water and Energy Development Company (P) Ltd.
P.O.Box : 746, Kathmandu, Nepal
Telephone: 00977-1-4247237, Fax: 00977-1-423217

1.5 Organization Responsible for Preparation of the Report

The proponent has appointed Jade Consult Pvt. Ltd. (formerly known as NEPDC) to carry out the EIA Study of the proposed project. The purpose of the study is to prepare the EIA Report of Upper Trishuli-I Hydroelectric Project (216 MW) complying legal requirement of Nepal. Nepal Energy and Power Development Pvt. Ltd. (NEPDC) was established and registered under GoN in the year 17th of Falgun 2057 i.e. 28th February, 2001 and was later named as Jade Consult Pvt. Ltd on 26th of Baisakh 2068 i.e. 9th May, 2011 . The company was

established with an objective to provide technical consulting services particularly in the field of hydropower development, Road, Transmission line, environmental engineering and environmental study.

The contact address of the organization is as under:
Jade Consult Pvt. Ltd.
Kabilmarg, Thapathali, Kathmandu, Nepal
Tel: 00977- 1- 4222202
Web: www.jadeconsult.com.np

1.6 Rationality for Conducting EIA Study

The Environment Protection Act (EPA) 1997 and the Environment Protection Rules (EPR) 1998 provide details on provisions to prepare and approve the EIA report of each hydropower project exceeding above 50 MW of installed capacity before implementation. As per the Schedule 2 of the EPR 1997, this project should undergo EIA process legally, and hence, should determine scoping, approve the Terms of Reference (TOR), and also approve final EIA report before project implementation by complying all requirements mentioned in the environmental laws. Furthermore the area falls within the Buffer zone of Langtang National park and hence required EIA (EPR 1997 scheduled 2, pertaining to rule 3 of article K of 3 as a part of the EIA process. The project will require acquisition of 27.20 ha forest for implementation and thus, also attract schedule 2, pertaining to rule 3 of article A of 4 to undergo EIA process.

This EIA report is prepared as per the approved ToRs (Annex 1.2) to comply with EPA, EPR and other legal requirements of Government of Nepal.

This EIA report is prepared as per the approved ToRs (*Annex 1.2*) to comply with EPA, EPR and other legal requirements of Government of Nepal.

1.7 Objective of EIA Study

The objectives of the EIA study of Upper Trishuli-I Hydroelectric Project are:

- Identify and Document the existing environment of the project area i.e. all important physical-chemical, biological and socio-economic and cultural baseline conditions
- Identify and document potential adverse and positive impacts on the local environment due to implementation and operation of Upper Trishuli-I Hydroelectric Project
- Estimate the loss of different categories of land, property forest and other resources as a part of site clearance
- Identify potential positive and adverse impacts
- Propose mitigation measures for adverse impacts and enhancement measures for positive impacts
- Prepare outline of an environmental management plan, including monitoring and auditing plans to assess the effectiveness of implemented mitigation measures.
- Carry out alternative analysis from the environmental point of view
- Provide information for decision makers about the environmental implications of the proposed project and associated costs for benefit augmentation and adverse impact mitigation
- Advise decision makers regarding the implementation of the project

1.8 Study Team

The study team was comprised of multi-disciplinary professional team of environmental experts. The name lists of qualified experts involved in this EIA Study are as follows:

1. Team Leader/Botanist / Forest Specialist - Dr. Mahendra Nath Subedi
2. Alt. Team Leader – Dr. C. M. Joshi

3. Environmental Engineer/ Environmental and Social Planner/EIA Study Coordinator - Mr. Abhishek B.C
4. Ecologist /Environmentalist - Dr. Pratima Sharma
5. Wildlife Expert/Fish Expert - Mr. Alok Poudyal
6. Geologist - Mr. Narayan Gopal Ghimire
7. Hydrologist - Mr. Suresh Marattha
8. Hydroelectric Engineer - Er. Sumendra Mool
9. Civil Engineer - Er. Sujan Shrestha.
10. Socio-economist - Mr. Damber Datta Awasthi
11. Project Coordinator - Mr. Sujan Raj Adhikari
12. Socioeconomist - Mr. Parshu Ram Ghimire
13. Forester - Mr. Jay Raj Mishra
14. Environmentalist - Mr. Bal Mukund Pokhrel
15. Data Management and Team Assistant – Mr. Manoj Joshi

1.9 Work Schedule of EIA

Table 1.1: Work Schedule for EIA Report Preparation

S. N.	months / Activities	1-5	6	7-9	10-12	12-15	16	17	18-19	20-22	23-24
1	Approval of ToR & Scoping										
2	Desk Work										
3	Preparation of Field work										
3.1	Preparation Field Questionnaire										
3.2	Preparation of Checklist										
3.3	Pre-test of Questionnaire										
4	Others										
5	Field Work										
6	Field Report										
7	Data Analysis										
8	Preparation of Draft Report										
8.1	Physical/Chemical Environment										
8.2	Biological Environment										
8.3	Socio economic & Cultural Environment										
8.4	Enhancement Measures and other write-ups										
9	Preparation of Public Hearing										
10	Comments on Draft Report										
11	Final Report Preparation & Submission										
12	Approval of EIA Report from Concerned Authorities										

1.10 EIA Budget

The proponent has allocated a budget of NRs. Two millions and four hundred thousand (Rs.85, 00,000/-) for EIA study.

1.11 Project Area Delineation

The study area was divided into three categories, depending on the proximity to the project sites and the intensity of the impacts of the project implementation. The categories are described below:

1.11.1 Category A: High Impact Area

This category includes all the areas where activities related to the project will take place. This area has been studied in detail regarding the impacts on physical, biological as well as socio-economic and cultural environment. Since many of the project activities and establishment of project facilities are confined nearby the settlement areas, i.e. Hakubesi-Hakubesi-Fulbariand Baluwa village, these areas are designated as high impact area. Similarly, the river stretch and the immediate areas from the intake site to the powerhouse site, including the adit sites has been categorized as high impact area or the Category - A area as well.

1.11.2 Category B: Moderate Impact Area

This category includes the areas, which will not have direct impact of construction activities but may be influenced by the activities of construction workers. The villages located nearby the project structures and facilities between Hakubesi and Baluwa village could be affected due to project activities. This category also includes forest areas and settlements within two to three hours walking distance from the project constructions site.

1.11.3 Category C: Low Impact Area

This category includes the outlying areas including national park area, which is far from the project for interactions on a daily or weekly basis. The physical and biotic environments in this area will probably experience minimal impact. However, some impacts may be felt in the socio-economic and cultural environment because such an area may supply labour force for the project. Additionally, electricity from the project will be distributed in these areas. Overall, adverse impacts on such areas will be very low, hence such areas were considered as low impact areas.

2 METHODOLOGY

The EIA study of Upper Trishuli -I Hydroelectric Project (216 MW) has been basically carried out by referring approved Terms of Reference. The different study method includes:

2.1 Desk Study and Literature Review

The study team reviewed all the available but relevant literature(s), published or unpublished to collect secondary information on physical, biological, socio-economic and cultural parameters within the Project area with particular emphasis on the direct impact zone. The study of secondary data aimed primarily at describing the initial state of the area, as precisely as possible, before the baseline study. These include district profile, VDC profile, literatures related to Langtang National Park, etc. Information relating to project, particularly, the location of key project structures and facilities are studied in 1:25,000 topographic maps to understand the bio-physical and social environment of the project.

The team also reviewed all the relevant legal provisions, EIA guidelines and manual, approved ToR and scoping documents. Additionally, topographical or geological maps and photographs interpretation were thoroughly studied to extract the information on physical environment. Moreover, an extensive review of information furnished by the feasibility study was made. Furthermore, discussions were held among the study team regarding field methodologies to obtain the database required for the evaluation of impact due to project implementation. These exercises developed a better basis for the preparation of field study schedules and methodology to be used during field studies to come up with required data base to satisfy the ToR requirement for impact evaluation.

2.2 Field Study

2.2.1 Physical Environment

An extensive review of the information furnished by the feasibility study was done along with the analysis and interpretation of data collected during the field study. The data collected from the field was the main basis to assess the potential impacts of project implementation on the physical environment. During the field study, special attention was given to the analysis of geomorphic feature, such as fan deposits, landslides, rock falls, and slope stability. Current geomorphic process was identified and their intensity and magnitude in the event of high flood loaded with sediments or sudden clouds bursts were assessed. The secondary information generated from the desk study was verified during the survey of the project-affected area.

The EIA study has integrated spatial analysis with the application of Geographic Information System (GIS) and remote sensing (RS). The application of GIS and RS assisted in enhancing the understanding of project components, environmental condition of impact area, and interaction between them. GIS was used for defining the project by indicating its location. The geographic coordinates and the political-administrative boundaries of the project components were illustrated. RS image analysis identified biophysical environment (for

example land use, land cover, forest type, forest conditions etc.) of the project area. The understanding of environmental condition of the project area is essential for the anticipation of impacts. At the stage of acquiring baseline information for EIA, thematic maps of environmental resources were prepared. The brainstorming sessions with the EIA team identified the following themes of the maps:

- Physical and Biological Environmental Maps
- Digital Elevation Map (DEM)
- Land Use Map
- Geological Map
- Drainage Map
- Slope Map
- Vegetation Map
- Socio-economic Map
- Settlement Map
- Population Distribution Map
- Land Tenure Map

The input data for the preparation of the thematic maps were:

- Scanned Analogues Topological Map 1:25,000
- Remote Sensing Image Data
- Digital Data Acquired from Survey Department
- Field Verification Survey and GPS Data Acquired from the Field Work
- Field Measurement Data Obtained from Experts
- Secondary Data Information from Literature

Fieldwork was carried out in different time of 2011 and 2012. Consultations were held in the field with project-affected persons and with community groups. The key methods of primary data collection are given below:

- *Plot less:* Extensive field visits and observations were made in the field.
- *GPS and Altimeter recordings:* Coordinates and altitudinal values were recorded in the field for land use classification and other analysis purpose.
- *Remote sensing images, Digitizing Maps and Plots:* As a final output of remote sensing, GIS and GPS data, field maps were prepared showing the location and physical conditions of study area.
- *Participatory Rural Appraisal (PRA):* PRA meetings were conducted at different strategic location in the field.
- *Checklist Survey:* Structured questionnaire sessions were administered at different locations and existing literatures were consulted.

The topographic map of 1:50,000 scale was used as a base map for field observation and verification of topographic features, drainage, and land use pattern in the project-affected area. Instruments used in the field were:

- Global Positioning System (GPS)
- Altimeter
- Magnetic compass
- Portable pH Metre

- Water sample bottle
- BOD bottles, pipette, reagents
- Digital camera

The information obtained from the analysis of the water samples collected from strategic points of the Trishuli River was taken into consideration, and likely changes in water quality from the project implementation were analysed. During field survey, water samples from various sites were collected. In-situ measurement was conducted for parameters like temperature, pH, dissolved oxygen (DO), and specific conductivity. For the determination of other physio-chemical parameters of water such as, total solids, total suspended solids, chloride, nitrate, and phosphate, water samples were from different sites and preserved in the icebox and analysed in the laboratory

All information on climate was taken from existing sources, technical reports, and literatures. The climate information of the project impact area was taken from the meteorological station close to the project area.

Information on geology has been taken mostly from the feasibility reports prepared by the technical groups of the project proponent. However, the field study was conducted for the duration of two weeks, focusing mainly on two purposes i.e.

- Geological mapping of the area and
- Engineering geological investigation

Preparation of geological map of the study area was performed with the information from the field survey. The survey consisted of traverse mapping along the banks of river and its tributaries and several traverses were made along and across the ridges, and along the trails. During field survey, the dip and strike of the rocks, boundary between different rock types of every location were plotted on the topographic maps 1:25,000.

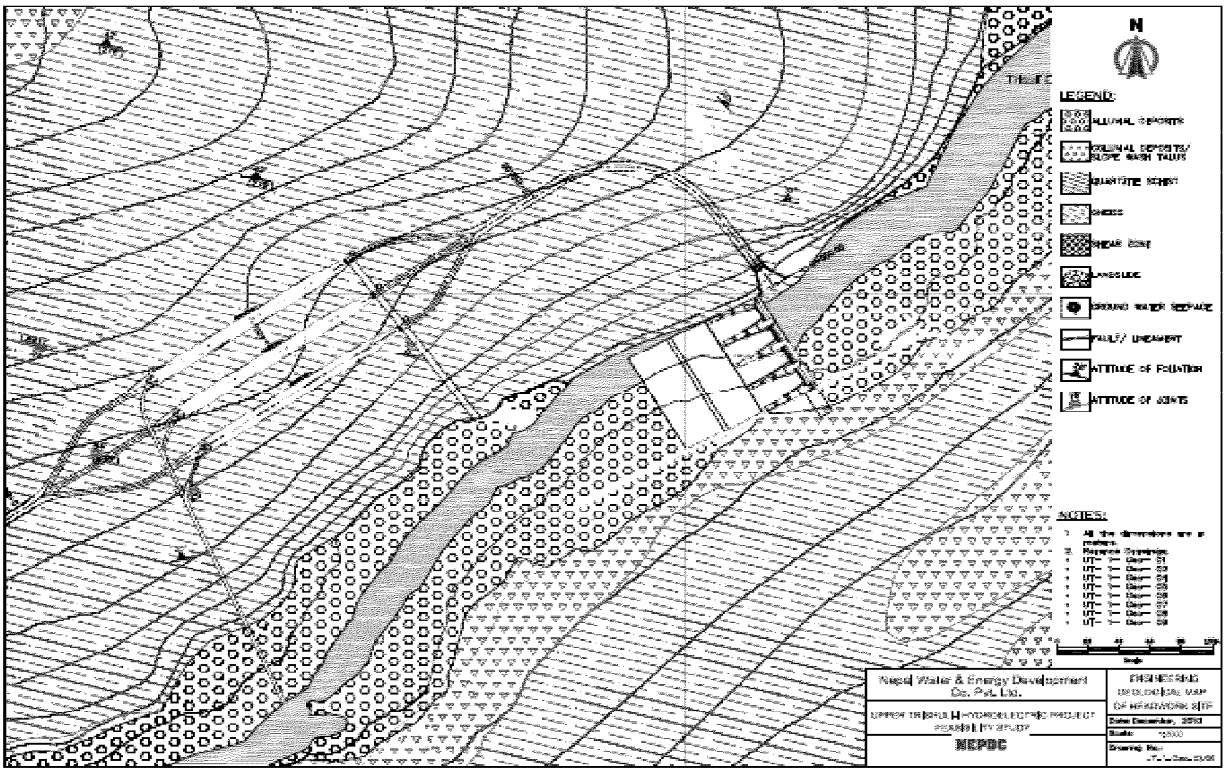


Figure 2-1: Engineering Geological Map of the Weir Site

The engineering-geological mapping was carried out in the study site, specifically along tunnel alignment, around weir Site, and powerhouse site. The measurements were recorded in the topographical map 1:50,000. The parameters measured and traced as well as observed during the fieldwork were:

- major and minor discontinuities (fault, fold, joint sets)
- rock type, and its weathering condition
- cultivated land
- landslide
- creeping area
- springs
- seepage, including underground water condition
- active gulley and areas suffering from active river undercutting

Relevant literatures have been revised for assessing the baseline condition of the watershed. Field survey was taken along the banks of Trishuli River and its tributaries. The field survey was carried out for gathering of targeted hydrological facts of the area, such as daily discharge, instantaneous peak discharge, drainage, gradients of river channels, and precipitation rate. Annual water discharge data was obtained from the permanent stations setup by the company.

Stream flow, or discharge, is the volume of water flowing through a fixed point in a fixed unit of time. For water flow in streams, the value is expressed in cubic metre per second (m3/s). Discharges of tributaries of Trishuli were measured by area-velocity method-one of the direct methods for discharge measurement. Cross-sectional area is determined by

stretching a tape across the channel to measure distance at the cross-section locations where depth is measured with a calibrated rod. Area is depth x width in small increments across the channel. The float method was used for the measurement of velocity. Discharge is obtained as the product of the cross-sectional area of flow in the river and the average velocity of flow.

$$Q = A \times V \ (m^3/s)$$

Where,
Q = Discharge of the Stream
A = Cross-sectional area of the flow
V = Average Velocity of the flow

2.2.2 Biological Environment

2.2.2.1 *Flora and Vegetation*

39 sample plots were chosen to assess the status of the natural vegetation and biodiversity of the UT-I HEP project sites. Representative units of the major forest types or vegetative areas were selected as far as practicable. Quadrates of 25m x 25m plot were made in most of the cases. In some cases, the sample plots were restricted to 20m x 20m and 20m x 15m area due to the unavailability of the sizable area and due to the absence of better forested area.

The circumference at breast height (CBH) was measured at 1.3m from the ground level and later converted to diameter (DBH) for volume and basal area estimation. Ground conditions such as gregariousness of the herbaceous vegetation, rock outcrops, richness of the ground flora, etc. were also studied. Height of the few tallest trees (3 to 4) was measured by using 2-3m poles up to certain height and rest of the part was calculated based on this measurement. Comparative height was taken for other trees. Ecological parameters such as crown coverage, aspect, slope inclination, etc. were also recorded for detail analysis and further study. Crown coverage was estimated from ocular estimation. Ground flora was identified on the field as far as possible and unidentified trees and other species were later identified in the National Herbarium and also with the help of standard literatures (Press et al., 2000; DPR, 2001; Regmi, 1982; Polunin and Stainton, 1984).

Resource use pattern of the forest plants and forest products were recorded after the consultation with numbers of local residents with samples of the plants in doubtful cases. Several ethno-botanical information was also gathered for revealing the specific use of plants found in and around the project area.

Furthermore, a walkover survey along with interview with the key informants were carried out in the project area for collecting information on the effect of project activities on biological environment, particularly on forest.

Different plant species and forest types were observed between Pondage area and Tailrace and in the region of key project activity's sites such as, powerhouse, surge tank, spoil disposal sites, headworks, adits, construction camps, quarry sites, access road, etc.

The classification of trees, poles, and saplings used in the study is: Trees over 30 cm dbh are considered as timber trees, trees having 10 to 29.9 cm dbh are referred to as pole size trees and trees with less than 10 cm dbh are termed saplings. Based on this information, loss of tree species, loss of standing wood volume, were calculated for each tree species using following formulas:

- dbh (d) = CBH/ π, where $\pi = 3.14$
- Basal Area = $\pi d^2/4$
- Volume (m^3) = Basal Area x Tree height x Form factor,
- (Form factor = 0.5)



Figure 2-2: Measurement of CBH of Trees

2.2.2.2 *Mammals, Birds, Herpetofauna and Butterflies*

Both primary and secondary data were used for the collection of information. Primary data was collected from direct observation along transects (Sutherland, 1997). Each transect was about 300 m long (Sutherland, 1997) and was set up at the impact or activity area of proposed project. Transect walk was performed mainly in early morning, and evening (Paudel, 2003). Each transect was visited thrice and each visit lasted for three hours. Wild animals seen on either side of transect were noted.

Besides that, pugmarks/footprints, droppings/pallets, ground digging and uprooting, tree scratching and marking, remains (skin, fur, feathers, bones, horns/antlers and carcasses), nests, holes and burrows, etc were also used for the data collection. In addition, call counts, cries, smell/odor, leftover food, trampling of plants, flowers and fruit bunches were also recorded (Sutherland, 1997). Butterflies were collected by using butterfly net (Sutherland 1997) of diameter 29 cm.

Secondary data was collected through questionnaire method. FGDs were conducted with local people, members of LNP, forest-goers or cattle grazers, project local field staff, community forest user group etc. Field guide books containing photographs of the wild animals were shown during FGDs to verify the data. Data recorded from the field were compared with the available secondary literature and reviewed. List of people present in wildlife FGD is presented in Annex 2.1.

Field guidebook of Shah (2004) for herpetofauna, Inskipp & Inskipp (1991) for birds, Baral & Shah (2006) for mammals and Smith (2006) for butterflies were followed.

2.2.2.3 *Fish*

Fish sampling was conducted at five different sampling stations within the stretch between headworks and tailrace. Cast net (diameter 2.9 m and mesh size 1.9 cm) was used for sampling fishes. Besides that other fishing gears such as hooks, gill net (Mahajaal) were also used by mobilizing the local fishermen. Catch per unit effort (CPUE) was used to generate indices of abundance (Cowx, 1991). The collected fish species were identified at site to the extent possible. The measurements of total length, weight and other morphological characteristic were recorded. After the measurement, the sampled fishes were again released back in the sampling stations.

FGDs were conducted with local fisherman to know habit, habitat and diversity of fishes and to access potential impact due to project in future.

Field guidebook of Shrestha, J. (1994) for fishes was followed.

2.2.2.4 *Plankton*

For phytoplankton sampling, 10-L of composite sample was prepared by mixing the samples collected from different area of a sampling site. 1% Lugol's solution was added for the preservation (www.evergladesplan.org).

Sample Collection and Preservation Field Procedure For zooplankton sampling, 100 liters of river water from different area of a site was filtered through 80 µm plankton net. The zooplankton collected at the bottom plankton net was preserved by using 5 % formaldehyde solution. These samples were identified in lab. Aquatic invertebrates from the 1m2 substrate were collected from three sites in each sampling station. The substrate was place in water bucket and sieved, starting with a 4 mm mesh size to 0.5 mm mesh size. Species thus obtained were preserved in 5% formalin and identified in lab (Sutherland, 1997).

Aquatic invertebrates from the 1m2 substrate were collected from three sites in each sampling station (Moore, 1990). The substrate was place in water bucket and sieved, starting with a 4 mm mesh size to 0.5 mm mesh size. Species thus obtained were preserved in 5% formalin and identified in lab (Sutherland, 1997).

2.2.3 Socio-Economic and Cultural Environment

The information regarding Socio-economic and cultural environment were collected by using questionnaire, checklists, observation, rapid rural appraisal (key informant survey), household survey, focus group discussion, participatory rural appraisal (PRA), discussion with district level offices, consultation meeting, VDCs, community groups, women group, etc.

These techniques were applied to collect the village level information on population age group, ethnicity, occupation, land holding, cropping pattern, local production and productivity, livestock rearing, food sufficiency, water supply, common diseases &common

method of treatment, user's group, accessibility to different socio-economic services, livestock farming, cultural practices, cultural sites, archaeological/historical, religious sites, tourism, etc.

2.2.3.1 Household Questionnaires

The households losing land (permanently and temporarily) due to land acquisition by the project were interviewed using a structured questionnaire (***Annex 2.2***) to obtain base line information on demographic and educational status, ownership patterns, farm practices, energy sources, basic health conditions, housing as well as information on project related issues such as resettlement, compensation, and expectation from the project.

2.2.3.2 Focus Group Discussion (FGD)

Focus group discussions were conducted with major groups, namely, (i) religious groups, (ii) group of women, and (iii) farmers. The attitude of these focus groups towards the project, its potential impacts, and their expectations from the project were explored through the discussion. The major issues raised and list of people participated in the FGD is presented in ***Annex 2.3.1 and 2.3.2***.

2.2.3.3 Consultation Meeting

Consultation meetings were organized at different settlements of project affected VDCs to update the local people regarding the project as well as to collect the concerns and views of the people of project area regarding the project. Furthermore, the officials of LNP were also consulted regarding their views and concern for proposed project. The major issues raised and list of people participated in the consultation meeting is presented in ***Annex 2.4.1 and 2.4.2.***

2.2.3.4 Key Informant Interviews

Key informant interviews were conducted in the project impact area to obtain information on the status of resources in the past and at present time. Such a survey was necessary to determine the issues, which were not addressed by other survey instruments. Some local residents of Haku, Thulo Haku, Hakubesi-Fulbari, Gogane, Baluwa, Ramche, and Dhunche village were also assigned to assist in field study and social survey. The checklist used in key informant interviews is presented in ***Annex 2.5.***

Apart from that, the secondary sources such as maps and studies made at different times were also referred to have a glimpse of social and cultural environment of the project area. A topographical map of scale 1:50,000 were used to obtain some social and cultural features. Similarly, aerial photographs were also used to determine natural resources.

2.3 Identification, Prediction and Evaluation of Environmental Impacts

The EIA Study has identified, predicted and evaluated each impact of the project activities on environment for both construction and operational stages. Each impact were identified, predicted and evaluated by using matrix methods on physical, biological, socio-economic and cultural aspects. Both beneficial measures and adverse impacts mitigation measures

were recommended for each impact identified and predicted. The magnitude of each potential impact were identified as Low, Medium, and High; the duration of impact were termed as Short-term, Medium-term and Long-term and extent of impact as Regional, Local or Site Specific. Professional judgment, scientific evidences, public concern as well as environmental standards are the key point followed for evaluating impacts.

2.4 Public Consultations and Public Hearing

Public consultation was carried out in various occasion during EIA study to inform the people regarding the project and its different features, and to collect the various information regarding baseline environment. The public consultation played a significant role to determine mitigation measures and enhancement measures to address other development prospect of local people. Public consultation was carried out through focused group discussions and consultation meeting.

In accordance with the provision of EPA 97 & EPR 98 , Water Resource Act and Electricity Act, 1992, a public hearing was conducted at Hakubesi of Haku VDC on 2068-7-19 (5th November, 2011) in the presence of local people and stakeholders. The people of all three project affected VDCs (Dhunche, Haku and Ramche were informed through local messengers & runners. In addition, a Public Notice was also published in national newspaper ***(Annex 2.6)*** to invite the people and stakeholders of the project area for attending the Public Hearing. During public hearing, the findings of EIA study were presented to the participants and additional concerns & views of the people & stakeholders of project area were collected. The synopsis of public hearing is presented in ***Annex 2.7*** of the report. The recommendation letter from the project affected VDCs and DDC is presented in ***Annex 2.8***.

2.5 Limitation of Study

Issues like noise level predictions from point to point along the track will not be accurate at all receivers. Sound frequency values will vary due to high topographic variations. Other limitations were that, the water samples were taken once and may not represent the water chemistry of the entire year.

Different parameters of research methodology were applied for studying the vegetation and plant in question, however, there were several limitations due to the adverse topography, phenological condition of plants and absence of flowering and fruiting bodies for identification.

Fish migration, abundance throughout the year, temporal variation in water temperature and relation between fish abundance & food supply pattern needs a long-term analysis and high-level scientific research. So, some of these information are collected through secondary literatures. Due to cold blooded nature, herpetofauna undergo hibernation and aestivation during winter and summer months. Major data about herpetofauna, migratory birds and mammals were collected by showing photograph of these species during FGDs. So, the list also includes species observed and reported by the locals with the help of photographs. Socioeconomic data on income, expenditures, amount of fish harvest etc. was given by the local people.

Socioeconomic data on income, expenditures, land productivity etc. was given by the local in round figure. Some of the issues raised by the locals were not relevant to project context, hence excluded from the report. It is difficult to put social issues into a number-crunching process. There is a need to develop the legitimacy of interactive approaches, and to discuss an issue-oriented approach, which involves interaction and negotiations. Cultural and spiritual values most of the time cannot be directly converted or related to compensation in terms of money, for example, scenic values to the spiritual aspect of nature. Hence, it is difficult to predict such kind of impacts. Sometimes in strong socio-economic bonds, there is a co-mingling of functions — so they do not separate out the social from educational from economic, political, or religious, that is difficult for the team to deal with. Native people have traditionally described themselves as an integral part of nature, and declared respect for the laws of ecology, which govern all life. The nature gives them everything they got — food to the mental well-being. It is difficult to predict impacts on such things. The locals depend on the land as a source of sustenance, culture, spirituality, meaning, identity and so on. In addition, how far in-migration factor of another culture will have impact on the social values into locals' decision-making is not easy to predict.

Assessment of Sensitivity of Receivers and the Magnitude of Change of project works are inherently subjective. Additional mitigation measures introduced during detail design and construction may assist in the reduction of residual impacts. No detail data exists for future planned projects or for the concurrent projects other than the one described in this report. Changes to these may affect the valuated impacts of the project.

3 PROJECT DESCRIPTION

The proposed Upper Trishuli-I Hydroelectric Project (216 MW) is a run-of-river type project. Initially proponent Nepal Water and Energy Development Company Ltd. (NWEDC) had the license of 75MW and ToR and Scoping was also approved but keeping in mind, a huge shortage in energy supply in Government owned Integrated Nepal Power System (INPS), the Proponent applied for the extension of Project boundaries through letter at Department of Electricity Development (DoED) on 2067-03-25. The extension of project boundaries and capacity upgrading with amendment in survey license, which was received from Department of Electricity Development on the letter, dated 2067-11-19. The main features of the project remain almost the same with diversion weir, side intake and underground desander at headworks and underground powerhouse. Due to the extensions of Project boundaries, the location of underground powerhouse has been shifted about 1.7 KM downstream towards the Mailun Dovan and Diameter of Headrace Tunnel has been increased. In this process, head gain of the project has been achieved which leads installed capacity of the project up gradation of 216 MW.

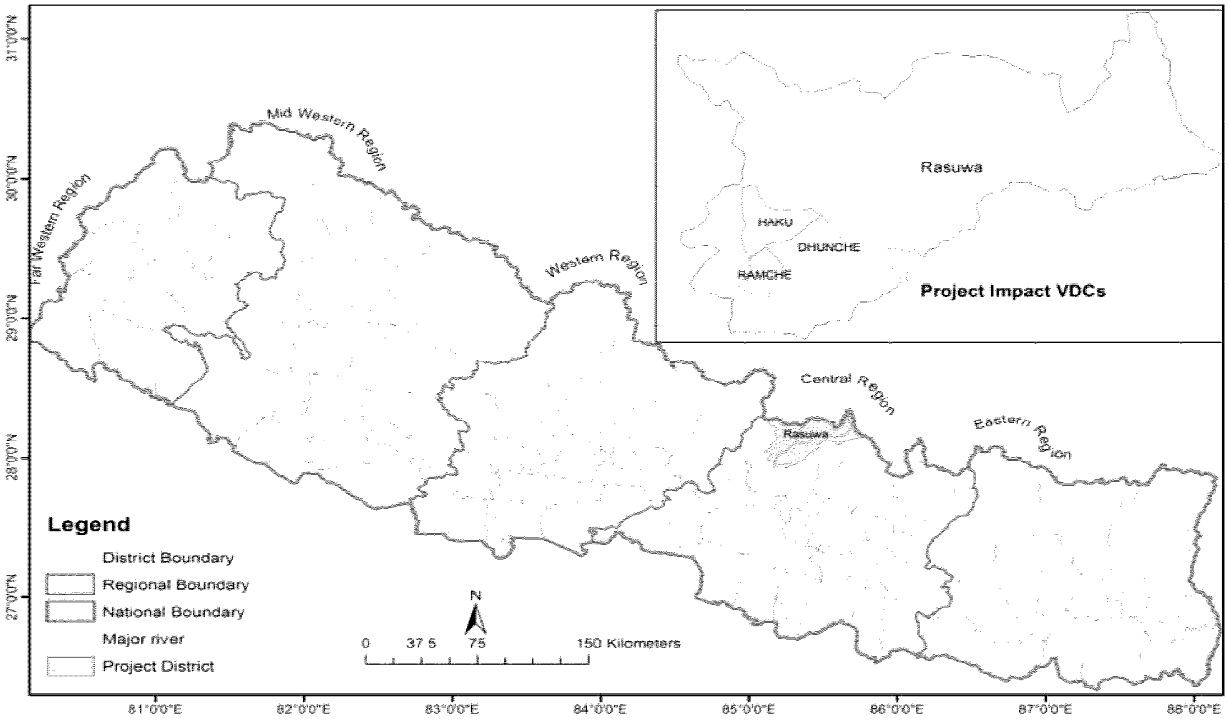


Figure 3-1: Location Map of the Project Area

3.1 Project Location

The Upper Trishuli-I Hydroelectric Project (216MW) is located in Haku (हाकु गा.वि.स), Dhunche (धुन्चे गा.वि.स) and Ramche (राम्चे गा.वि.स) VDCs of Rasuwa district of central development region of Nepal. Dhunche and Ramche VDCs are located at left bank of Trishuli River where as Haku VDC is situated at right bank of Trishuli River. Geographically, the project site is located within latitudes 28° 04' 27.5" and 28° 07' 42" North and longitudes 85° 12' 40" and 85° 18'

03" East. The weir site is situated at left and right bank of Trishuli River in Dhunche and Haku VDCs respectively near Hakubesi-Hakubesi-Fulbariand powerhouse is situated in Baluwa Phant of Haku VDC on the right bank of Trishuli River. Similarly, the intake structure, desander, headrace tunnel, adits, penstock tailrace, switchyard and remaining project facilities are located on the right side of Trishuli River in Haku VDC. Thus, except location of weir at Dhunche VDC, none of the project structures and facilities is located in left bank i.e. at Dhunche and Haku VDCs. The proposed project has been identified on the upper reaches of the Trishuli River, which is a major tributary of the Sapta Gandaki river system in the central Nepal. The entire project is located in Rasuwa District.

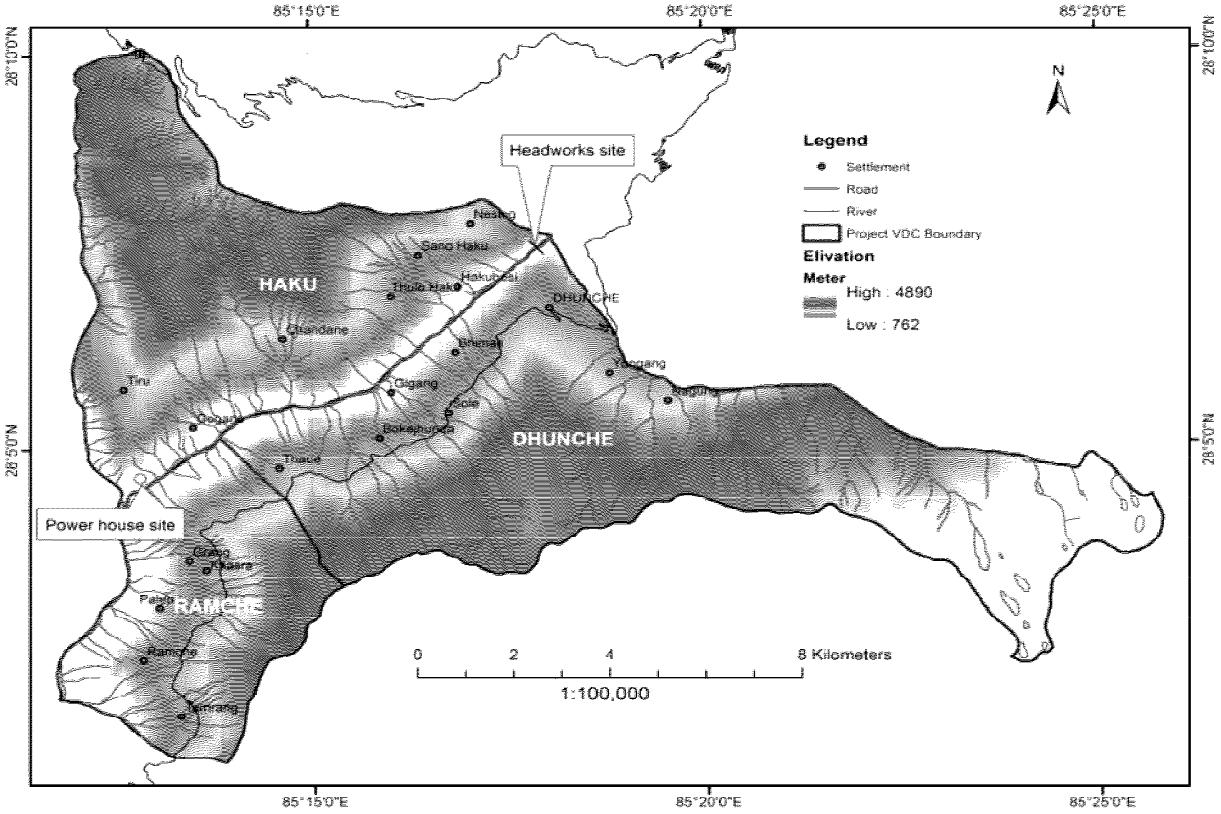


Figure 3-2: Location of Headworks and Powerhouse of UT-1 HEP

3.2 Project Accessibility

The intake area of Upper Trishuli-I Hydroelectric Project (216 MW) can be reached by two hours walk from Dhunche, headquarter of Rasuwa district. At present, there is no passable access for wheeled transport to headworks. However, the powerhouse site of proposed project is accessible by vehicles through 13 kilometre long seasonal road from Betrawati. Initially, the road to Mailun Dovan from Trishuli Bazaar was constructed by Mailun Hydropower Project, which was later upgraded by Upper Trishuli 3A HEP. With upgrading of the road and construction of new bridge in the Trishuli River, the distance is reduced to 13 kilometers.

The terrain of project area is highly inaccessible. Narrow seasonal foot trails can be seen at some places. A permanent foot trail is connecting *tallo* (lower), and *mathillo* (upper) Haku

village and a difficult narrow trail connects Haku and Mailun Dobhan. At powerhouse site, a Tuin (iron rope) connects both banks of Trishuli River.

3.3 Project Features

The proposed Upper Trishuli-I HEP (216 MW) is a run-of-river type of project. The project structures includes cofferdam, intake, diversion tunnel, weir, desander basins, headrace tunnel, penstock, surge tank, powerhouse, access tunnel, adits tunnels and tailrace tunnel. In addition, construction of access roads and transmission line to Upper Trishuli-3B substation are included in the project, however, out of scope of EIA study.

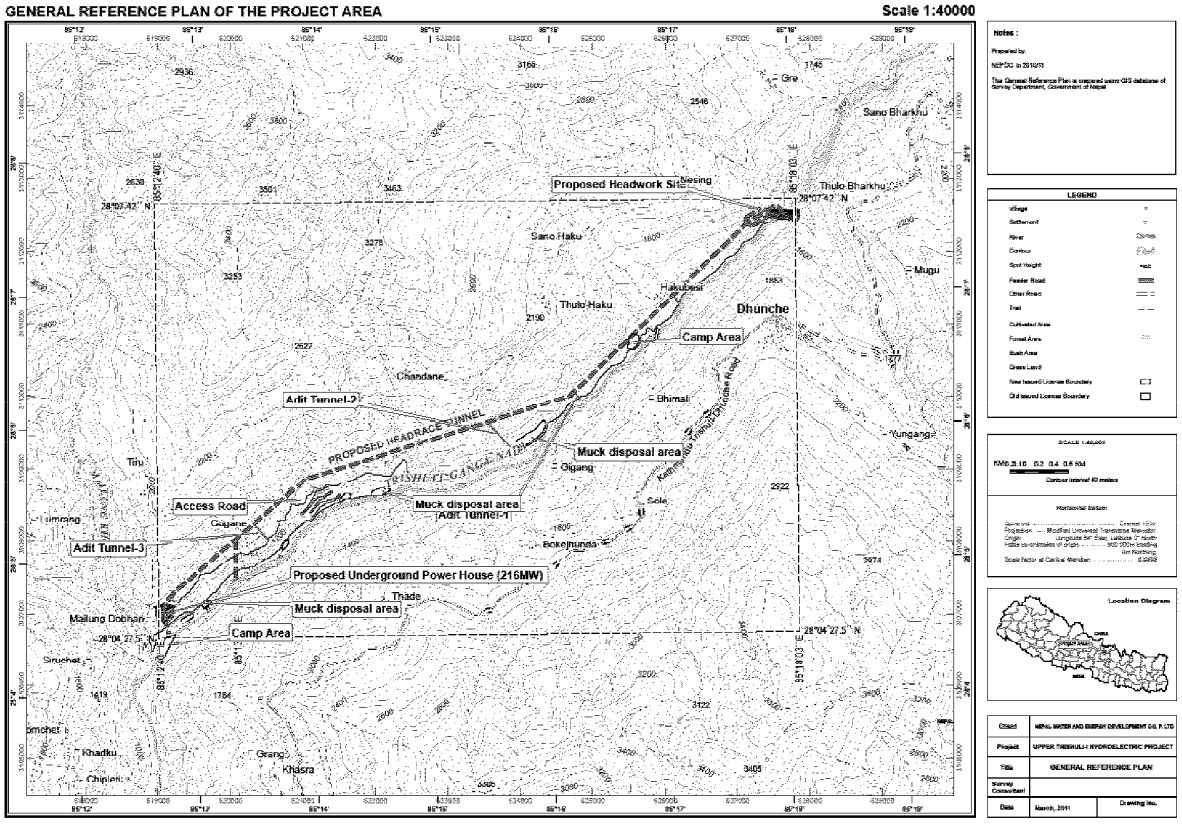


Figure 3-3: Project Structure and Facilities in Topographic Map of GoN (1:50,000 Scale)

Table 3.1: Salient Features of Upper Trishuli-I Hydroelectric Project

Item	Description
Location	Rasuwa District, Baghmati Zone(80 km northeast of Kathmandu) Intake site at Hakubesi of Haku VDC and powerhouse site at Mailun of Haku VDC Longitude: 85^{O} 12' 40" E – 85^{O} 18' 03" E Latitude: 28^{O} 04' 27.5" N – 28^{O} 07' 42" N
Catchment and hydrological data:	
Catchment area at intake site	4350 km^2
Area Below 3000 m elevation Intake Site	276.9 km^2
Area Below 5000m Elevation Intake Site	2445.3 km^2
Discharge at 90% Exceedance	34.27m^3/s
Design Discharge Q51	74m^3/s
Design flood (2000-year)	3202 m^3/s
Project Features:	
Gross Head	350m
Net Head	333.93m
Installed Capacity	216 MW
Average Annual Energy	1557 GWh
Diversion Structure	Weir (77m wide)
Intake	Side Intake Type
Desander	Underground (L=123 m, D = 22.60 m, W= 10 m, Number of Bay is 3)
Desanding Flushing	Underground Tunnel Length= 190 m and width 2.5 m
Head Race Tunnel Length	About 9.82 km, 6.5 m Circular shape
Surge tank	Circular shape 12 m diameter and 81.50 m height
Vertical Shaft	Length = 292m and diameter of shaft = 6.5m
Adit at different location	Length = 1135 m , D shape diameter 4 m
Type of Powerhouse	Underground
Size (L x B x H)	75.95 m x 10.10m x 31.31 m
Transformer Gallery	Underground Type
Switchyard & Office Area	Surface
Size (W x L)	85 m x 59 m
Turbine Type	Francis Turbine, 3 number each 72 MW
Power and Energy:	
Average Saleable Energy	1440 GWh/year
Access Road Length	20.30km road from Mailun Dhovan to intake site including all adit and road to Tungbar access.
Transmission Line	Connection to 10km length of 220 kV double circuit to Upper Trishuli -3B & another option of Mata-tirtha with 60 km length 220kV.
Construction Period:	
Construction period	5 years from start of construction
Project cost	US$ 382.583 Million
IRR	15.29%
B/C ratio at discount rate of 10%	1.197
Project Cost per kW	US$ 1771 (Before Financing)
Total Financial Cost including IDC	*US$ 486.450 Million*

Source: Nepal Water and Energy Development Company Ltd.

3.3.1 Project Structures and Facilities

This section briefly describes different structures and facilities of the proposed project.

3.3.1.1 Project Structures

The Upper Trishuli-I Hydroelectric Project (216MW) comprises of three major components i.e., headworks, water conveyance system and power facilities. A list of components considered in this project is listed below.

a. Headworks

The headworks of the Upper Trishuli-I Hydroelectric Project consist of diversion weir including radial gate, Intake, Desander basin, connecting tunnel, flushing tunnel and access tunnel to desander basin. After side intake, a connecting tunnel will divert water into a desander. In order to make work area dry for the construction of weir, river flow will be diverted using a cofferdam and diversion tunnel. All the structures in headwork area are underground except for the diversion weir and cofferdam during construction.

b. Cofferdam

A cofferdam of 16m height will be provided to retain water upstream of the headworks area. The cofferdam with 5m top width will have a clay core to prevent water seepage. A 7m high and 150m long downstream cofferdam will also be provided to prevent backwater from the diversion tunnel outlet.

c. Diversion Tunnel

Diversion tunnel have been proposed to divert river flow during construction. To divert the adopted flow the 7m diameter of D-shaped tunnel is calculated. The total length of diversion tunnel is 328m. To control the flow, the gate has been provided at the entry of the diversion tunnel.



Figure 3-4: Downstream from Weir Site of Trishuli River from nearby Sano Bharkhu

d. Diversion Weir

A diversion weir with radial gate will be constructed across the Trishuli River at the proposed intake site. About 40m long water way is required to pass the high flood at probable maximum flood (PMF) of 3230m^3/s with a head over the weir. The weir consist four bays separated with 4m of pier. During the operation of intake at the time of high flood, the silt accumulated near the intake will be flushed over the slope surface by opening the radial gates. A stilling basin of length 27.82m and width 77m will be provided to dissipate the energy produced from the flushing effect from radial gate opening

e. Intake

A side intake will be designed on the right bank of the Trishuli River. Design discharge for the project has calculated as 74m^3/s for an installed capacity of 216MW. Considering flushing requirement and downstream releases, the design discharge for the intake had been taken as 74m^3/s. The intake has of 16.4m wide and 4.9m high and vertical lift fixed wheel gates, which will be used to regulate the intake. The trash-rack structure will be provided in front of the intake to prevent debris flow.



Figure 3-5: Trishuli River Section at Weir Site

f. Connecting Tunnel

Inverted D-shaped connecting tunnel of 6.5m diameter will be adopted to convey the water from intake to desander. The connecting tunnel will be fully concrete lined. This connecting tunnel will divide the water into three desander basins.

g. Desander

Desander of the length 123m will be used in order to exclude silt particles bigger than 0.20mm size for the power flow and considering a shape factor of 0.7, fall velocity of 1.25cm/s at water temperature 10O C. Three rectangular bays of 10m wide each with a bed slope of 1:100 will be designed. For the purpose of desander excavation, 141m long D-

shaped access adit of 4.5m diameter will be used. Another 4.5m diameter D-shaped, 110m long adit will be provided for access to the desander flushing area. The efficiency of desander operation depends on the suspended sediment concentration on the river.

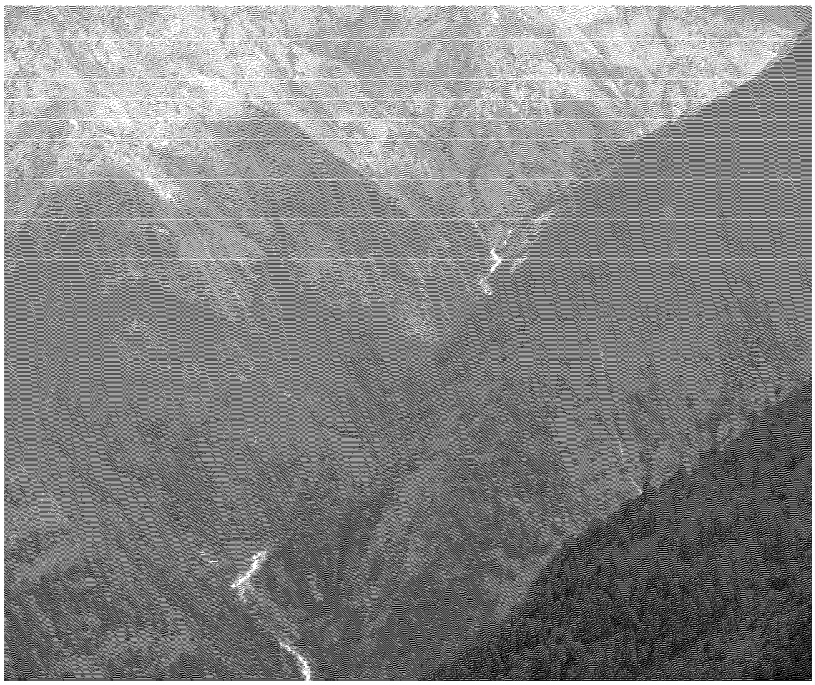


Figure 3-6: Trishuli River Weir Site, Tunnel Alignment and Haku VDC (on the way down to Weir site)

h. Headrace Tunnel

For the desander end, a circular shaped connecting tunnel intake will be provided for a length of 110m before water is diverted into 9820m long headrace tunnel. The headrace tunnel has been designed from the optimization of the tunnel size with respect to energy loss due to head losses.

i. Surge Tank

The restricted orifice-type surge tank will be used in Upper Trishuli-I Hydroelectric Project, which will be circular and concrete. Diameter and length of the surge tank will be 12m and 81.50 m respectively. The orifice diameters of the surge tank will be 3m, circular concrete.

j. Vertical Shaft

As there will be an underground powerhouse in this hydroelectric project, the vertical shaft configuration will be adopted in the design. At the end of vertical shaft, the pressure steel line penstock pipe will be used to withstand the hydraulic transient pressure. The length and diameter of the drop shaft will be 292m and 6.5m respectively. The length and diameter of steel lined penstock after drop shaft will be 141.0m and 6.0/4.3m respectively. For an easy excavation purpose, horseshoe shaped tunnel will be adopted for the construction of steel lined pressure tunnel. The excavated diameter will be 5.80m for 4.30m diameter steel lined tunnel.

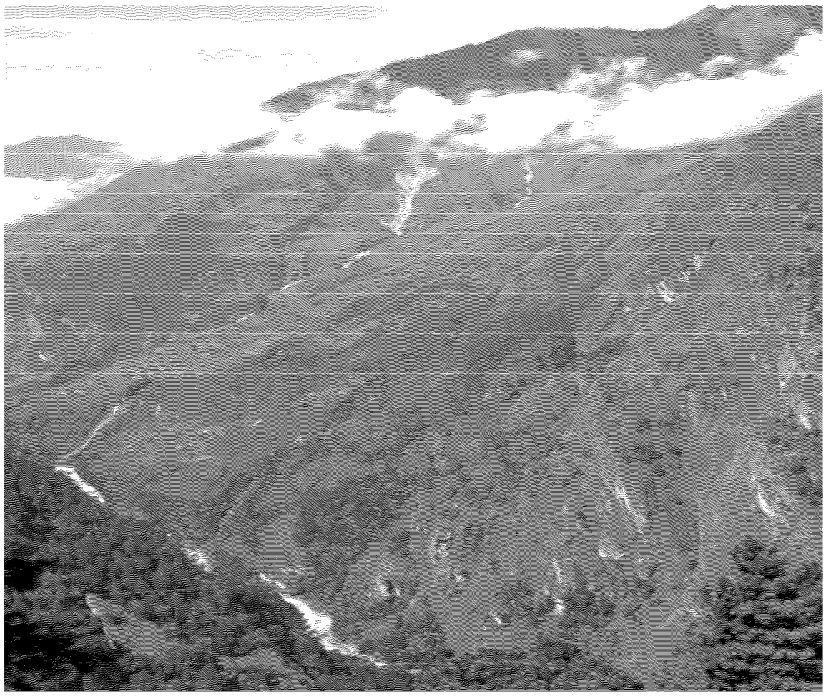


Figure 3-7: Power House, Surge Tank, Part of Tunnel Alignment (View from Gran)

k. Powerhouse

Due to the topographical constraints of the project area, an underground powerhouse will be constructed. The powerhouse will contain three units of turbine generator system spaced at 13.70m to produce 216 MW of hydroelectricity. The width of the powerhouse including cavern lining is 10.10m. The generator hall will be of 10.10m in width, 75.95m in length and 31.31m in height covering the combined area of the generator floor and service bay.

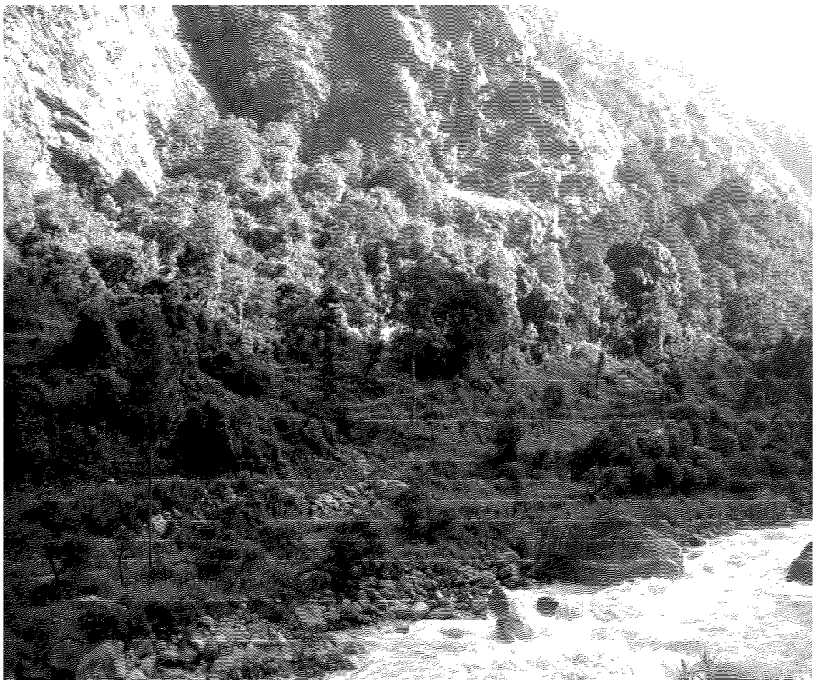


Figure 3-8: Power House Area

Overhead isolated phase bus ducts will be routed through "bus duct tunnel" connecting the powerhouse to the transformer switchyard. This bus duct will be D-shaped with a diameter of 3.5m and length of 240m. This bus duct shaft will have "electrical car", lighting facilities and "Ventilation duct".

l. Tailrace Tunnel

D-shaped tailrace tunnel of dimension of 6.5m and 227.52m long will be used for this hydroelectric project. In order to minimize the bed load entry to tailrace channel, a tailrace spillway will be provided. The length and the width of tailrace outlet will be 40m and 17m respectively. Since the high flood at tailrace channel outlet is higher than turbine setting elevation, it will require a tailrace gate to protect the flood entry at the time of plant shut down. The size of the gate will be 4.4m x 4.4m. This will be fixed wheel vertical lift gate.

m. Adit Tunnels

For the access of underground structures like powerhouse, vertical shaft, surge tank, tunnel, desander and tailrace number of construction adits (construction tunnel) will be used in Upper Trishuli-I Hydroelectric Project. The shape of the entire construction tunnel will be of D-shaped and shot Concrete-lined. Most of these adits will be in proximity of headworks and powerhouse area.

n. Switchyard

The switchyard will be located on the moderate to steeped terrain hill near the right bank of the Trishuli River. The switchyard will be 85m wide, 59m long, and house transformers, disconnecting switches, circuit breakers, current transformers, voltage transformers and bus bars along with any other necessary protection equipment. Three 3-phase transformers will be used.

o. Transmission Line

The project has planned to utilize 10km long transmission line of 220kV double circuit from UT- 1 HEP's powerhouse to the Upper Trishuli – 3B Substation Hub. Apart from this, the project has also planned an alternative 220 kV transmission line up to Matha-Tirtha substation located at 60km distance from the powerhouse.

Concurrently, as per EPR 97 (EPR, Schedule 1, Uu.Uu.1), a separate study 'Initial Environment Examination' is needed for transmission line. However, this Environmental Impact Assessment study is for hydropower component only, and hence environmental study of the transmission line component is outside the scope of present study.

3.3.1.2 Project Facilities

a. Internal Access Road

There is altogether 20.30 km of road, which needs to be constructed, to access all the project structures and facilities (intake site including all adits and road to Tungbar). However, the road stretches (7.76 km) from powerhouse site to Gogane village will be constructed by the local community of Haku VDC and the remaining road (12.54 km) from Gogane village to headworks site as well as surge shaft will be constructed by the proposed project. The road is mainly aligned along steep slope land.

b. Engineering, Contractor and Labour Camps

Engineering camps will be permanently established, both at Headworks and powerhouse sites. In headworks site, the permanent camp will be established north of Hakubesi-Hakubesi-Fulbariin Haku VDC. These camps will be used as project camps during operation period of the proposed project. Similarly, temporary contractors and labour camp will be established near headworks site at Hakubesi-Hakubesi-Fulbariand others at Buchet Phant and Gumchet. Likewise, two permanent camps will be established at Baluwa Phant and Mailun Dovan of Haku VDC, both on cultivated land.

c. Spoil /Muck Disposal Area

The project area lacks sufficient space such as river bank or barren land for muck and spoil disposal. In the Haku VDC, the project has identified 31 spoil and muck disposal sites, most of them located in the barren flood plain along the river bank. Few spoil disposal sites namely Spoil Disposal Area - 5, 6, 7, 8 and 14 are located in forest land and active land movement is also noticed in these sites.

d. Quarry Area

The aggregate required for the project will be fulfilled through quarry identified at different location of project sites. The project has identified four quarry areas, the first one is located at Bagar (flood plain) downstream of headworks, second one at downstream from Hakubesi landslide, third one at community forest land at Tungbar terrace and fourth one near switchyard in bushes and existing road.

The construction material survey and investigation includes identification of quarry sites and borrow areas, test pitting and laboratory testing. The investigation has been carried out to assess the availability of required volume of different types of construction materials such as impervious core material, coarse and fine aggregates, riprap stone and boulders in suitable quarry sites are available within the haulage distance. The laboratory tests and analysis of the collected samples were also carried out according to ASTM and AASTHO standards.

e. Batching Plant, Construction Yard /Store

Batching and store facility is provided at the low cultivated terrace of Tungbar and Dharanatar. Construction yards are located within the available facilities within the engineering, and contactor camp. The Construction vehicles/equipment to be used for the project construction works such as dozers, hauling trucks, excavators, tunnelling equipment, service vehicles along with appropriate parking facilities will be managed within these sites of engineering, contractor camp as well as other facilities. The construction materials will be also stored in these sites. The toxic materials including acid, petroleum products, batteries, etc shall be safely stored in store and other sites giving special attention to storage and handling as well as with proper management of safety and security.

3.3.2 Project Requirement

3.3.2.1 Land

The project will need 104.45 hectares of land for the construction and implementation of the project (**Table 3.2**). The acquisition of permanent and temporary land will be 47.58 hectares (45.55% of total land acquisition) and 56.88 hectares (54.45% of total land acquisition) respectively. The different types of land use required for establishment of Project Structures and Facilities is presented in **Table 3.2**.

Table 3.2: Land Requirement of UT-1 HPP for Establishment of Project Structures and Facilities

S.N.	Name of Project Structure and Facilities	Land Requirement (Hectare)											
					Land Use								
		Permanent	Temporary	Total	Agricultural Land (Khet and Bari)	Bushes	Agricultural Land (Khar Bari)	Forest	River	Bagar	Cliff	Existing Road	Total
1. Project Structures													
1.1	Pondage Area	2.44	0.00	2.44	0.00	0.00	0.00	0.29	0.78	0.57	0.80	0.00	2.44
1.2	Weir	0.76	0.00	0.76	0.00	0.00	0.00	0.39	0.16	0.12	0.08	0.00	0.76
1.3	Intake	0.03	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.03
1.4	Cutting for slope stabilization on right bank	0.47	0.00	0.47	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.00	0.47
1.5	Cutting for slope stabilization on left bank	2.02	0.00	2.02	0.00	0.00	0.00	2.02	0.00	0.00	0.00	0.00	2.02
1.6	Adit portal to Desander Basin	0.03	0.00	0.03	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.03
1.7	Adit 1	0.06	0.00	0.06	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.06
1.8	Adit 2	0.09	0.00	0.09	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09
1.9	Adit 3	0.14	0.00	0.14	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.14
1.10	Adit 4	0.09	0.00	0.09	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.09
1.11	Adit Portal to Surge tank	0.09	0.00	0.09	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.09
1.12	Air vent tunnel	0.03	0.00	0.03	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.03
1.13	Tailrace Portal	0.06	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.06
1.14	Switchyard	1.01	0.00	1.01	0.20	0.14	0.16	0.20	0.00	0.27	0.00	0.04	1.01

S.N.	Name of Project Structure and Facilities	Land Requirement (Hectare)											
					Land Use								
		Permanent	Temporary	Total	Agricultural Land (Khet and Bari)	Bushes	Agricultural Land (Khar Bari)	Forest	River	Bagar	Cliff	Existing Road	Total
Subtotal (1)		**7.31**	**0.00**	**7.31**	**0.29**	**0.14**	**0.16**	**3.35**	**0.94**	**1.02**	**1.38**	**0.04**	**7.31**
2. Project Facilities													
2.1. Access Road													
2.1.1	Access Road to Headwork	26.94	0.00	26.94	4.80	0.00	0.00	11.49	0.00	1.80	8.76	0.09	26.94
2.1.2	Access Road to Surge Shaft	7.85	0.00	7.85	1.20	0.00	0.00	6.56	0.00	0.00	0.00	0.09	7.85
2.1.3	Access Road to Tungbar Terrace	2.35	0.00	2.35	0.00	0.00	0.00	0.00	0.00	2.18	0.00	0.18	2.35
Sub Total (Access Road)		**37.14**	**0.00**	**37.14**	**6.00**	**0.00**	**0.00**	**18.05**	**0.00**	**3.98**	**8.76**	**0.35**	**37.14**
2.2. Quarry Site													
2.2.1	Quarry Site -1(Downstream of Weir)	0.00	1.27	1.27	0.00	0.00	0.00	0.00	0.00	1.27	0.00	0.00	1.27
2.2.2	Quarry Site - 2 (Near Hakubesi landslide)	0.00	0.77	0.77	0.00	0.00	0.00	0.00	0.00	0.00	0.77	0.00	0.77
2.2.3	Quarry Site - 3 (Tungbar Terrace)	0.00	1.30	1.30	0.00	0.00	0.00	0.95	0.00	0.00	0.00	0.35	1.30
2.2.4	Quarry Site - 4 (Near Switchyard)	0.00	6.27	6.27	0.00	5.92	0.00	0.00	0.00	0.00	0.00	0.35	6.27
Sub-total (Quarry Site)		**0.00**	**9.62**	**9.62**	**0.00**	**5.92**	**0.00**	**0.95**	**0.00**	**1.27**	**0.77**	**0.71**	**9.62**
2.3.Spoil/Muck Disposal Area													
2.3.1	Spoil Disposal Area - 1 (Northeast from Fulbari)	0.00	0.32	0.32	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.32
2.3.2	Spoil Disposal Area - 2 (Northeast from Fulbari)	0.00	0.43	0.43	0.00	0.00	0.00	0.00	0.00	0.43	0.00	0.00	0.43
2.3.3	Spoil Disposal Area - 3 (Fulbari)	0.00	0.52	0.52	0.00	0.00	0.00	0.00	0.00	0.52	0.00	0.00	0.52
2.3.4	Spoil Disposal Area - 4 (Northeast of Fulbari)	0.00	1.33	1.33	0.00	0.00	0.00	0.00	0.00	1.33	0.00	0.00	1.33
2.3.5	Spoil Disposal Area - 5 (Northeast of Hakubesi)	0.00	1.13	1.13	0.00	0.00	0.00	1.13	0.00	0.00	0.00	0.00	1.13
2.3.6	Spoil Disposal Area - 6 (Northeast of Hakubesi Landslide)	0.00	0.84	0.84	0.00	0.00	0.00	0.84	0.00	0.00	0.00	0.00	0.84

S.N.	Name of Project Structure and Facilities	Land Requirement (Hectare)											
					Land Use								
		Permanent	Temporary	Total	Agricultural Land (Khet and Bari)	Bushes	Agricultural Land (Khar Bari)	Forest	River	Bagar	Cliff	Existing Road	Total
2.3.7	Spoil Disposal Area - 7 (Southwest of Hakubesi Landslide)	0.00	2.65	2.65	0.75	0.00	0.00	1.00	0.00	0.90	0.00	0.00	2.65
2.3.8	Spoil Disposal Area - 8 (Southwest of Hakubesi Landslide)	0.00	2.74	2.74	0.00	0.00	0.00	1.28	0.00	1.46	0.00	0.00	2.74
2.3.9	Spoil Disposal Area - 9 (Southwest of Hakubesi Landslide)	0.00	2.52	2.52	0.00	0.00	0.00	0.00	0.00	0.00	2.52	0.00	2.52
2.3.10	Spoil Disposal Area - 10 (North east of Buchet Phant)	0.00	1.35	1.35	0.00	0.00	0.00	0.00	0.00	1.35	0.00	0.00	1.35
2.3.11	Spoil Disposal Area - 11 (Buchet Phant)	0.00	2.33	2.33	2.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.33
2.3.12	Spoil Disposal Area - 12 (Southeast of Buchet Phant)	0.00	3.27	3.27	0.00	0.00	0.00	0.00	0.00	3.27	0.00	0.00	3.27
2.3.13	Spoil Disposal Area - 13 (Southeast of Buchet Phant)	0.00	0.89	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.89	0.00	0.89
2.3.14	Spoil Disposal Area - 14 (Tungbar Terrace)	0.00	3.00	3.00	0.00	0.80	0.82	0.53	0.00	0.85	0.00	0.00	3.00
2.3.15	Spoil Disposal Area - 15 (Dharanetar)	0.00	2.47	2.47	0.00	0.00	0.00	0.00	0.00	2.47	0.00	0.00	2.47
2.3.16	Spoil Disposal Area - 16 (Downstream of Dharanatar)	0.00	0.44	0.44	0.00	0.00	0.00	0.00	0.00	0.44	0.00	0.00	0.44
2.3.17	Spoil Disposal Area - 17 (Upstream of Gumchet)	0.00	0.44	0.44	0.00	0.00	0.00	0.00	0.00	0.44	0.00	0.00	0.44
2.3.18	Spoil Disposal Area - 18 (Gumchet)	0.00	0.37	0.37	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00	0.37
2.3.19	Spoil Disposal Area - 19 (Gumchet)	0.00	0.52	0.52	0.00	0.00	0.00	0.00	0.00	0.52	0.00	0.00	0.52
2.3.20	Spoil Disposal Area - 20 (Gumchet)	0.00	1.38	1.38	0.00	0.00	0.00	0.00	0.00	1.38	0.00	0.00	1.38
2.3.21	Spoil Disposal Area - 21 (Downstream from Gumchet)	0.00	0.93	0.93	0.00	0.00	0.00	0.00	0.00	0.93	0.00	0.00	0.93
2.3.22	Spoil Disposal Area - 22 (Downstream from Gumchet)	0.00	0.40	0.40	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.40

S.N.	Name of Project Structure and Facilities	Land Requirement (Hectare)											
					Land Use								
		Permanent	Temporary	Total	Agricultural Land (Khet and Bari)	Bushes	Agricultural Land (Khar Bari)	Forest	River	Bagar	Cliff	Existing Road	Total
2.3.23	Spoil Disposal Area - 23 (Downstream from Gumchet)	0.00	1.63	1.63	0.00	0.00	0.00	0.00	0.00	1.63	0.00	0.00	1.63
2.3.24	Spoil Disposal Area - 24 (Upstream of Baluwa Phant)	0.00	1.03	1.03	0.00	0.00	0.00	0.00	0.00	1.03	0.00	0.00	1.03
2.3.25	Spoil Disposal Area - 25 (Baluwa Phant)	0.00	0.68	0.68	0.00	0.00	0.00	0.00	0.00	0.68	0.00	0.00	0.68
2.3.26	Spoil Disposal Area -26 (Switchyard)	0.00	0.43	0.43	0.08	0.06	0.07	0.08	0.00	0.12	0.00	0.02	0.43
2.3.27	Spoil Disposal Area - 27 (Near Switchyard)	0.00	0.24	0.24	0.02	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.24
2.3.28	Spoil Disposal Area - 28 (Mailun Dovan)	0.00	0.82	0.82	0.00	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.82
2.3.29	Spoil Disposal Area - 29 (Mailun Dovan)	0.00	1.25	1.25	0.00	0.00	0.00	0.00	0.00	1.25	0.00	0.00	1.25
2.3.30	Spoil Disposal Area - 30 (Near Mailun Headwork)	0.00	1.30	1.30	0.00	0.00	0.00	0.00	0.00	1.30	0.00	0.00	1.30
2.3.31	Spoil Disposal Area - 31 (Near Mailun Headwork)	0.00	1.28	1.28	0.00	0.00	0.00	0.00	0.00	1.28	0.00	0.00	1.28
	Sub-total (Spoil/Muck Disposal Sites)	**0.00**	**38.92**	**38.92**	**3.17**	**1.18**	**0.89**	**4.86**	**0.00**	**25.39**	**3.41**	**0.02**	**38.92**
2.4.Camp and other Facilities													
2.4.1	Camp Facility -1 and Engineering Camp -1 (Northeast of Hakubesi-Fulbari)	0.50	0.00	0.50	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50
2.4.2	Construction Yard - 1 (Hakubesi-Fulbari)	0.00	2.01	2.01	2.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.01
2.4.3	Camp Facilities - 2 (Hakubesi-Fulbari)	0.00	1.36	1.36	1.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.36
2.4.4	Construction Yard - 2 & Camp Facility - 3 (Buchet Phant)	0.00	2.59	2.59	2.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.59
2.4.5	Batching Plant Facility - 1 (Tungbar)	0.00	1.46	1.46	1.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.46
2.4.6	Store Facility - 1 (Dharanetar)	0.00	0.82	0.82	0.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.82
2.4.7	Camp Facility - 4 (Gumchet)	0.00	0.09	0.09	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09

S.N.	Name of Project Structure and Facilities	Land Requirement (Hectare)											
					Land Use								
		Permanent	Temporary	Total	Agricultural Land (Khet and Bari)	Bushes	Agricultural Land (Khar Bari)	Forest	River	Bagar	Cliff	Existing Road	Total
2.4.8	Camp Facility - 5 (Baluwa Phant)	0.93	0.00	0.93	0.72	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.93
2.4.9	Camp Facility - 6, Engineering Camp - 2 & Batching Plant Facility - 2 (Mailun Dovan)	1.69	0.00	1.69	1.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.69
Sub-total (Camp and Other Facilities)		**3.12**	**8.34**	**11.46**	**11.25**	**0.22**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**11.46**
Sub-Total (2)		**40.26**	**56.88**	**97.14**	**20.42**	**7.31**	**0.89**	**23.86**	**0.00**	**30.64**	**12.94**	**1.08**	**97.14**
Total (1+2)		**47.58**	**56.88**	**104.45**	**20.71**	**7.45**	**1.04**	**27.20**	**0.94**	**31.66**	**14.32**	**1.12**	**104.45**
Percentage		**45.55**	**54.45**	**100.00**	**19.83**	**7.14**	**1.00**	**26.05**	**0.90**	**30.31**	**13.71**	**1.07**	**100.00**

Source: Feasibility Study Report, Upper Trishuli-I HEP and EIA Field Survey, 201

3.3.2.2Human Resource

The total workforce including skilled, semi-skilled, and unskilled labour during the peak construction period of the proposed project will be about 1100. The major project related employment will rest on the local populace during construction. The employment opportunities will be given to seriously affected peoples and disadvantaged groups.

3.3.2.3 Construction Material

The most of construction materials required for the project will be procured from the domestic producers/ suppliers. Cement and steel will be sourced from the nearer factories in Nepal. The procurement is through vehicle. Both coarse and fine aggregates will be produced from the rocks and river deposits obtained from the quarries as per site condition. Some coarse aggregates will also be processed from the excavated materials. The materials for backfill and rock fill will also be processed from the excavated materials. As per site condition and materials required, some materials will be imported from outside markets within the country or outside it. The materials for backfill and rock fill will be processed from the excavated materials. The tentative amount of explosive to be used is 7800 Tons for underground structures like headrace tunnel, powerhouse, surge tank and access road. All the required toxic chemicals including acid, petroleum products, and batteries will be stored in the storage facilities. The construction vehicles such as dozers, hauling trucks, excavators, tunnelling equipment, service vehicles, etc will be parked within project facilities such as construction yard storage, batching plant, etc as per their requirement.

Table 3.3: Requirement of Construction Material

SN	Material	Quantity	Unit	Remarks
1	Cement	57500	Metric Ton	
2	Reinforcement bars	7750	Metric Ton	
3	Aggregate	122078	Cubic Meter	
4	Sand	61100	Cubic Meter	
5	Explosive	7800	Tons	

Source: Feasibility Study Report, Upper Trishuli-I HPP

3.3.2.4 Construction and Implementation Schedule

The project is planned for five years of construction from the Contract Award to Commissioning stage. In order to meet such a schedule, construction of access roads will need to start some six months earlier than the main scheme works.

The project schedule is estimated as three thousand one hundred forty four days. Civil works will start on November 2013 and the project will start production from February 2019. The work for the Headworks area will be started from June 2014 and will be complete in January 2018. For the construction of the Desander, it will take 6 months' time.

A brief account of sequencing of the construction activities and major construction activities undertaken is presented in the table below.

Table 3.4: Tentative Schedule Project Implementation

Particulars	Time																											
	2012				2013				2014				2015				2016				2017				2018			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Project Grounding																												
Infrastructure Development																												
Civil Works																												
Testing/Production																												

Source: Feasibility Study Report, Upper Trishuli-I HPP

3.3.3 Construction Cost

The total financial cost at the end of construction of project includes taxes and duties, price contingency and interest during construction is estimated is US$ 486,450,569, with the construction period of 5 years and based on the assumed disbursement of cash flow for that construction period. The cost of the project per KW is US$ 2252 per kW.

3.3.4 Project Operation Mode

Project will be developed as a run-off river scheme. It may be noted that annual maintenance of the generating machines is normally undertaken during lean flow period. The following table shows monthly flow and turbine discharge.

Table 3.5: Month Wise Water Available

Months	River Discharge (m^3/s)	Downstream Release (10% of Monthly flow)	Turbine Discharge
January	43.50	4.35	39.15
February	38.40	3.84	34.56
March	38.40	3.84	34.56
April	48.60	4.86	43.74
May	89.20	8.92	74.00
June	236.80	23.68	74.00
July	500.20	50.02	74.00
August	568.90	56.89	74.00
September	375.80	37.58	74.00
October	161.30	16.13	74.00
November	79.60	7.96	71.64
December	54.20	5.42	48.78

Source: Feasibility Study Report, Upper Trishuli-I HPP

Table 3.6: Water and its Major Role in the Project Component

SN	Description	Remarks
1	Water storage hours	The project is run off the river type. Some storage of water is also provided to make the water level constant at 1255 masl during the operation; this level is the maximum water level, which is provided to discharge the constant amount of water to the turbine.
2	Turbine numbers to be operated	3
3	Hours of operation	24 hours for six months period and rest month/hour of operation depends on the discharge of the river
4	Water released from tailrace in the operation periods (m3/s)	Same as turbine discharge
5	Annual energy production	1556 GWh

Source: Feasibility Study Report, Upper Trishuli-I HPP

4 EXISTING ENVIRONMENTAL CONDITION

This chapter highlights the existing environmental condition of the project impact area to facilitate identifying significant environmental issues and to determine the areas of EIA study for the project. The baseline condition of the project area is established from available literature and secondary data and primary field survey

4.1 Physical Environment

4.1.1 Physiography

In general, there are three physiographic regions, High Himalayas, High Mountains and the Middle Mountains, which reflect the underlying geology. They are continuous as linear belts along the length of the country. The middle Mountains has an average width of 60km and range of elevation in between 200m and 3,000m. High Mountain zone with an altitude of more than 3,000m is generally covered by forests with sparse vegetation. The hills of Middle Mountain and High Mountain slowly rise to north and give away to snow-capped ranges of High Himalaya. This zone is devoid of cultivation and mostly covered by glaciers, snow peaks, conifer forests, rocky cliffs and colluvium deposits. To the northwest, far below the village runs the Trishuli River with the Trishuli Khola tributary running north west to south east between Dhunche and the facing hillside where the road bends round towards Thulo Bharkhu village. The area is predominantly rural with a subsistence farming community, but because it is connected by road to Kathmandu, it also serves as a tourist destination.

Due to both constant movement and fragility of the ground layers, disturbances such as heavy rainstorms, landslides occur frequently. Every year during the rainy season landslides severely affect the region, causing loss of lives and property. Lack of good agricultural land has been a major cause for a very low density of population in this zone. All the engineering structure of this project lies in Middle Mountain Zone. Soils range from ancient river terrace to deeply weathered residual soil.

Table 4.1: Land Area Distribution of Project Affected VDCs

ILAKA No	VDC	Area in Sq.km.	% of the District	Access Source
1	Dhunche	77.83	5.14	Road
1	Haku	50.47	3.33	Foot Trail
4	Ramche	26.22	1.73	Road

Source: DDC Profile, Rasuwa, 2063

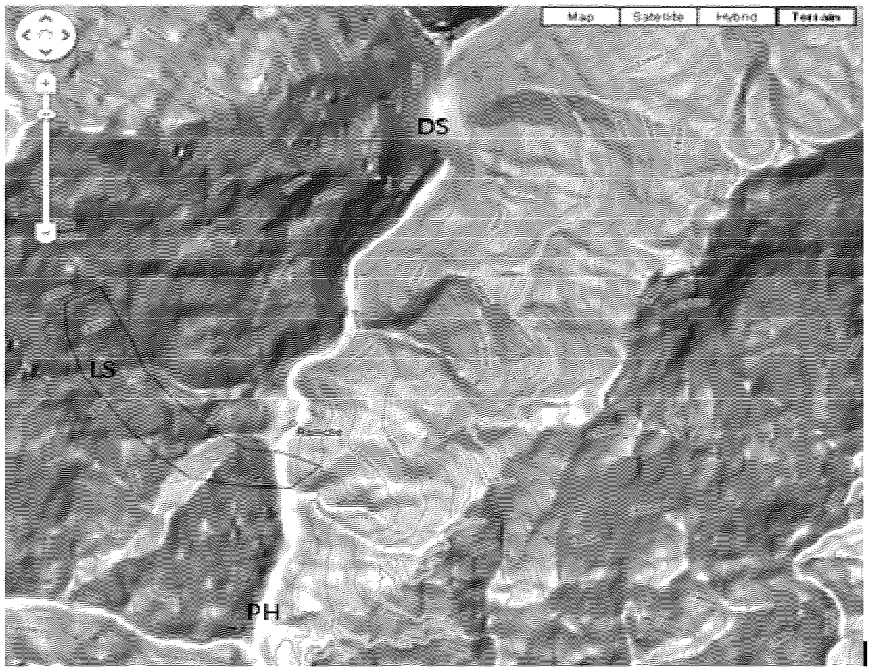


Figure 4-1: Terrain Map of Project Area (DS: Dam or Weir, PH: Powerhouse, LS: Haku Landslide)

4.1.2 Topography

The project area lies in the upper stream of Trishuli River in Rasuwa District in Higher Himalayan zone of central Nepal. The land surface is somewhat rugged and with steep slopes to vertical cliff containing residual soil and exposing hard rock.

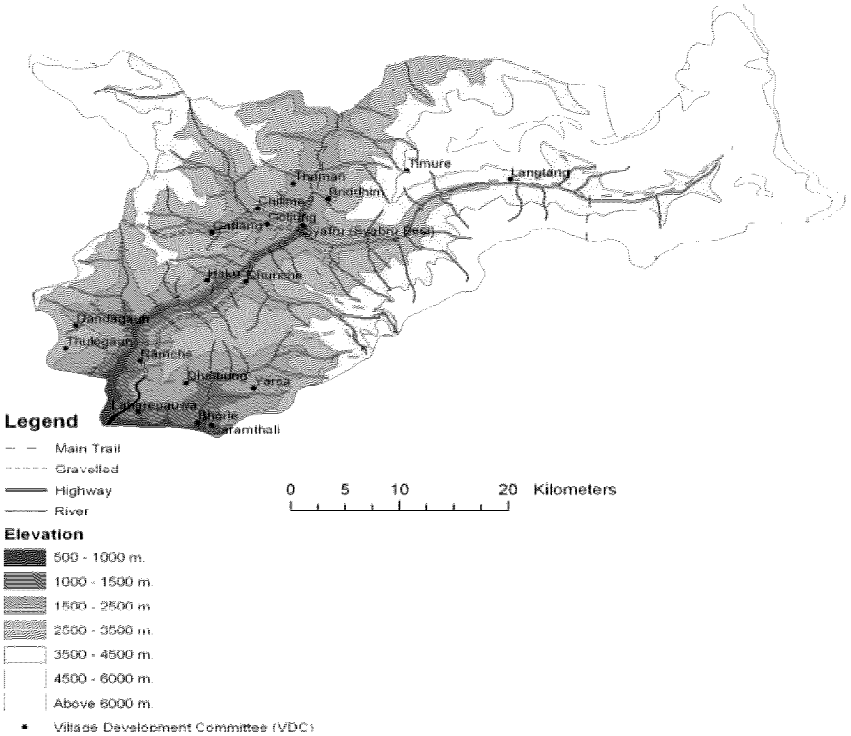


Figure 4-2: Topographical and Access Map of the Project Area

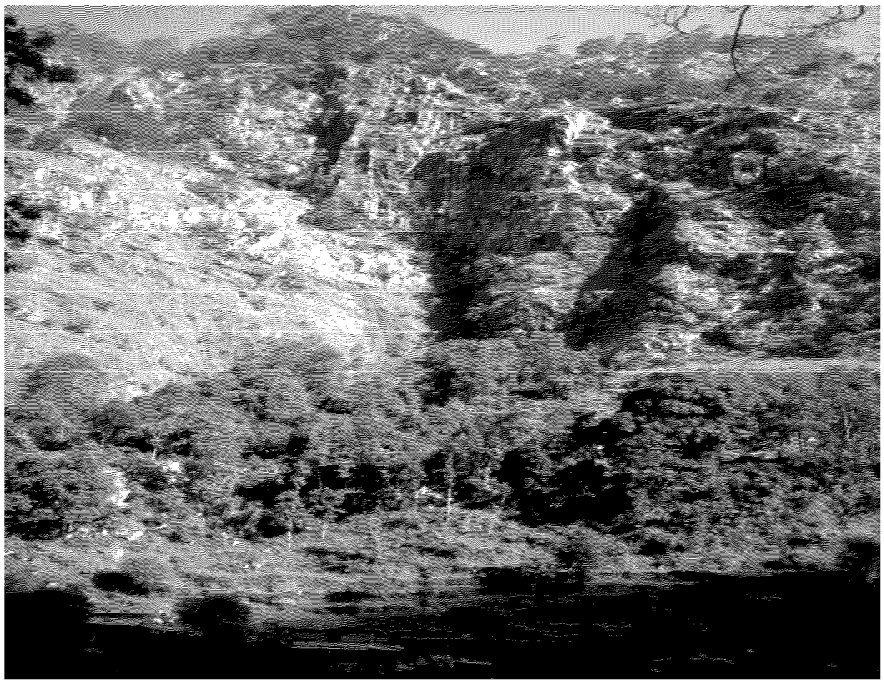


Figure 4-3: Location of Power House Area

4.1.3 Climate

In Langtang, general climate is pronounced winter with about minus -10 °C. The River is frozen for about 3-4 months during winter on the upper surface in the upper reaches of Kyangjin valley and melts slowly by the end of February to early March. The summer is mild with marked rain from June to September, rest of the months are mildly cold and are optimum for tourism and other conservation activities. Summer is the only growing season when plant growth and agriculture production is feasible. The annual maximum temperature in the project area occurs generally in the month of May and ranges from 18˚C to 20˚C. Likewise, the minimum temperature generally occurs in February and January ranging from 0˚C to 5˚

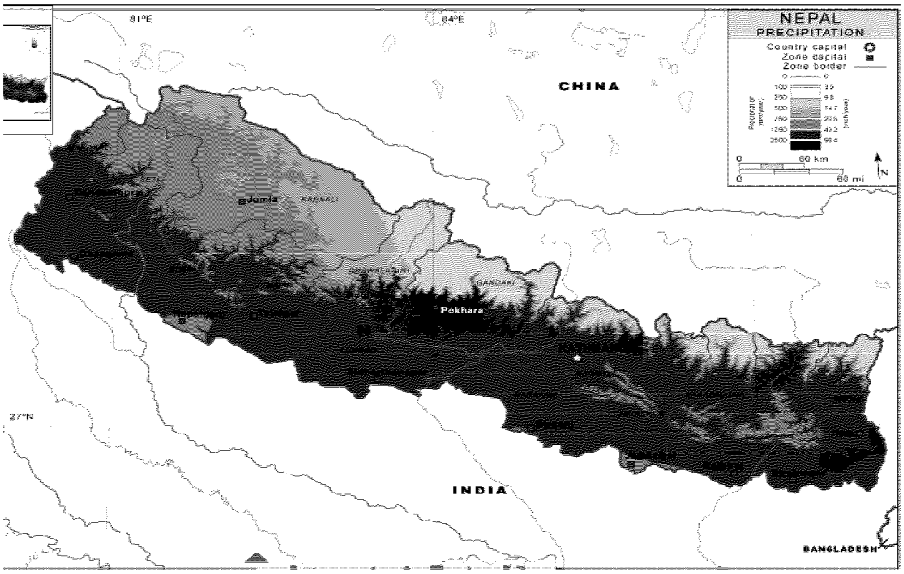


Figure 4-4: Precipitation Map of Nepal

4.1.4 Precipitation

The climate of Nepal is totally controlled by monsoon winds and topography. In Nepal, the precipitation decreases from east to west during summer whereas in winter it shows reverse trend. As in other parts of Nepal, the Trishuli River catchments also experience the effects of the southwest monsoon. The region receives approximately 80% of the annual rainfall during this period. The average annual basin precipitation of the project site is between 2000 to 2500mm. The evaporation occurs at the maximum rate during dry period of pre-monsoon season.

Based on the data of the nearest weather station (Dhunche, 1982 m), the annual rainfall was 2038 mm with the highest rainfall in the month of July (Figure 4.5). The highest average maximum temperature was recorded during June, and the lowest average minimum temperature during.

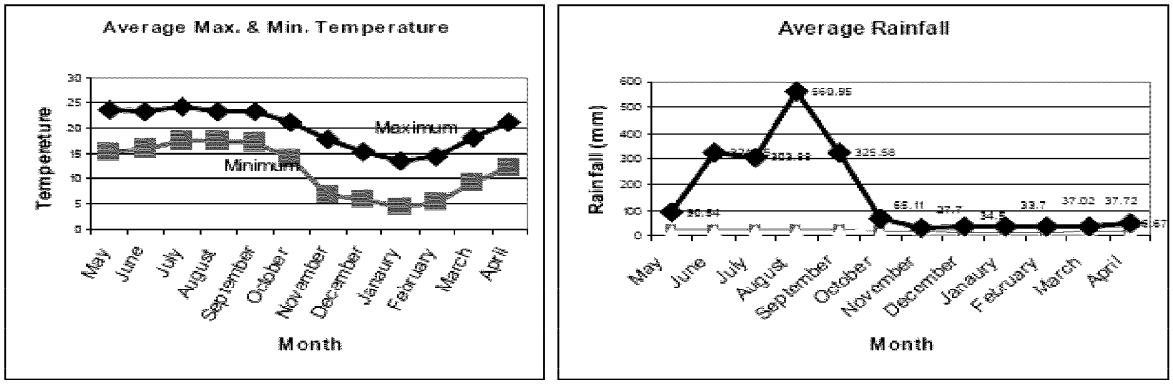


Figure 4-5: Average Maximum and Minimum Temperature and Rainfall in Rasuwa District

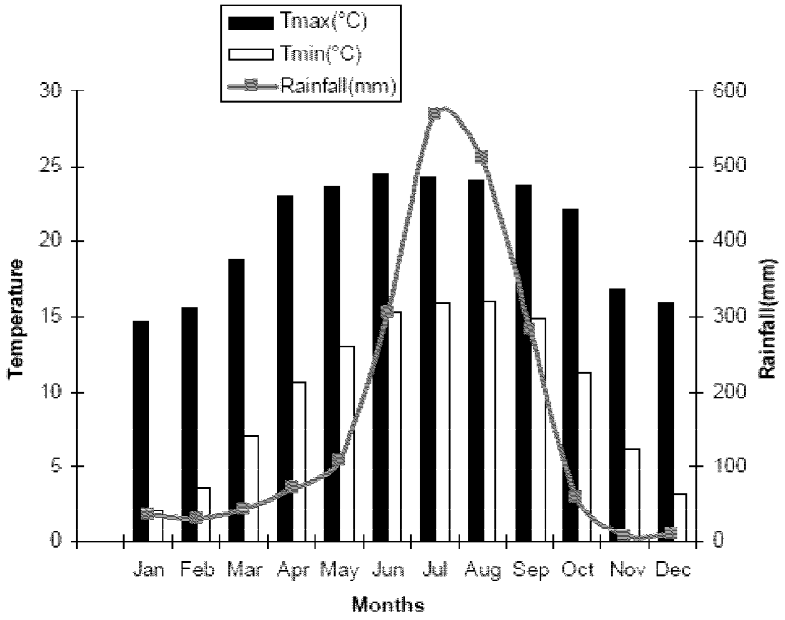


Figure 4-6: Average monthly temperature (°C) and rainfall (mm) recorded at Dhunche station between 1999 and 2008

Sub-Tropical Conditions are characterised by warm, moist summers, coinciding with monsoon season (June-September); relatively warm and sunny autumn and spring seasons;

and cold winters with clear skies and occasional snowfalls (coldest months being January and February). Altitudinal and topographic variation, however, produces considerable localized differences in conditions. Thus, the Helambu area is exposed to the full force of the monsoon and has the highest precipitation (mean annual precipitation at Sarmathang, 2,625m, just outside the park's southern boundary, is 3363mm), whereas Langtang Valley is shielded by the Gosainkunda ridge and receives much less precipitation (annual precipitation at Langtang Village, 3,429m, was 1027mm in 1976-77). This river basin is located in Central Himalayan Region, therefore, monsoon in this area is more extended, and rainfall can be expected in any month of the year. However, about 70 per cent of the total rainfall is recorded from February to August.

Table 4.2: Mean Monthly Rainfall at Project Area

Month	Dhunche rainfall in mm	Month	Dhunche rainfall in mm
Jan	33.70	Jul	303.88
Feb	37.02	Aug	560.85
Mar	37.72	Sep	325.58
Apr	46.67	Oct	65.11
May	90.54	Nov	27.7
June	324.05	Dec	34.80
Annual	1887		

Source: Department of Hydrology and Meteorology

Daily rainfall records have been maintaining at these stations since 1972. The average annual rainfall recorded at Dhunche was 600 mm. Daily rainfall of Dhunche stations for the year 2009 is presented in the figure below.

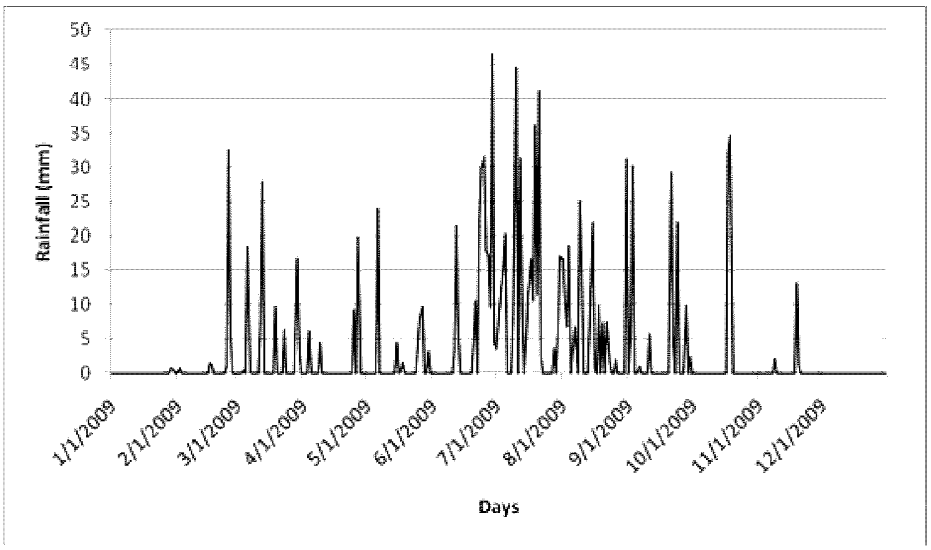


Figure 4-7: Daily Rainfall Recorded at the Dhunche Station in the Year, 2009

Almost all types of climatic conditions, which are strongly controlled by altitudinal effects, could be observed in the project district. Substantial climatic differences could be observed over a very short horizontal distances. Based on temperature and rainfall, Goldsmith (1981) divided the climatic condition of the project district into seven categories, which is illustrated in **Table 4.3** below.

Table 4.3: Trishuli River Basin - Climatic Condition

Climatic Type	Landscape	Altitude, m	Mean temperature and maximum temperature, °C				Annual Rainfall, (mm)
			Summer		Winter		
Hot dry subtropical	Valley bottom	< 500	25	32	10	24	1000
Warm dry subtropical	Valley bottoms of southern mid hills	500–1400	22	30	8	22	1000
Warm moist	Middle hills	800–1700	18	21	6	19	1000–2500
Cool moist	Middle hills	1700–2800	15	22	2*	12	1000–2500
Cold moist	High ridges above middle hill	2800–4000	10	17	5**	6	1000–2500
Alpine	Lower ridges of High Himalayas	4000–5000	***				NA
Arctic	High Himalayas	Above 5000					NA

Source: Goldsmith (1981)
*Note: *Freezing possible in some nights, ** Freezing possible every night, *** Freezing possible every night of the year, very short cool summer, very cold winter, ***NA Not Available*

Furthermore, based on altitudinal variation, which strongly correlates with temperature, Staintain, Dobremez classified Nepalese bio-climate into 11 categories.

4.1.5 Drainage and Hydrology

The Trishuli River is a trans-Himalayan river in central Nepal. The highest altitude point near the project area is Langtang Lirung Peak, which is 7,227m high from above mean sea level. Other high peaks are Langtang Ri 7,205m and Dorje Mountain 6,979m. Trishuli River drains all the water from these peaks before the weir site and is one of the major tributaries of the Saptagandaki River system. The downstream area of the Kyangjin River lies inside the Langtang National Park until Ramche/Cabbagere. The river that stretches up to Syaphrubesi from Kyangjin is named as Langtang River. The river is called Bhote Koshi until it joins with river Trishuli, below Dhunche and after joining with the river originating from Gosaikunda it is called Trishuli. The use of water between the river stretch of Dhovan (meeting point of two rivers-Trishuli and Bhote Koshi) to Kyangjin through Syaphrubesi is mainly used for domestic purpose for washing and drinking purposes by hotel, grazing animals and few local Ghattas (water mill used for grinding local crop products such as corn, buckwheat and millet). The Trishuli River after Cabbagere up to Betrawati is a buffer zone area of the Langtang National Park. The overall drainage pattern of the project area is dendrite.

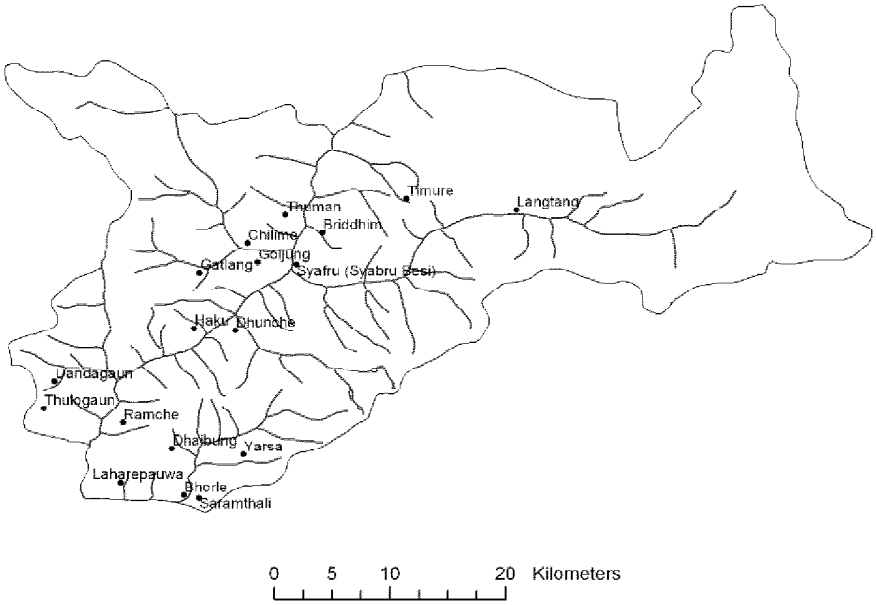


Figure 4-8: Drainage Map of Rasuwa District

4.1.6 Water Quality

The study of water quality of a river is highly imperative in understanding the river functioning and capacity of the river to support lives. The quality of water is a function of either or both natural influences and human activities (UNEP GEMS, 2008). Water quality assessments can provide a lot of information on different nutrients and pollutants present in water. Based on that information various aspects of a water system such as river or lake can be understood to manage water wisely.

Trishuli River is one of the largest rivers of Nepal with many tributaries. In order to assess water quality of this river near the project site, six different stations were selected for water sampling. These sampling stations were chosen at various intervals of Trishuli River. Following are the sampling stations:

Table 4.4: Sampling Stations

S.N.	Sample No.	Location	River
1.	W 1	Upstream of Confluence	Bhote Koshi
2.	W 2	Upstream of Confluence	Trishuli
3.	W 3	Downstream of Confluence	Trishuli
4.	W 4	Weir Site	Trishuli
5.	W 5	Confluence of Trishuli River and Ghatte Khola	Ghatte Khola
6.	W 6	Power House Site (Mailun Dovan)	Trishuli

Source: EIA Field Survey, 2011

The samples were taken by using standard sampling methods. Various physicochemical parameters of water samples were tested under standard lab conditions in order to measure the quality of water of the river vis-à-vis National Drinking Water Quality Standards (NDWQS) and river ecology.

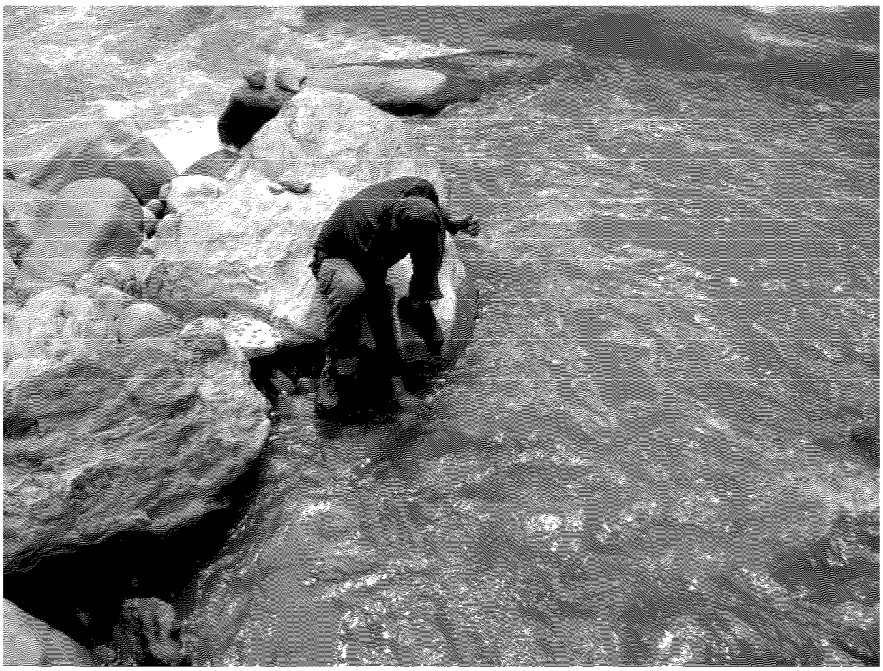


Figure 4-9: EIA Team Member Collecting Water Sample

Water of Trishuli River and its tributaries was slightly alkaline. This indicates presence of carbonates in the water of Trishuli. Turbidity of the water samples from Trishuli River were in range of less than 1 to 39. Higher turbidity was from the samples taken on the day of rainfall. Plant productivity decreases with the higher turbidity in the rivers (*Davies et al. 2008*). Conductivity of the water samples from Trishuli River ranged between 53–115µS/cm. The values of electrical conductivity were within the national standards and were not substantial to affect river ecology adversely. TDS concentration of Trishuli River at the study sites varied between 23-55mg/l. The TDS values show that water of Trishuli is soft in nature.

Total suspended solids (TSS, sometimes-called filterable solids) in water are organic and mineral particulate matters, which do not pass through a 0.45 µm (*Weiner, 2008*). They may include silt, clay, metal oxides, sulphides, algae, bacteria, and fungi. The water samples showed TSS in range of 2.6 to 133.8 mg/l. The TSS value is negotiable in terms of its possible adversities to ecosystem. Total alkalinity of the water of Trishuli River and its tributaries varied between 19-41 mg/l as $CaCO_3$, which indicates slightly acidic environment in the river. Total acidity ranged from 77mg/l to 206 mg/l. higher value of total acidity indicates presence of higher dissolved CO_2.. Nitrate value was found in the range of less than 0.1 mg/l to 1.3mg/l. Nitrate value was significantly, lesser which indicates negligible agricultural effluents to the river. Ammonia content of the samples were found 0, 0.1 and mostly <0.1 mg/L as N that is within the limit of NDWQS and very negligible to harm aquatic animals.

Total hardness was found in the range of 16mg $CaCO_3$ /litre to 55mg $CaCO_3$ /litre in the water samples. The result shows river water is relatively lower in hardness. The calcium content of the water samples were in range of 5mg/l to 18mg/l. These concentrations were low compared to NAAQS and suitable for the good river health.

Table 4.5: Water Quality of Trishuli River and its Tributaries

Parameters	Unit	Sample						NDWQS	Method
		W_1	W_2	W_3	W_4	W_5	W_6		
Colour		< 1	< 1	< 1	< 1	< 1	< 1	5(15) (Max)	Spectrophotometric
Turbidity	NTU	34	< 1	7.1	31	4	39	5(10) (Max)	Spectrophotometric
Conductivity	µS/cm	127	63	115	120	53	112.7	1500 (Max)	Electrometric
TDS	mg/L	55	27	50	52	23	49	1000 (Max)	Electrometric
TSS	mg/L	116.6	2.6	88.9	42.8	14.8	133.8	-	Filtration
Total Solids	mg/L	38	149	109	48	194	183		Gravimetric and Evaporation
Lab Temp	°C	25.2	22.6	22.6	22.6	22.6	25.2	-	Thermometer
CHEMICAL									
T. Alkalinity	mg/L as CaCO3	41	24	41	43	19	40	-	Titration & Electrometric
T. Acidity	mg/L as PO4	86	103	77	77	120	206	-	Spectrophotometry (Ant.tar-Ammo molibdate)
Chloride	mg/L as Cl	2.5	1	2	5.6	1.5	NA	250(Max)	Titration, Mohr's Method
Nitrate	mg/L as NO3	0.8	1	1.3	1	< 0.1	0.7	50 (Max)	Spectrophotometric (Sulfoalicylic acid)
Ammonia	mg/L as N	0.1	< 0.1	0.1	0	< 0.1	0.1	1.5 (Max)	Spectrophotometric (Nessler's)
Total Hardness	mg/L as CaCO3	55	28	51	51	16	48	500 (Max)	Titration, Na 2 EDTA
Calcium	mg/L as Ca	18	8	16	16	5	16	200 (Max)	Titration, Na 2 EDTA

Note: NDWQS – National Drinking Water Quality Standard (2062)
( ) = If there is no alternative source of water
Remarks: The observed values of all the tested parameters of all the samples are found to be within the limit of NDWQS, except that of Turbidity of Sample
W_1 = Water Sample of Intake (1) Intake site (Trishuli River)
W_2 = Water Sample of Intake (2) Before confluence (Trishuli River)
W_3 = Dam Site
W_4 = Bhotekoshi before the confluence point
W_5 = Hakubesi (Confluence of Trishuli and Ghattekhola)
W_6 = Power house site (Mailun Dhovan)

4.1.7 Air Quality

There is no permanent environmental monitoring station in the project area. However, site specific monitoring conducted in 2008 and indicated that the air quality in the project area was good during the evaluation period. There are no industrial pollution sources in the project area, and transportation density is not high. The proposed project area lies in hilly area with no point or ambient sources of air pollution such as industries, vehicular emission,

etc. The air quality mention here is through observation and not by measuring parameters. In a normal situation, the ambient air quality is perceived to be good and is expected to be within the WHO guidelines value for all criteria.

4.1.8 Noise Level

The project is located in the Valley of Trishuli River and is surrounded by steep hills. There are some houses in the project area. No permanent roads exist in the project area. The sources of noise in the project area are only natural such as animals, wind movement, flowing river and streams. The noise pollution in the core project area can be considered as insignificant.

4.1.9 Soil Quality

Sampled soils were dug out from the depth of 2 feet to avoid the humus material in the soil. The pH, gradation analysis, and were analysed by using pH metre, sieve analysis and laboratory test.

Two major areas were selected for soil sampling. One was weir site and the other was landslide zone in Haku. Altogether four soil samples were analysed from these two sites. Table 4.6: Soil sampling sites

Table 4.6: Soil Sampling Site

Area	Soil Sample	Northing	Easting	Altitude (m)
Weir site	S3	N28.12154	E85.29053	1334
	S4	N28.12204	E85.29153	1334
Thulo Haku area	S1	N28.11869	E85.26249	2102
	S2	N28.11848	E85.26312	2086

Source: Soil Sample Survey, 2011

The soil sample data shows that the soil-sampled sites are slightly acidic or almost neutral in nature.

Table 4.7: pH value of Soil of Project Construction Site

Area	Soil Sample	Northing	Easting	pH	Altitude (m)
Weir site	S3	N28.12154	E85.29053	7.06	1334
	S4	N28.12204	E85.29153	6.05	1334
Thulo Haku area	S1	N28.11869	E85.26249	6.14	2102
	S2	N28.11848	E85.26312	6.7	2086

Source: Soil Sample Survey, 2011

4.1.10 Sediments and Sedimentation

The sedimentation is a major problem in the river as of its tremendous carrying capacity due to high velocity of flow caused by high gradient and yearly effects of snow melting upstream in the valley. Snowmelt contributes mainly to the river flow and rainfall adds the flows during the months of June to September. The head works of the project is close to the Himalayan range. The agricultural practice in this area is rare and population density is very thin. The main source of fine sediment is from the process of sheet and reel erosion. Landslides and mass wasting are the main sources of suspended and bed load sediment.

Those events produce very high sediment load and materials are deposited along the bed and produces high sediment concentration during the following years. Some minor landslides are seen along the river but did not appear to be a major threat to the project. In the project area, the riverbed material consists of cobbles and boulders, embedded in finer material like gravel, sand, and silt.

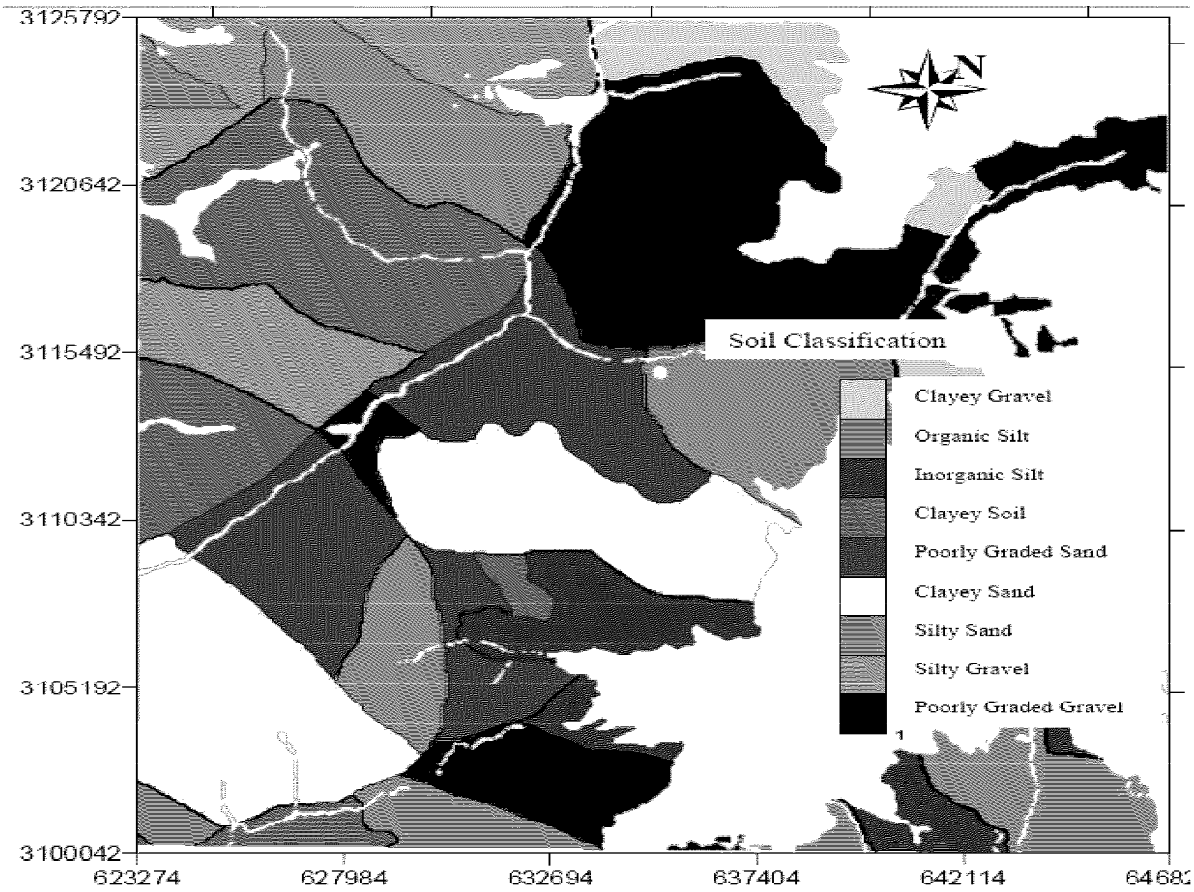


Figure 4-10: Soil Map of the Project Area (*Source: Acharya, 2003)*

4.1.11 Geomorphology

As the site is located in the hilly region to high mountains, there is quite a variation in the geology and geomorphology in the study area. The geology of the area is more or less related to the elevation of the area. Lower regions primarily the areas having elevation less than 2400m above the sea level dominantly constitute the phyllite, quartzite, limestone and granites. Bands of fine-grained quartz-muscovite biotitic, schist or phyllitic schist are also found in the region. The landslide is at the southern limb of the Kuncha-Gorkha anticlinorium formed by alternating bands of metasandstones and chlorite-phyllite. Up to 30m., thick loosely packed colluvium (fine-grained sand to huge boulders) is filled in a wedge-shaped structure formed by joint and foliation. *Acharya, 2003* investigated this area during his master's degree thesis and came up to the following result. In the mountainous region, the prevailed soil type has been gravelly soil particularly the poorly graded gravel or sandy soil. The poorly graded gravel has been observed as 19.17% of the total study area. Likewise, 19.48% of the total area has been defined as the silty sand. As these types of soils have poor productivity and the topography of the region is hilly, the dominant land-cover in

the area has been forest or grassland. Only limited areas in the mountainous region have clayey or silty soil where people start cultivation to meet their daily needs.

4.1.12 General Geology

The geological structure of the Himalayan origin can be broadly divided into three east–west-trending zones, separated by major north-dipping faults. At the southern margin of the origin, the Main Boundary Thrust (MBT) juxtaposes molassic sediments of the Siwalik foreland with the low-grade metasedimentary rocks of the Lesser Himalayan sequence. To the north, across the Main Central Thrust (MCT), the main divide of the Himalayan range is composed of the Higher Himalayan Crystalline (HHC), which structurally overlies the Lesser Himalayan sequence. Further, north, the HHC are truncated by a major normal fault system, the South Tibetan Detachment (STD), north of which lies in the Tibetan sedimentary sequence. The following Geologic map of Langtang region shows sample locations, distribution of metamorphic index minerals and isograds, lithological units, and inferred thrusts (After Matthew J. Kohn, 2008). Major fault systems include the South Tibetan Detachment system (STD), the Main Central Thrust system (MCT), and the Main Boundary Thrust system (MBT). Small open square north of Kathmandu indicates the location of study area.

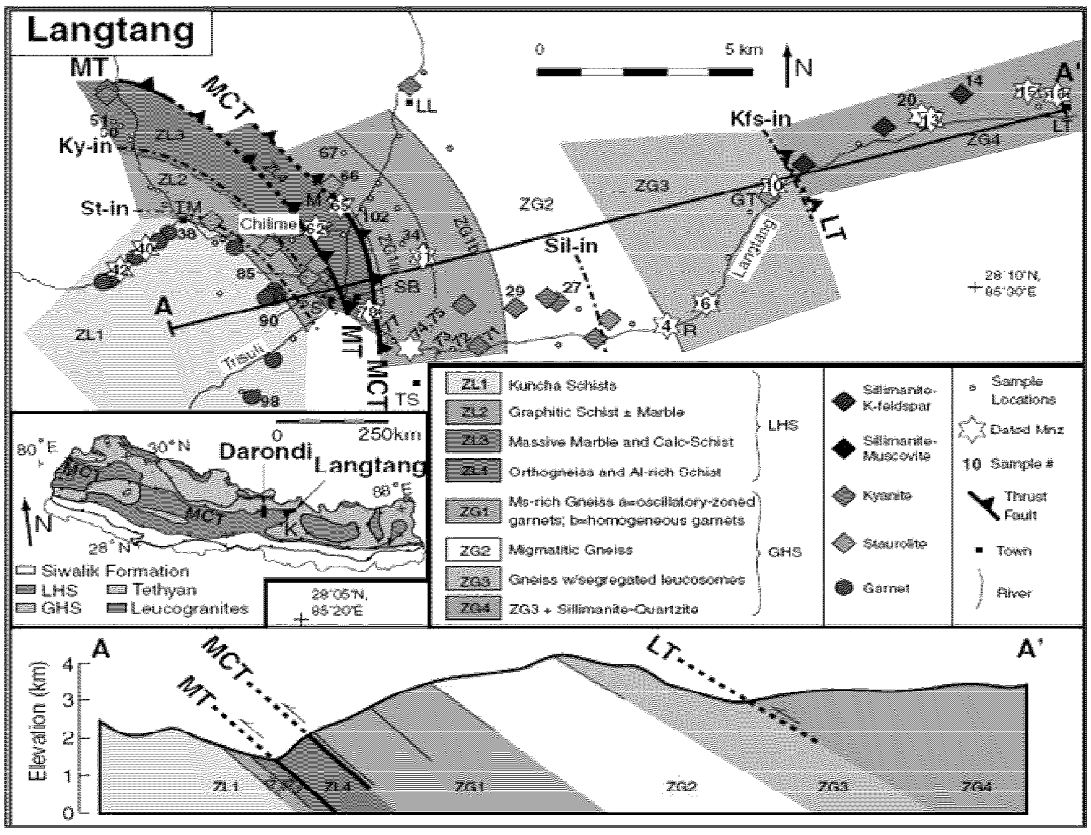


Figure 4-11: Geological Map of Langtang Region

The Main Central Thrust of the central Himalaya juxtaposes the Lesser Himalayan sequence (foot wall) with the Greater Himalayan sequence (hanging wall), both of which are regarded as components of the northern passive margin of India. Considerable uncertainty surrounds their respective ages and sedimentary derivation. U-Pb and Sm-Nd isotopic studies of

samples from the Langtang area, Central Nepal, demonstrate important distinctions between the two rock packages. The Greater Himalayan sequence had a sedimentary provenance that included a major source of 0.8–1.0 Ga zircons, implying a Late Proterozoic age. The source of the Precambrian part of the Lesser Himalayan sequence contained 1.87–2.60Ga zircons, and its depositional age is probably Middle Proterozoic. Nd isotopic characteristics of the two sequences are different: at 21Ma, the Greater Himalayan rocks had eNd values between –14.6 and –18.5 while their Lesser Himalayan counterparts had values between –21.4 and –25.9, giving rise to major differences in their model ages.

4.1.13Geology of Project Area

The project area belongs to the Lesser Himalayan Zone of Central Nepal. The predominant rock type of the project area is Phyllitic schist with metasandstone but in some area phyllitc quartzite can also be found inter bedded with Ulleri gneiss rock.

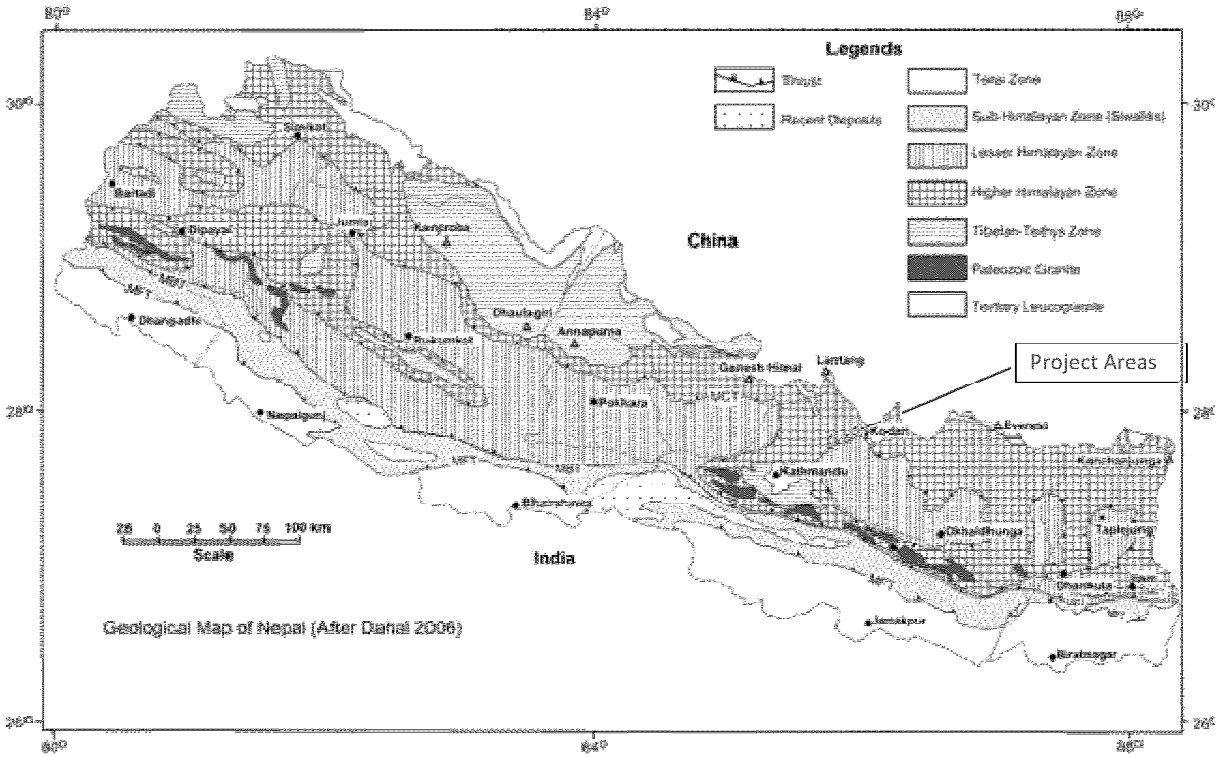


Figure 4-12: Geology of the Project Area

At the confluence of the Langtang khola with the Trishuli (Bothe Kosi) river, the Syabru Besi augen gneiss and their western prolongation in the Mailun Khola are considered as equivalents of the Ulleri gneiss although they appear above the Benighat schist of the upper Midland group (Le Fort and PeÃcher, 1974; Macfarlane et al., 1992). The 'natural' components consist of tectonic activities (which is possibly stronger in this area as the MCT is situated close by), unpredictable precipitation levels during the summer monsoon months and the steepness of the slopes because of which we can see lots of instability zone in the project area. The MCT passes near to Sybru Besi, which is only few km far from weir site.

All the project structures are located on the right bank of the Trishuli River. The surface deposit in the project area mainly consists of colluviums and alluvium. Alluvium is mainly found in the riverbed level and in the Dhovan area alluvium is found as alluvial terrace. This

alluvium is mainly composed of boulder, cobble and gravel in sandy silty matrix. The colluviums deposits are mainly dispersed along the hill slope. The thickness of alluvium and colluviums deposits is assorted in different area. Geologically the project area is stable but some landslide is observed in vicinity.

a. Weir Site

The weir site area is located downstream from Dhovan of Trishuli and Bhotekoshi River of Haku VDC in Rasuwa District. In the weir site, bedrock is exposed on the right bank of Trishuli River. The predominant rock of the weir site is massive blocky to locally fracture, moderately jointed and slightly weathered phyllite quartzite with schist. The rock is strong to very strong with uniaxial strength of around 150-200mpa. The orientation of rock is very favourable for the construction of weir. The joints are mostly tight occasionally few centimetres open, rough, irregular and moderately spaced. Alluvium terrace deposit is mainly found here. The rock slope on both banks is stable.

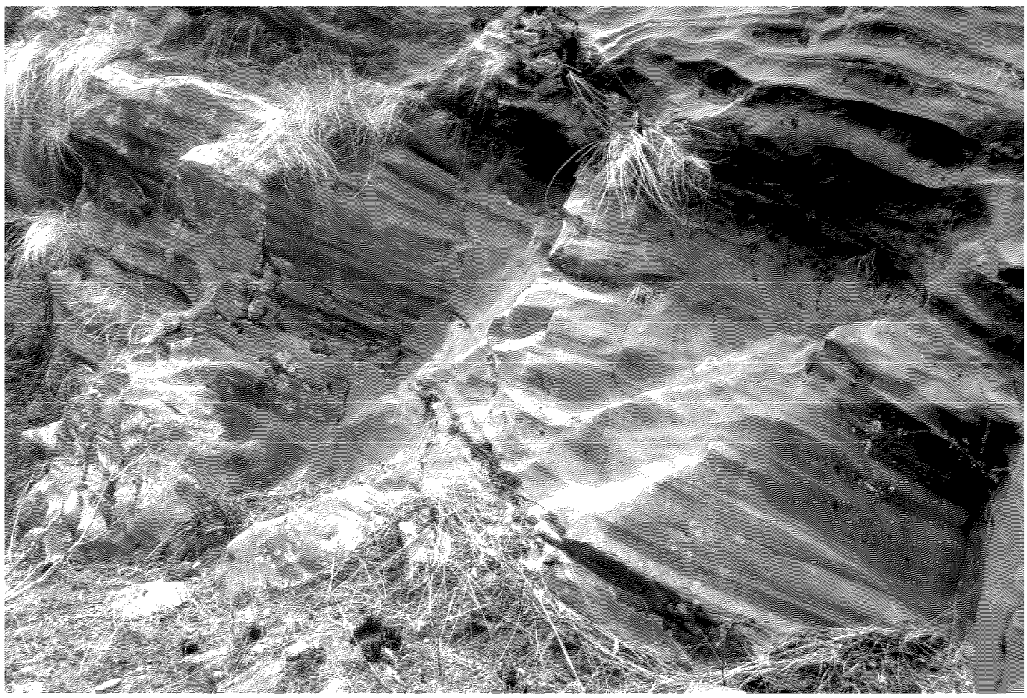


Figure 4-13: Geology of Weir Site Area



Figure 4-14: Tunnel Alignment

b. Tunnel Area

The entire headrace tunnels passes through the monotonous massive, blocky, locally fractured to slightly weathered phyllitic quartzite rock sequence, though in some area gneiss and schist are also acquire. The tunnel passes through the right bank of Trishuli River. The rock is medium strong to strong with uniaxial strength of around 70mpa. The rock cover is found to be sufficient throughout the tunnel area in this study but detail work has to be carried out in the next phase



Figure 4-15: Tunnel Alignment

c. Powerhouse

The powerhouse is proposed near Baluwa village at the right bank of Trishuli River. The rocks out crops are well distributed on the mountain slope near powerhouse area. The rock out crops found in nearby powerhouse area is generally massive, slightly fractured and moderately weathered quartzite and grit stone. The rock is medium strong to strong with uniaxial strength of around 75mpa.



Figure 4-16: Powerhouse Area

Detail lab test has not been conducted yet for weathering and strength parameter. This geological survey was carried out within a very limited time and, hence, the information on detailed geological data, geo-engineering map of the area etc. is limited.

4.1.14 Quaternary Deposit

Because of the various surface processes of erosion and sediments' transport, the following Quaternary deposits can be seen along the Trishuli riverbed:

a. Fluvial Deposit

These represent the sediments found in the riverbed, deposited and continuously transported and rearranged by the water flowing energy of the river. They are constituted of predominant rounded, medium to high sphericity, mainly quartzite and phyllite with a sandy soil matrix.

b. Alluvial Deposit

These materials outcrop at the bottom of the valley floor to constitute morphological terraces slightly raised above the riverbed. They fill the entire Trishuli valley floor. They are constituted by well-rounded, medium to high sphericity, heterometric, mainly quartzite and phyllite clasts embedded in a silty sandy matrix.

c. Colluvium Deposit

These materials originate from the down slope movement by erosion and/or force of gravity. They are collected at the base of mountains or foothills, with little or no sorting.

Over the project area, colluvium deposits have been observed along the right and left flanks of the Trishuli River valley. These soils are heterogeneous in size, with angular clasts of low sphericity.

4.1.15Seismic Hazard Risk

The Nepalese Himalaya occupies the central one-third portion of Himalaya area. Due to continued northward movement of the Indian plate against the Asian landmass, it keeps the Himalayan region constantly active and fragile. Numerous active faults, within Nepal and the adjacent regions are some potential sources of earthquake, along with moderate to deep focus earthquakes that develop along the main decollement plane beneath the Himalayas. The Himalayan belt is located in the plate boundary between the Tibetan plate in north and Eurasian plate in south, which is still moving that is why it is considered seismically active. However, based on relevant information from the previous studies and historical information, seismic risk factor for the project can be derived based on earthquake design coefficients used in other major hydroelectric projects in Nepal.

The geomorphic investigation has shown that active tectonics in Himalaya of Nepal is dominated by a major thrust fault which reaches the surface along the foothills (Lav'e and Avouac, 2000) where deformed Holocene terraces indicate a slip along the MHT aborts 21.5-± 1.5mm/yr. of horizontal shortening on the long term.

MHT is locked along the Himalaya of Nepal and the stress build up at the top of the locked zone is responsible for the belt of micro-seismic activity that runs along the front of the high range (Pandey et al. 1999; Cattin and Avouac, 2000). The MHT is segmented along the strike direction as well as in dip direction. Dip direction is correlated with seismological as well as structural geological features. The absence of great earthquakes west of 850 E longitudes in the last 500 years points the matured state of seismic gap. As most part of Nepalese Himalaya lies in matured gap, seismic source with the time dependent magnitude may be interesting for hazard computation.

An epicentre distribution map (Bajracharya, 1994) of Nepal shows that the epicentres with magnitude 4-5 have been reported in the project area. Likewise, simplified risk map (Bajracharya, 1994) of Nepal based on the historic seismic data shows that the project area lays in the area of medium risk.

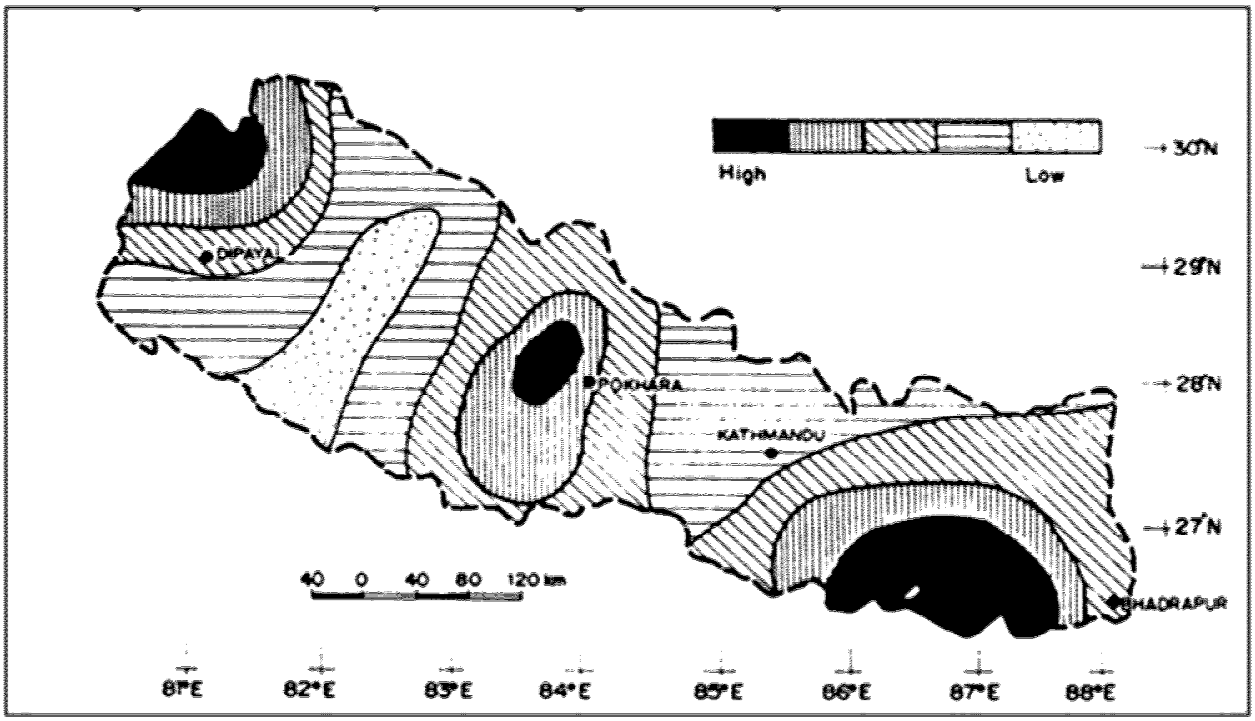


Figure 4-17: Simplified Seismic Risk Map of Nepal (Bajracharya, 1994)

There are also intervening medium to large earthquakes that occurred in different sector of Himalaya which were smaller than those earthquake, but still were quite devastating. When a sector of Himalaya moves and produce earthquakes, it will take some time from (decades to centuries) to repeat that event at the same place. Today, earth scientists are more concerned about the lack of occurrence of any great earthquake between Kathmandu and Dehradun, India, in the past centuries (500 years) and have named it central seismic gap. It is most likely that this segment of Himalaya is due for a major break to trigger mega earthquake in the Himalaya. It is suspected that it may be the greatest earthquake that we have so far experienced in the Himalaya in the past few centuries. However, the existence of the MCT in the project area further accelerates the seismic risk. Therefore, the proximity to such structural features is important while assessing the seismicity of the project. A detailed seismicity study is recommended to derive the seismic design coefficient during the detail design study.

4.1.16 Landslide

The project area shows diverse nature of slopes from medium to high slope angle. Majority of the areas have high slopes including the river valley and its upper part. According to information supplied by the villagers of Dhunche, a rotational slide occurred during high precipitation on the roadside leaving Dhunche village, near the bridge, which crosses the Trishuli River. The road was blocked and the road support was badly damaged. Above the fall is farm and shrub area. The outline of a much earlier and larger slide, now covered in shrub, can be seen above the scarp of the present one.

The Ramche landslide is located at 36km sector of the Trishuli-Dhunche motor road in Rasuwa district. According to the local residents, it was first activated in 1983 and reactivated at the night of 14 August 2003, killing 23 army men on site and injuring many

others. Since then, the landslide has been active. Geologically, the landslide is at the southern limb of the Kuncha-Gorkha anticlinorium formed by alternating bands of meta-sandstones and chlorite-phyllite. Up to 30m thick, loosely packed colluviums (fine-grained sand to huge boulders) are filled in a wedge-shaped structure formed by joint and foliation. Bedrock is exposed at both the crown and toe of the slide. The motor road passes across the slide. Diversion of stream water over the colluviums for irrigation, increased infiltration due to excavation for making road together with sealing effect of impermeable Kuncha phyllites at the base of the colluviums has increased pore water pressure in the soil. Reduced soil strength due to pore water pressure together with vibration of land due to heavy traffic have caused the debris to flow down slope on the rock surface. The slide seems more active in monsoon and relatively stable in winter. The movement rate is more than a metre per year. It has developed several cracks on the surface causing collapse of houses. The slide has put more than 100 people and their cattle, living in 16 houses of Polchet village at immediate risk.

The Thade landslide area is situated in the Himalayan crystalline formation consisting of Precambrian high-grade metamorphic rocks. A major geological lineation is seen passing through the nearby area. The material present in this landslide topography shows different types of rocks schist, quartzite, gneiss and meta-sandstone. The presence of lineation also suggests the existence of a fault zone. Landslide boundary is made clear by scarps separating the stable area from the unstable ones. In the landslide area itself, many breaks in topography (alternate steeper and gentle slopes) provide the basis for distribution of blocks. The topography of the slope movement area has changed several times after the area became active. The movement was observed mostly during monsoon season.



Figure 4-18: Landslide of Ramche



Figure 4-19: Landslide of Thade

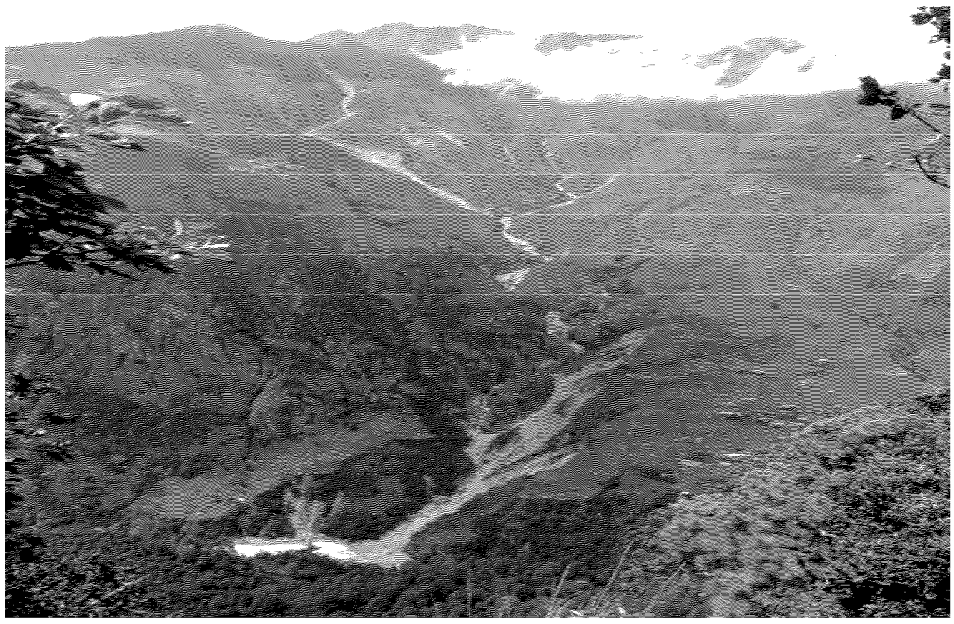


Figure 4-20: Haku Landslide

Haku landslide is the major landslide within the project area and it is continuously cutting slope mass and laterally towards Hakubesi. It is huge and can be illustrated from a distance as an earth slump but could also be described as a debris slide. Few people from the village gave information about its age and existence. A villager gave an approximate age of 9 years in presence of torrential rain but some stated it was much older. The main point in conformity is that it was continuing. People used to cultivate maize, millet, barley and wheat in the area, which has now become the landslide area near the village of Thulo Haku. Due to lack of cultivation area in the village people stared to cut into the forest for cultivable land. Landslide substance consists of boulder size material of Metasandstone and schist, which is cemented by fine grain soil. During the dry period, the soil presence in between boulders

helps to keep it intact so that the movement is low but in the presence of high torrential rainfall those soil is washed and big and small boulder starts to roll forming debris flow. The perennial stream that flows right through Thulo Haku, Thanku Khola that lies in the landslide area is another major cause of landslide. Due to the incision, the fine material washes away because of which loose material form debris flow. The depth of the landslide material is more than 10 metres. It is suggested that some major investigation work have to be conducted before commencement of the project to determine the overburden pressure as this landslide lies in the tunnel alignment.

Similarly, another landslide, Sarghang landslide occurs near the proposed Adit 1. It lies between Hakubesi-Fulbariand Hakubesi. It can also be described as a debris slide triggered by seasonal stream.



Figure 4-21:Sarghang landslide

The activity of sloped profile is extremely variable, ranging from active movement to stable. GIS to hydrological applications has been regarded as one of the important application fields, related to environmental problem solving in the viewpoint of information systems. A slope stability analysis on a regional scale is presented for the northern part of the Rasuwa district in Nepal, covering 409 km^2. A physically based slope stability model coupled to a simplified groundwater flow model was used to estimate soil wetness, and safety maps were generated for three steady state and two quasi-dynamic conditions. (*G. Acharya et al., 2005*)

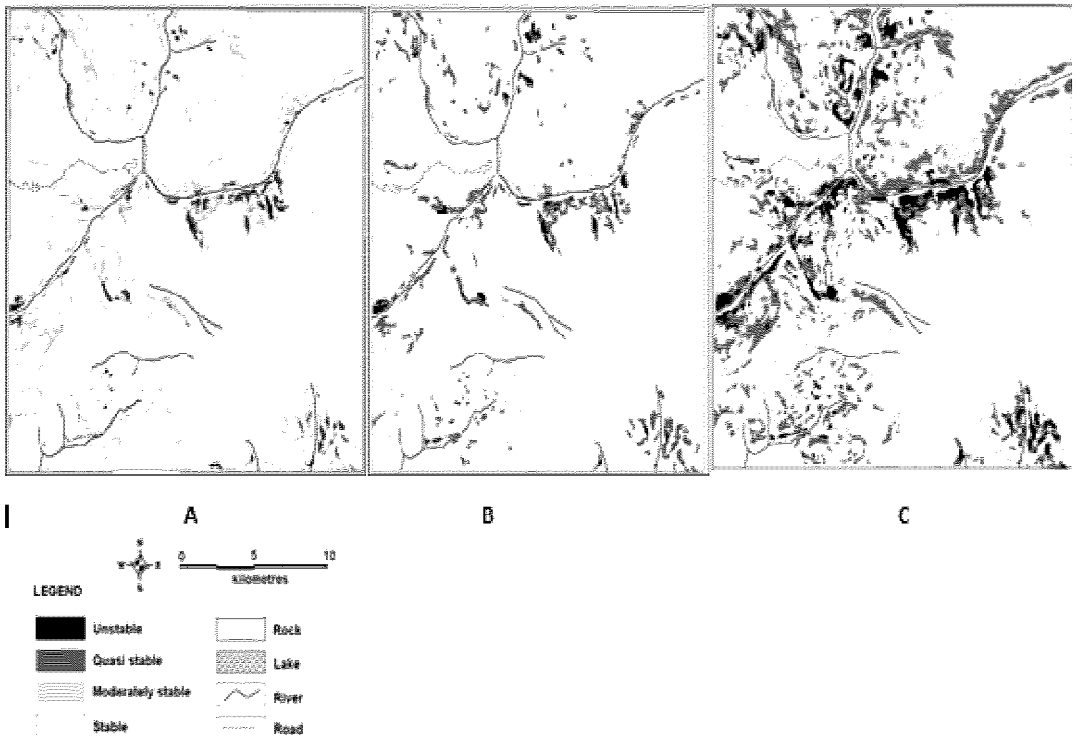


Figure 4-22: Different Stability Zones in the Project Area at Different Water Condition

The spatial distribution of the stability classes for dry conditions is depicted in scenario A of figure 43, which shows that most areas are stable in dry conditions. A map with the spatial distribution of the stability classes for half-saturated conditions is shown in scenario B. The 1% of slopes, which are unstable in the half-saturated scenario, should be considered as the most dangerous sites from the point of view of possible landslide accidents as these areas are located on slopes of 30 degrees or more and predominantly used for agriculture. People in these mountainous areas cultivate the land on very steep slopes without terracing—a very dangerous practice in view of the possibility of landslides. The results indicate that such locations can be easily identified in the field and hence preventive measures could be taken. The fully saturated scenario C is the worst from the point of view of slope stability, but from the physical point of view, it should be considered as exceptional and rather unlikely. Further analysis shows that slopes of 22 degrees can be regarded as safe even under the most severe conditions. Thus, some stabilization work should be applied during the construction period.

4.1.17GLOF

Glacier and ice cover some 17 per cent of the Greater Himalayan Region, a total area of nearly 113,000 km^2, the largest area covered by glaciers and permafrost outside the polar region. The Himalayan region alone has some 35,000 km^2 of glaciers, and a total ice reserve of 3700 cubic kilometres. It is the source of the nine largest rivers in Asia, whose basins are home to over 1.3 billion people. Various studies suggest that the warming in the Himalayas has been greater than the global average. Warming in Nepal and Tibet increased progressively within a range of 0.2-0.6 degrees Celsius per decade between 1951 and 2001, particularly during autumn and winter. The length of the growing season has increased by almost fifteen days over the past thirty years. Glacier melt in the Himalayas is likely to

increase intensity and frequency of various environmental risks, including floods and avalanches and failure of moraine-dammed lakes, and affect the water regime within the next couple of decades. When these dams break, devastating debris flows occur, internationally called GLOFs (Glacier Lake Outburst Floods). Before any measures can be taken to avert such catastrophes, comprehensive studies of the glacier, the lake and its surroundings are necessary. The geotechnical, geohydraulic, hydrological and glaciological conditions related to the lake, the glacier and their surroundings must be investigated for this purpose. The Langtang Glacier, located at approximately 28° 30 N Latitude and 85° 30 E Longitude, ranges in altitude from 4500 to 7000m and has a surface area of 75km^2. As are many Himalayan glaciers, approximately 47% of the Langtang Glacier is covered by debris, however the debris thickness is unknown (the average thickness on the nearby Lirung Glacier at 4400m altitude is 0.5metres (Fujita, 1996). The debris covers has a significant effect on ablation rates, and consequently on the glacier mass balance (Ostrem, 1959; Mattson and Gardener, 1989). The Langtang glacier which is the longest glacier in Nepal is about 36.6 Km far from the headwork site. Apart from this, there are two major Glacier lakes identified and these are at a distance between 36 and 41km from the weir site. Among the three identified names Langang, Longda and Khymjung, none are included under the high-risk GLOF category.

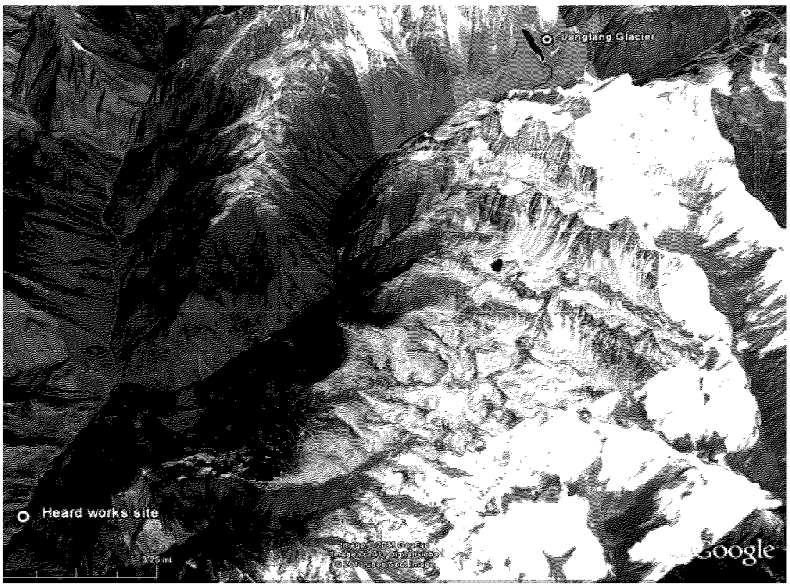


Figure 4-23: Langtang Glacier and Lake near UT-I Headwork

Gosaikunda is an alpine freshwater oligotrophic lake series with alpine meadows, bogs, lakes/ponds, streams, wet steep slopes creating a unique and representative wetland in the high Himalayan Paleoartic biogeographical region. It is one of the world's highest freshwater lake systems and is an important source of water for Trishuli River originating from Trishuli Dhara in Gosaikunda. The water volume is 1.472 million cubic metres and discharge in outlet is 60Lit/sec whereas the inlet discharge is 35Lit/sec. It is situated at the height of 4,380 metres from sea level, and melts and sips down to form the Trishuli River. It is on the way of a popular trekking route of Dhunche-Gosaikunda-Helambu trail. In fact, there are 108 total lakes, small to medium in this area and the challenging Lauribina La pass 4,610 metres on its outskirts. The water of Gosaikunda falls to Sarswoti Kunda through Bhairab Kunda then through Trishuli River.

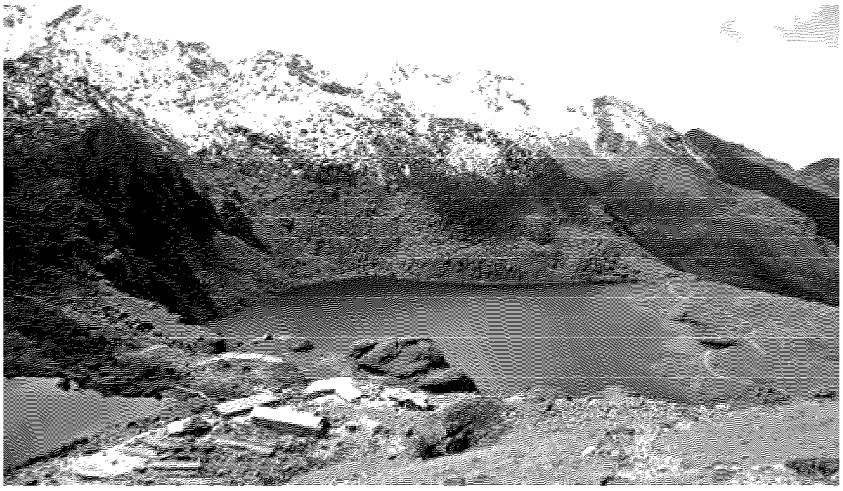


Figure 4-24: Gosaikunda Lake

4.1.18 Existing Water Use

Trishuli River and its tributaries collectively represent an abundant wealth of water. However, the stretch of Trishuli River between headworks and powerhouse sites is not used for any purpose except a cremation site practiced by 8 households (50 people) of Dalit of Haku VDC at foothill of Hakubesi-Fulbari. It was observed that people consume piped water for drinking purposes mainly from public taps sourced by local streams and gully. There is no direct consumptive use of water of Trishuli River in project stretch for drinking by local inhabitants due to higher inaccessibility of the river. Irrigation is not practiced due to higher differences in gradient of river and settlements. The existing water mills and micro-hydropower are operated through the local streams and are not dependent on Trishuli River.

4.1.19 Tributaries of Trishuli River within the Project Stretch

Nine major tributaries from Haku to Mailun contribute large amount water to Trishuli River. Followings are the major perennial rivers draining into the Trishuli River. There are several seasonal springs, which contribute to the water in the River.

Table 4.8: Major Tributaries in the Project Area

Left Side of Trishuli River			Right Side of Trishuli River		
S.N.	Tributaries Name	Location	S.N.	Tributaries Name	Location
1	Pangling Khola	Fulbari, Haku	1	Bhote Koshi	Dhunche
2	Thanku Khola	Haku Besi, Haku	2	Bimali Khola	Dhunche
3	Kharsyong Khola	Gogane, Haku	3	Ghatte Khola	Ramche
4	Daldung Khola	Gogane, Haku			
5	Lising Khola	Mailun, Haku			
6	Mailun Khola	Mailun, Haku			

Source: EIA Field Survey, 2011 and Topographic Map, Survey Department, Government of Nepal (1:50,000)

4.1.20 Groundwater and spring

The overall underground excavation condition of the desander, tunnel, powerhouse cavern and tailrace is deep sheeted with thick rock cover. Additionally, the rock mass is almost

intact with not more than two sets of regular joints so that it is envisaged that there will not be probability of surface water seepage into the tunnel during underground excavation. Furthermore, the water table of the project area is low due to its topographical and geological or geophysical conditions. Thus, the impact on groundwater and spring isn't adhered. However, proper precaution needs to be performed during tunnelling and other underground excavation works. Furthermore, the locations of nearby settlements are quite above the tunnel excavation site (Hakubesi-Phulbari: Horizontal distance: 15 m to 208m, Vertical distance: 176m to 223m and Gogane: Horizontal distance -36.3m, Vertical distance -265m). The educational institutions are also located within these settlements. The excavation activities will not have any significant effect to the structures of the settlements health and educational institutions.

4.1.21Land Use

The land use of project construction and development site mainly comprises of forest and cultivated land. Major portion of access road is aligned along forest. Similarly, camp sites and engineering camp are mainly situated in cultivated land where as spoil disposal sites are basically located in river bank (Bagar). As per Table 3.2, the land uses of project construction site are Bagar (30.31%), forest (26.05%), cultivated land (19.83%), cliff (13.71%), Bushes (7.14%), Khar Bari (1.00%), river (0.90%) and existing road (1.07%).

4.2 Biological Environment

The project area mainly lies adjacent to the Langtang National Park (LNP) in Haku, Dhuche and Ramche VDCs of Rasuwa district. Langtang National Park (1,710 km2) and buffer zone (420 km2), is distinguished as having one of the greatest altitudinal ranges (1000 m-7245 m) within its boundaries (Bhuju, et al. 2007).

Langtang National Park encloses the catchments of two major river systems. The first one draining west into the Trishuli River and the other one is draining east to the Sun Koshi River. The climatological variation conditions of the Central Himalaya are found in this region. The complex topography and geology together with the varied climatic patterns have enabled a wide spectrum of vegetation types. These include small areas of subtropical forest (below 1000 m) Oaks, chirpine, maple, fir, blue pine, hemlock spruce and various species of rhododendron make up the main forest species. The variations in altitude and topography along with the existing forest cover (approx. 25% of the total area) provide habitat for a wide range of animals including wild dog, red panda, pika, muntjac, musk deer, Himalayan black bear, Himalayan tahr, ghoral, serow, rhesus monkey and common langur. The Trishuli-Bhote Koshi River forms an important route for birds on spring and autumn migrations between India and Tibet. (*dnpwc.gov.np*).

The headworks area is very close to the confluence of Trishuli River and Bhote Koshi at Trishuli Dovan, Bhote Koshi being the main source of the river. Thereafter, the river continues to be called Trishuli River as it originates from the famous sacred lake of Gosaikunda.

4.2.1 Flora and Vegetation

The project area is rich in terms of plant bio-diversity consisting distinct bands of vegetation. However, due to steep topography, on both sides of the river, the flora and vegetation of the project site itself is found less gregarious in comparison to the surrounding vegetation of the region.

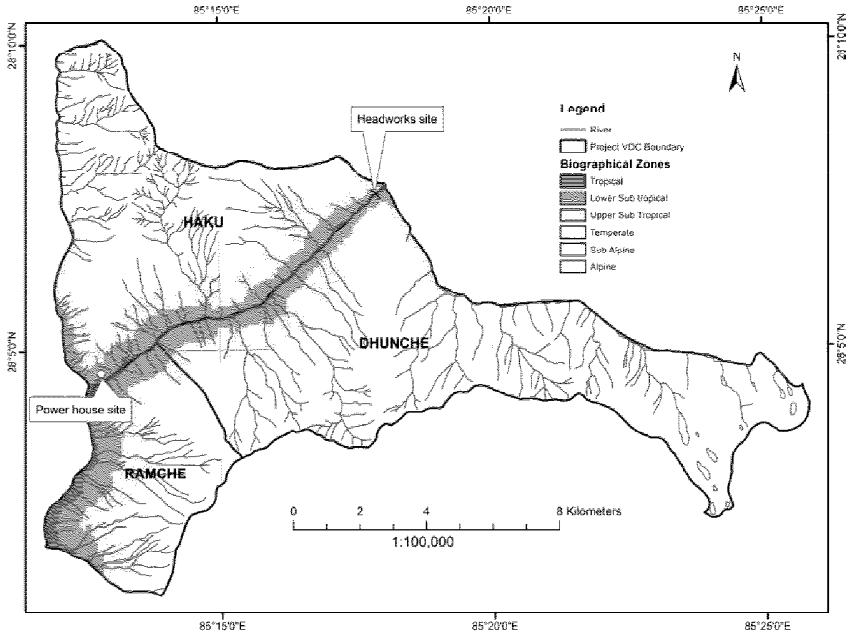


Figure 4 25: Biographical Zonation of the Project Area

The left side of the headworks area falls on the buffer zone of the Langtang National Park whereas the rest of the project structures are located on the right side of the river and the National Park boundary is separated by the Trishuli River itself.

Langtang National Park was gazetted in 1976 and it covers an area of 1710 Km^2 extending from upper tropical zone to permanent snow and ice. In a broad way, the park can be regarded as a section of the inner Himalayas which is bisected east west by the Langtang river and north -south by the Bhote Koshi river, which from its glacial water-heads drains to the Trishuli river in the south. The flora and vegetation is representative to that of lower sub-tropical and upper-tropical areas found in the similar climatic zones of central Nepal. However, there is strong influence on the vegetation depending upon the local habitat condition and exposure of the mountain slopes. In broad sense, central Nepal is a meeting point of humid and more diversified eastern flora, characteristic to the eastern Himalaya, and rather dry western part. Therefore, the region is an intermixed zone between eastern and western Himalayan elements.

According to Dobremez (1976), vegetation types of Nepal are distributed in six bio-climatic zones that cover from Tropical to Nival zone and are further sub-divided into eleven sub-zones. The sites for the hydroelectric construction fall within the range of 905m to 1235m in altitude and it represents upper tropical (500-1000m) and lower sub-tropical (from 1000-1500m) zone in altitudinal basis in this classification system.

The landforms of Nepal lying between 1000m and 300m fall into a distinct ecological zone that may be called hill Sal forest zone. The Sal zone also penetrates deep into a number of mountainous districts along valley floors and terraces created by major river including Trishuli River.

TISC (2002) has summarized vegetation and forest types and provided a synopsis of dominant riverine vegetation of Nepal. Accordingly, in the central part of Nepal, the pine forest is confined in the sub-tropical region i.e. from 1000-2000m and similarly the Sal forest is confined in the upper tropical region between 300-1000m. As the project site lies between 900-1200m, there is dominance of these two tree species as forest components. It is mixed with oaks in the upper limit and with Sal in the lower region. It is mentioned that at lower altitudes (approx. 1000m), chir- pine is mixed with hill Sal on S facing slopes and with *Englehardtia spicata* and *Toona ciliata* in damp ravines and gullies which is similar with the present case.

Like other parts of Nepal Nepalese alder (*Alnus nepalensis*) has a wide range in natural distribution (500-2700m). However, it is in the sub-tropical zone (1000-2000m) that *Alnus nepalensis* forms dense forest along moist sites such as ravines. This scenario is reflected in the case of the present project area. Therefore, hill sal, chirpine and alder comprise the main forest component of the project area.

4.2.1.1 Regional Bio-diversity

The project area is located nearby the Langtang National park. Langtang National Park is the fourth national park in Nepal as the first Himalayan national park. The protected area exceeds in the Nuwakot, Rasuwa and Sindhulpalchok districts of the central Himalayan region encompassing 26 Village Development Committees

The region is very rich in terms of plant bio-diversity. The project area lies in the transitional zone of tropical and sub-tropical bio-climatic zone. The tropical area below the project site is having gentle and flat terraces and the altitude gradually reduces whereas in case of the upstream side the altitude increases considerably in short geographical span.

The principal forest type at the downstream side is composed of Sal (*Shorea robusta*) and this species is having better quality trees on the relatively flat areas where as the on the mountainsides the trees are rather smaller due to adverse habitat conditions. Other constituent species of *Shorea* forest include *Semecarpus anacardium, Lagesrtroemia parviflora, Terminalia* spp., etc. Comparatively the sub-tropical area is richer in terms of regional bio-diversity representing the main tree species such as *Pinus roxburghii, Quercus lanata, Pinus wallichiana, Rhododendron arboreum,* etc. This region harbours several plant species having various kinds of life forms.



Figure 4-26: *Rhododendron arboretum*

The following list provides a glimpse of regional diversity, which is enlisted through field visit records and secondary sources (DMP, 1976). They are recognized in two levels i.e. local (L) and regional (R). The detail of regional bio-diversity is presented in ***Annex 4.1.***

4.2.1.2 Local Biodiversity and Surrounding Vegetation

There is a slight diverse scenario in the surrounding vegetation of the project area in comparison to the regional vegetation. Major part of vegetation is covered by locally established vegetation units with varying composition of tree species. Notable tree species of the project locality are *Schima wallichii, Englehardtia spicata, Toona ciliata, Wendlandia* sp., *Macaranga pustulata, Alnus nepalensis, Pinus roxburghii, Boehmeria rugulosa, Myrica esculenta, Mallotus philippinensis, Bauhinia variegata, Syzyzium* sp., *Benthamedia capitata, Choerospondias axillari* and different species of *Ficus*. Prominent shrubs of the project construction sites and vicinity are *Rubus ellipticus, Maesa chisia, M. macrophylla, Colebrokia oppositifolia, woodfprdia fruiticosa, Cythula tomentosa*, etc. Similarly, among the herbs *Eupatorium adenophorum* is seen as most prominent one while other species such as *Aegeratum conyzoides, Artemisis indica*, *A. dubia, Pogonantherum* sp., *Dryopteris cochleata, Asparagus racemosus*, etc.are common.

It has been already mentioned that the project area lies in the upper tropical and lower sub-tropical climatic belt of Nepal and part of it encompasses buffer zone of Langtang National Park. The government forests of buffer zone of Dhunche and Ramche VDCs are managed by local buffer zone user committee formed under LNP. However, the government forests of

Haku VDC are managed by the local community user groups. There are altogether 15 community forests in Haku VDC. Among these forests, 6 community forests will be affected by the construction of the proposed project namely Larwang Pakha, Thangsingh Pakha, Lumbu Danda (Buchet), Larwang Pakha (Tudi Danda), Dhanasila Kanya (Jongjang Pakha) and Dakshin Kali. The detail of Local bio-diversity is presented in ***Annex 4.1.***

Table 4.9: Community Forest of Haku VDCs

SN	Name of Community Forest	Area (Hectare)	Benefitted Households	Ward No.	Remarks
1	Reluneha Singh	14.50	86	2,7	
2	Nehasingh Pakha	7.50	53	2	
3	Larwang Pakha (Reltang Pakha)	3	27	3	
4	Ghyang Pakha	2.28	140	5	
5	Larwang Pakha	5.00	49	3	Affected by Proposed Project
6	Thangsingh Pakha	35	49	3	Affected by Proposed Project
7	Larwang Pakha (Tudi Danda)	14.75	61	3	Affected by Proposed Project
8	Kaltachet (Kalta Kharka)	75	53	2	
9	Nehasingh (Jom Kharka)	47	38	1	
10	Thulo Haku (Kalo Ban)	84	140	4,6	
11	Dakshin Kali	182.85	83	8,9	
12	Lumbu Danda (Buchet)	5.60	25	7	Affected by Proposed Project
13	Dhanasila Kanya (Jongjang Pakha)	30.18	50	9	Affected by Proposed Project
14	Pangyung Pakha	11	61	8	
15	Jaisur	13.84	94		
Total		531.50	1009.00		

Source: Information on Community Forest User Group, District Forest Office, Rasuwa and Field Survey, 2011

The committee protects and manages the forest as well as conducts local community development activities. The whole project area, including the project construction sites, is situated either in the rocky terrain or in the little flat area formed by the river flood plain with degraded forest patches or bushy vegetation.

4.2.1.3 Ethno-Botany

Traditional and Ethno-botanical study of the project area showed that local people are partially dependant on forest and forest based non-timber forest products (NTFP) . People are using forest-based resources to fulfil their daily needs. Collection of firewood, wild fruits and vegetables for own consumption is the common practice in the area. However, selling them in local market in little quantity is in practice in the areas outside the National Park and the Buffer Zone area. ***Annex 4.2*** represents the recorded traditional and ethno-botanical uses of the various plant species of the project area.

4.2.1.4 Agro-Diversity

Though little area is available for agricultural activity the study, area comprises traditional farming system characterized by integrated crop-livestock production sub-system for the subsistence of the households. Farmers cultivate mostly in limited area and grow some cereals like maize, millets, wheat, various pulses , mustard, vegetables etc. and some perennial crops like fruits, fodder and timber species mostly for home consumption under rain-fed conditions. ***Annex 4.3*** presents the commonly grown varieties cereals/pseudo cereals, and common crops grown in the area that are also usually found in the hilly midland areas of Nepal.

4.2.1.5 Description of Vegetation of Project Structures, Facilities and Monitoring Plots

1. Project Structures

a. Pondage Area

The site for pondage area is close to the downstream of Trishuli - Bhote Koshi confluence and left portion of it falls in Buffer Zone area of Langtang National Park and is managed by Navakunda Buffer Zone User Committee formed under LNP. The prominent tree species of buffer zone site is mainly Toona ciliata and Schima wallichii. The site is highly dominated by Arundinaria thickets and few individuals of Cythula tomentosa. Similarly, the prominent herb of this locality is Achyranthus bidentata. Similarly, the right bank is distinguished by rocky and steep terrain with poor growth of vegetation. The dominant tree species is Englehardtia spicata where as the common shrub and herb is Maesa chisia and Eupatorium adenophorum respectively. In left bank, valley bottom is a bit flat and the forest vegetation is much luxuriant characterized by high diameter class and tree height. (For detail, Refer: Annex 4.4, Sample Plot No. 1 & 2 and Section 4.2.1.6, Sample Plot 1 & 2).

b. Weir, Intake

The weir site lies in both left and right bank of Trishuli River. The left bank falls in Buffer Zone area of Langtang National Park. These forest areas are managed by Navakunda Buffer Zone User Committee by LNP and consists relatively matured trees of *Schima wallichii and Englehardtia spicata*. Due to riverine habitat condition, Alnus trees of moderate growth condition are fairly represented. The prominent shrub and herb species of this locality is *Debregeasia* sp and *Eupatorium adenophorum*. The right bank is very steep such that luxuriant growth of vegetation is not possible. (For detail, Refer: ***Annex 4.4***, Sample Plot No. 3 and Section 4.2.1.6, Sample Plot 3).



Figure 4-27: Vegetation at Weir Site, Left bank

c. Adit Portal to Desander Basin

The forest/vegetation around here is managed by CFUG. As the site is located near the bottom of the cliff, little area is available for the growth of tall vegetation and the colonization of trees is also limited due to rocky topographical condition. The prominent tree species of the locality are Wendlandia sp., Macaranga pustulata, Englehardtia spicata with few representations of Alnus nepalensis. The prominent shrubs and herbs include Maesa chisia, and Nephrolepsis cordifolia. (For detail, Refer: ***Annex 4.4***, Sample Plot No. 4 and Section 4.2.1.6, Sample Plot 4).

d. Adit 1

This area is close to the settlement and the forest is managed by the local CFUG. Adit 1 is located in gentle terrain and distinguished with mixed type of vegetation consisting of trees such as Pinus roxburghii, Boehmeria rugulosa and Syzyzium sp. The prominent shrubs and herbs are Colebrokia oppositifolia, and Eupatorium adenophorum. (For detail, Refer: ***Annex 4.4***, Sample Plot No. 11 and Section 4.2.1.6, Sample Plot 11).

e. Adit 2

Adit 2 is located in Buchet Phant on cultivated land (Khet) which has remained fallow from some years. The construction of Adit 2 will not result in the loss of tree species; however, the site is located near by the community forest. Thus, some plots are taken nearby Adit 2 namely sample Plot Nos. 36, 37 and 38 for comparison to the adjacent vegetaion and

monitoring purpose in future. (For detail, Refer ***Annex 4.4***, Sample Plot No. 36, 37 and 38 and Section 4.2.1.6, Sample Plot 36, 37 and 38).

f. Adit 3

This site is located in steep terrain and the forest is under the management of community users group. The site is dominated by relatively matured trees of Pinus roxburghii. The prominent shrubs and herbs are represented by Inula cappa and Eupatorium adenophorum. (For detail, Refer Annex 4.4, Sample Plot No. 22 and Section 4.2.1.6, Sample Plot 22)

g. Adit 4

The forest is managed by the community users group. The site is highly dominated by matured to moderately grown Shorea robusta patch. Though the site is located in moderately steep terrain, it sustains good growth of vegetation. The common shrub and herb of the site are Colebrokia oppositifolia and Cheilanthus sp. (For detail, Refer: ***Annex 4.4***, Sample Plot No. 26 and Section 4.2.1.6, Sample Plot 26).

h. Adit Portal to Surge Tank

This site is under the management of community user's group. This site is located in steep to moderate topography. This site is dominated by *Shorea robusta.* The site is having very good regeneration of Sal trees with frequent regeneration of other tree species. Among the shrubs, the site is populated by *Inula* sp. Among the herb layer species, *Pogonantherum* sp is more common. (For detail, Refer: ***Annex 4.4***, Sample Plot No. 29 and Section 4.2.1.6, Sample Plot 29).

i. Air Vent Tunnel

This site is under the management of community user's group. The site is located in steep topography. This site is highly dominated by *Shorea robusta*. The density of trees is also relatively thin in comparison to surrounding vegetation. Among the shrubs, the site is found to be mainly composed of *Inula* sp. Similarly, among the herb layer species, it is better represented by *Carex* sp. (For detail, Refer: ***Annex 4.4***, Sample Plot No. 29 and Section 4.2.1.6, Sample Plot 29).

j. Switchyard

This site is owned privately by the villagers of Baluwa Phant, Mailun. This site has moderate slope terrain and is basically dominated by Shorea robusta of fair growth condition. The common shrub and herb species are Murrya sp. and Bidens pilossa. (For detail, Refer: ***Annex 4.4***, Sample Plot No. 31 and Section 4.2.1.6, Sample Plot Nos.31).

k. Tailrace Portal

This site is almost flat land and is located near the river bank of Trishuli River. There is not any significant vegetation in the sites of tailrace portal. However, few disturbed trees of Boehmeria rugulosa, Mallotus philippensis and young Pinus trees are present in this area. Some common shrub and herb species of the site are Maesa chisia, Colebrokia oppositifolia, Artemisia sp., Bistorta capitata, Eupatorium adenophorum, urtioca dioca, etc.

2. Project Facilities

a. Access Road

i. Access Road to Headworks

During vegetation survey, a total of 13 sample plots [12 for community forest and 1 (sample Plot No.15) for private forest)] were laid down for access road. The access road for the project construction sites passes from different habitats from the areas comprising of bushy vegetation to forest sites with sparsely distributed trees of community and privately managed forests. The road mainly passes from barren land to rocky terrains with moderate to steep slopes. Due to the presence of vertical cliffs at several places, there is absence of good vegetated sites and hence, most part of the forest area is less significant in terms of plant diversity. The main tree, shrub and herb species recorded along access road to headworks are Schima wallichii, Shorea robusta,Pinus roxburghii,Macaranga pustulata,Phyllanthus emblica,Boehmeria rugulosa, Myrica esculenta, Wendlandia sp., Alnus nepalensis,Coriaria nepalensis, Colebrokia oppositifolia, Rubus ellipticus, Murraya sp., Woodfordia fruiticosa, Indigofera sp.,Inula cappa, Artemisia sp., Bistorta capitata, Eupatorium adenophorum, Urtica dioca, Pogonantherum sp., Cheilanthus sp., Nephrolepis cordifolia, etc. (For detail, Refer: ***Annex 4.4***, Sample Plot Nos.5, 6, 7, 8, 10, 12, 13, 15, 18, 19, 20, 21, 25) and Section 4.2.1.6, Sample Plot Nos. 5, 6, 7, 8, 10, 12, 13, 15, 18, 19, 20, 21, 25).

ii. Access Road to Surge Shaft

The forest segment for access road leading to surge shaft is under the management of community user's group namely Dhanasila Kanya and Dakshinkali community forest. This area is highly dominated by *Shorea robusta*. Major portion of the road in this stretch falls under Dakshinkali community forest, and comparatively, the forest under Dhanasila Kanya C.F of this forest stretch is rich in terms of diversity, population density and basal area coverage. Among the shrubs, the site is found to be composed of *Inula* sp. and *Desmodium* sp. Similarly, among the herb layer species, it is represented by *Eupatorium adenophorum* and *Carex* sp. (For detail, Refer: ***Annex 4.4***, Sample Plot No. 27 and 28 and Section 4.2.1.6, Sample Plot Nos. 27 and 28).

iii. Access Road to Tungbar Terrace

The land use around Tungbar terrace consists of Bagar and exiting road and is basically fallow land. The nearby area mainly comprises of bushy vegetation, agricultural lands and few forest patches. Thus, the construction of road will not result in loss of any tree species of forest land. The tree species of the surrounding area are represented by Toona ciliata, Schima wallichii, Boehmeria rugulosa, Bombax ceiba, Albizzia sp., etc. Similarly, shrubs and herbs of this locality have been enumerated as Colebrokia oppositifolia, Woodfordia fruiticosa, Indigofera sp.,Inula cappa, Cassia tora, Rubus ellipticus Artemisia sp., Bistorta capitata, Eupatorium adenophorum, Cynodon dactylon,Urtica dioca, Pogonantherum sp., Cheilanthus sp., Nephrolepis cordifolia, Oxalis sp., Bistorta capitata, Cheilanthus sp.,etc.

b. Quarry Site

There are altogether 4 Quarry sites proposed for UT-1 project. Quarry Site-1 is located on river bank (Bagar) and devoid of vegetation. Similarly, Quarry Site-2 is located on a denuded hilly slope and hence there is not any significant vegetation of ecological importance. The common shrub and herb species of Quarry site-2 are Maesa macrophylla, Inula cappa, Indigofera sp, Maesa chisia, Artemisia sp., Eupatorium adenophorum, carex sp., Bistorta

capitata, etc. The Quarry Site-3 is close to Tungbar with gentle slope terrain and thinly covered by Shorea robutsa and few other tree species. The site for Quarry Site-4 is located in rocky terrain and situated close to switchyard area. The common plant species of the site are Sarcococca sp., Colebrokia oppositifolia, Artemisia sp., Murraya sp., Urtica dioca, Bidens pilosa, etc. However, the surrounding vegetation is composed of Shorea robusta, Mallotus philippinensis, Trichilia connoroids, etc. (For detail, Refer: ***Annex 4.4***, Sample Plot No.24 and Section 4.2.1.6, Sample Plot No.24).

c. Spoil and Muck Disposal Areas

The availability of adequate lands for Spoil and Muck Disposal at convenient places (fallow land or wide flood plain) is very much limited in case of the present project due to rocky and steep topographical settings on both sides of the river resulting in lack of wide flood plain. Therefore, several sites have been selected on the river banks or flood plains to cope with this situation. Among the 31 sites selected for disposal of muck and spoil, most of the sites have been managed on the river flood plain (Bagar), few on agricultural land and only 6 sites (Spoil and Muck Disposal Area-5, 6, 7, 8, 14 and 26) have to be adjusted on the gentle slope forested land, which have almost negligible coverage of vegetation except Spoil and Muck Disposal Area-26. The representing trees, shrubs and herbs of these forest sites are Schima wallichii, Shorea robusta, Mallotus philippinensis,Callicarpa arborea, Toona ciliata, Alnus nepalensis, Phyllanthus emblica,Boehmeria rugulosa,Ficus cunia, Bombax ceiba, Bauhinia variegata, Wendlandia sp., Syzyzium sp. Englehardtia spicata, Albizzia sp. , Desmodium oojeinens, Rubus ellipticus,Cyathula tomentosa,Maesa macrophylla,Berberis asiatica, Colebrokia oppositifolia, Inula sp., Artemisia indica, Eupatorium adenophorum,Cissampelos sp., Cheilanthus sp., Crassocephalum crepidioides, Artemisia sp. and Sonchus sp.,etc. The spoil disposal sites situated on river bank (Bagar) are almost devoid of significant vegetation. . Some common shrub and herb species of the spoil disposal sites located at river bank (Bagar) are Colebrokia oppositifolia, Maesa macrophylla, Maesa chisia, Artemisia sp., Solanum xanthocarpum, Eupatorium adenophorum, urtioca dioca, etc.

(For detail, Refer: ***Annex 4.4***, Sample Plot Nos.9, 14, 16, 17, 23 and 32 and Section 4.2.1.6, Sample Plot Nos.9, 14, 16, 17, 23 and 32).

d. Camp Facility -1 and Engineering Camp -1(N/E of Fulbari)

The site for Camp facility -1 and Engineering camp -1 has been selected in the farmland (non-irrigated land or Bari) close to the settlement namely Hakubesi-Fulbari. Maize, millet, beans and different types of vegetable such as tomato, pumpkin, radish, green vegetables, etc are cultivated in this land. Few young and sparsely distributed trees of Alnus nepalensis are found to be presented in this land. In addition, Myrica esculenta are found to be grown. The shrubs and herbs of this locality have been noted as Rubus ellipticus, Coriaria nepalensis, Artemisia indica, Sida sp., Eupatorium adenophorum, Pogonantherum sp.,Thysanolaena maxima, etc.

e. Construction Yard-1 (Fulbari)

The site for Construction yard-1 has been also located close to Fulbari, Hakubesi. This site is also non-irrigated land and cultivation of cereal crops such as maize and millet are carried out in this land along with other vegetables. Few standing tress of *Bauhinia variegata, Wendlandia* sp. are recorded in this site. The common shrubs and herbs of this locality are

Cyarhula tomentosa, Maesa macrophylla, Coriaria nepalensis, Artemisia indica, Thysanolaena maxima, Kydia sp., *Eupatorium adenophorum,* etc.

f. Camp Facilities -2

The site for Camp facility -2, has been also selected close to the settlement namely Hakubesi-Fulbari. This site is also a non-irrigated cultivated land (Bari) and crops & vegetables such as maize, millet, tomato, cucumber, radish, pumpkin, cauliflower, etc are mainly grown. Some plant species such as Callicarpa arborea , Ficus cunia, Mallotus philippinensis are found in this site. The prominent shrubs and herbs commonly found around this locality are Indigofera sp., Thysanolaena maxima, Artemisia indica, Sida sp., Eupatorium adenophorum, Thysanolaena maxima, Imperata cylindrica, etc.

g. Construction Yard-2 & Camp Facilities -3, (Buchet)

The site for Construction Yard-2 & Camp Facilities -3 has been selected in considerably flat land of Buchet Phant. This land has remained fallow from some years such that no crops or vegetables are grown in this land. The common ground flora of this site have been enumerated as Maesa chisia, Phyllanthus sp., Kydia sp., Colebrokia oppositifolia, Woodfordia fruiticosa, Indigofera sp.,Inula cappa, Cassia tora, Rubus ellipticus, Mimosa sp., Artemisia indica, Achyranthus bidentata, Eupatorium adenophorum, Cynodon dactylon, Pogonantherum sp., Carex sp., Cheilanthus sp., Pteris sp., Nephrolepis cordifolia with several clumps of Urtica dioca, etc. The site is surrounded by forests of different growth status. Major tree species of this locality are Schima wallichii, Pinus roxburghii and Englehardtia spicata. Other associated trees species are Wendlandia sp., Ficus cunia, Toona ciliata, Syzyzium sp., Desmodium oojeinense and Albizzia sp.

h. Batching Plant Facility -1 (Tungbar)

The site for Batching plant facility -1 is planned at Tungbar which is a cultivated land (irrigated land or Khet). Paddy, wheat, potato and mustard are basically grown in this land. This site is surrounded at northwest by forested vegetation and bushes at southeast i.e. along river bank. Due to increased human activity as well as the site being located close to the river bank, trees around this site are much disturbed. The major tree species of the locality are Boehmeria rugulosa, Toona ciliata, Trichilia connoroids, Albizzia sp., etc. The common shrubs and herbs of this locality are Colebrokia oppositifolia, Indigofera sp.,Inula cappa, Cassia tora, Artemisia sp., Bistorta capitata, Eupatorium adenophorum, Cynodon dactylon, Urtica dioca, Nephrolepis cordifolia, Bistorta capitata, Oxalis sp., Galinsoga parviflora, Pteris sp.,etc.

i. Store Facility-1 (Dharanatar)

The site chosen for Store facility-1 is situated in low cultivated terraces (irrigated land or khet) and therefore, there is no any significant vegetation of forestry importance. Some regenerating trees of *Englehardtia spicata, Bombax ceiba* are noted in the site along with some pruned trees of *Ficus cunia, Trichilia connoroides*. The prominent shrubs and herbs of this site locality are *Colebrokia oppositifolia, Woodfordia fruiticosa, Urtica dioca, Cynodon dactylon, Chenopodium album*, etc. Few fruit plants such as Mango (*Mangifera indica*), Banana (*Musa* sp.) and Guava (*Psidium guajava*) are also grown in the agricultural field. Similarly, the crops such as paddy, wheat and potato are grown in this land.

j. Camp Facility -4 (Gumchet)

The site chosen for Camp Facility-4 is situated in sloping terrace-cultivated land (Bari or non-irrigated land). At the vicinity of the site, there are some small trees of *Boehmeria rugulosa* and *Alnus nepalensis*. Common shrubs and herbs of this site are *Colebrokia oppositifolia*, *Jatropa curcus*, *Artemisia* sp., *Urtica dioca*, *Galinsoga parviflora, Nephrolepis cordifolia, Imperata cylindrica, Pteris* sp., etc. Few clumps of Banana and a small parcel of land with tobacco plants (*Nicotiana tobaccum*) are also observed around this site.

k. Camp facility -5 (Baluwaphant)

The site for Camp facility- 5 is selected in an agricultural field (irrigated land or Khet) which is close to the riverbank. Medium sized boulders are scattered in this land. Paddy, wheat, potato and mustard are basically grown in this land. Two residential houses are also located in this site. The common plants observed in the site include *Solanum xanthocarpum, Ageratum conyzoides, Bidens pilosa, Crassocephalum crepidioides, Cynodon dactylon*, *Urtica dioca, Oxalis sp.,* etc.

l. Camp Facility - 6, Engineering Camp -2 & Batching Plant Facility-2 (Mailun Dovan)

This site is located in irrigated cultivated land (Khet), however, has been remained fallow from some years. Some medium sized boulders are also present in this area. At present, more than 60% land is covered by tall *Artemisia indica.* Other associated species are *Bidens pilosa*, *Solanum xanthocarpum, Urtica dioca, Barleria cristata, etc.* At the vicinity, some of the tree species such as *Schima wallichii, Ficus* sp., *Indigofera* sp., *Trichilia connoroides, Mallotus philippinensis, Mangifera indica, etc.* are found.

3. Monitoring Plots

Periodic monitoring is very important to evaluate the changes of the existing environmental status with the lapse of time. In the context of the proposed project, spontaneous use of natural resources, especially to that of forest and its products, from the surrounding population has been a general phenomenon that has been affecting the regular functioning of the forest ecosystem. If the exploitation is greater than its regenerating capacity, it quickly leads to the environmental degradation. However, most of the project structures and facilities lie in the riverbanks and forest area with already degraded sites, significant loss of vegetation is not envisaged. However, In spite of degraded status of forest area, some monitoring plots (degraded or natural) have been selected near by the project structures and facilities. The establishment of these plots will be of immense value to compare the changes (negative or positive) that is very important for the better life of the project itself as the vegetated area plays a vital role for checking the soil erosion, regulating hydrological cycle and providing good habitat for wildlife.

About 7 sample plots nearby the project construction site have selected as monitoring plots. The Sample Plot No.33 is taken at upper hill of Intake, right bank. Similarly, Sample Plot No.34 is taken 160m upstream of weir at right bank of Trishuli River nearby the confluence of Trishuli- Bhote Koshi. The Sample Plot No.35 is taken immediate west of Spoil and Muck Disposal Area-2. Similarly, Sample Plot No.36 is taken immediate south of Spoil Disposal Area-6. Addition to these plots, three plots namely Sample Plot Nos.37, 38 and 39 are taken in Buchet Phant. (For detail, Refer: ***Annex 4.4***, Sample Plot Nos.33, 34, 35, 36, 37, 38 and 39 and Section 4.2.1.6, Sample Plot Nos.33, 34, 35, 36, 37, 38 and 39).

4.2.1.6Description of Sample Plots

Sample Plot No.1 (Pondage Area, Left Bank)

This plot is located about 60m upstream of weir site at left bank of Trishuli River and falls in Buffer Zone of Langtang National Park. It is dominated by *Toona ciliata*. The diameter of *Toona ciliata* ranges from 0.29m to 0.86m and the tree height also reaches up to 24m. The next dominant tree species is *Schima wallichii* having almost similar growth status. The plot also is represented by *Englehardtia spicata*, *Wendlandia* sp., *Syzygium* sp., and *Callicarpa arborea*. Though the tree density is found in less number (13 nos. in the plot), Basal area % is found to be 0.487 due to maturity of trees. The plot is highly dominated by *Arundinaria* thickets and few individuals of *Cythula tomentosa*. Similarly, the plot is dominated by *Achyranthus bidentata, Boehmeria* sp., *Asparagus racemosus* and *Urtica dioca* in decreasing order among the herb layer species.

Sample Plot No.2 (Pondage area, Right Bank)

This plot is located about 70m upstream at the right bank of Trishuli River. The forest area around this locality is managed by CFUG. The diameter of tree ranges from 0.08 to 0.28m. The height of trees is limited up to 9m only. The tree species composition is represented by *Englehardtia spicata, Wendlandia* sp., *Saurauia napaulensis, Macaranga pustulata* and *Grewia optiva*. Basal area value is found to be very low i.e. 0.075 only. The plot is dominated by *Maesa chisia* and *Rubus* sp. The plot is highly dominated by *Eupatorium adenophorum, Nephrolepis cordifolia and* Pilea sp.

Sample Plot No.3 (Weir/CSS, Left Bank)

This plot is within Buffer Zone of Langtang National Park. It is composed of relatively matured trees of *Englehardtia spicata* having diameter range from 0.21m to 0.99m. The optimum height reaches up to 22m. Similarly, the plot consists of matured trees of *Schima wallichii* having diameter range from 0.13 to 0.78m. Matured tree of *Macaranga pustulata* is singly represented. Due to riverine habitat condition, Alnus trees of moderate growth condition are fairly represented with diameter range from 0.25m to 0.45m. The Basal area percentage covered by the trees (in relation to ground area) is found to be 0.43. The dominant shrubs are *Debregeasia* sp., *Woodfordia fruiticosa* and *Maesa chisia* in decreasing order. Similarly, it is dominated by *Pogonantherum* sp. *Eupatorium adenophorum* and *Rubia manjith* among the herb layer species.

Sample Plot No.4 (Adit Portal to Desander Basin)

This plot is located on the right bank of the river and is managed by Community Forest User's Group. The trees are small in size and the diameter ranges from 0.05m to 0.27m only. The representative tree species are Alnus *nepalensis, Wendlandia* sp., *Syzygium* sp., *Macaranga pustulata, Englehardtia spicata and Ficus* sp. The value of Basal area is found to be modest i.e. 0.044 % only. The plot is dominated by shrubs of *Rubus* sp., *Maesa chisia* and *Woodfordia fruiticosa* in decreasing order. Similarly, the plot is dominated by *Eupatorium adenophorum, Nephrolepis cordifolia* and *Achyranthus bidentata* in decreasing order among the herb layer species.

Sample Plot No.5 (Access Road to Headworks)

This plot is having sparse vegetation with low tree density and is managed by local CFUG. The plot is mainly dominated by *Pinus roxburghii*, *Macaranga pustulata, Schima wallichii,*

Englehardtia spicata and *Bauhinia variegata.* The maximum diameter and height of trees in the plot reaches up to 0.32m and 12m respectively. Similarly, the value of basal area is found to be very low i.e. 0.049% only. The plot is dominated by *Rubus ellipticus, Colebrokia oppositifolia, and Coriaria nepalensis* among the shrub layer species. Other common species among the herb layer are *Imperata cylindrica, Artemisia* sp. *and Scoltzia* sp. in decreasing order.

Sample Plot No.6 (Access Road to Headworks)

This plot is managed by local CFUG. It is diversified plot with several tree species such as *Wendlandia* sp., *Pinus roxburghii, Englehardtia spicata, Boehmeria rugulosa, Myrica esculenta, Desmodium oojeinense, Phyllanthus embica, Bauhinia variegata, Ficus cunia* and *Callicarpa arborea*. The diameter ranges from 0.05m to 0.11m only. The height is limited to 7m except one Pine tree (13m). The basal area value is also found to be extremely low i.e. 0.023% only. Among the shrubs, the plot is dominated by *Coriaria nepalens ,Desmodium* sp. and *Indigofera* sp. in order of dominance. Similarly, among the herb layer species it is dominated by *Heteropogon contortus and Pogonantherum* sp. whereas *Anaphalis busua* is only represented.

Sample Plot No. 7 (Access Road to Headworks)

This plot is managed by local CFUG. It is diversified plot similar to Sample Plot No.6 with several tree species such as *Boehmeria rugulosa, wendlandia* sp., *Myrica esculenta, Phyllanthus embica* etc. However, this plot is highly dominated by *Pinus roxburghii* whereas *Alnus nepalensis* and *Ficus religiosa* are additionally represented. The diameter value ranges from 0.04m to 0.21m and Basal area value is found to be little higher (0.048%) than Sample Plot 6. Among the shrubs, the plot is dominated by *Colebrokia oppositifolia and Inula cappa with* few individuals of *Sida* sp. Similarly, among the herb layer species, it is represented by *Imperata cylindrica, Cheilanthus* sp., *Pteris sp.* and *Clematis* sp.

Sample Plot No.8 (Access Road to Headworks)

This plot is managed by local CFUG. It is diversified plot in terms of tree diversity with several tree species such as *Schima wallichii ,Boehmeria rugulosa, Wendlandia* sp., *Englehardtia spicata, Mallotus philippinensis, Ficus cunia* and *Syzyzium* sp. but it is dominated more by *Wendlandia* sp. and *Pinus roxburghii.* The diameter value ranges from 0.04m to 0.29m. The basal area value is found to be 0.048% and similar to Sample Plot No.7. Among the shrubs, the plot is dominated by *Cythula tomentosa, Maesa macrophylla, Inula cappa and Rubus ellipticus.* Similarly, among the herb layer species, this plot is represented by *Artemisia indica, Nephrolepis cordifolia, Eupatorium adenophorum* and *Cheilanthus* sp.

Sample Plot No.9 (Spoil Disposal Area-5)

This plot is managed by local CFUG. It is also a diversified plot with tree species with the domination of *Schima wallichii, Mallotus philippinensis, Wendlandia* sp., *Callicarpa arborea, and Ficus cunia whereas Englehardtia spicata, Syzyzium* sp., *Alnus nepalensis* and *Toona ciliata* are only represented. D value ranges from 0.06 to 0.54m. The basal area value is also found to be 0.100 %. Among the shrubs, the plot is dominated by *Cythula tomentosa and Rubus ellipticus.* Similarly, among the herb layer species, this plot is represented by *Eupatorium adenophorum Artemisia indica and* a small clump of *Thysanolaena maxima.*

Sample Plot No.10 (Access Road to Headworks)

This plot is managed by local CFUG. It is little diversified forest plot with tree species with the domination of *Pinus roxburghii*. Other common tree species are *Wendlandia* sp., *Englehardtia spicata, Bauhinia variegata* and *Phyllanthus embica* whereas *Syzium* sp., *Myrica esculenta* and *Grewia optiva* are singly represented. The diameter value ranges from 0.06m to 0.51m. The basal area value also is found to be 0.136 %. Among the shrubs, the plot is represented by *Inula* sp., *Berberis asiatica, Coriaria nepalensis* and *Indigofera* sp. Similarly, among the herb layer species, this plot is represented by *Themeda* sp., *Eupatorium adenophorum, Pteris* sp. and *Carex* sp.

Sample Plot No.11 (Adit-1)

It is also diversified plot with tree species with the domination of *Pinus roxburghii*. Other common tree species are *Boehmeria rugulosa, Myrica esculenta, Macaranga pustulata, Bauhinia variegata, Mallotus philippinensis* and *Bombax ceiba*. The diameter value ranges from 0.08m to 0.65m. The tree height is limited to 16m. The basal area is found to be 0.127 %. Among the shrubs, the plot is dominated by *Colebrokia oppositifolia* whereas *Rubus ellipticus, Maesa chisa and Coriaria nepalensis* are solely represented. Similarly, among the herb layer species, the plot is represented by *Urtica dioca, Artemisia* sp., *Eupatorium adenophorum, Nephrolepis cordifolia and Pteris* sp.

Sample Plot No.12 (Access Road to Headworks)

The plot is managed by local CFUG. The entire plot is composed of *Pinus roxburghii* only. Almost trees are of moderate size and diameter value ranges from 0.09m to 0.27m. The tree height reaches up to 23m. The basal area value is found to be 0.140 %. Among the shrubs, the plot is dominated by *Rubus ellipticus and Colebrokia oppositifolia* whereas *Berberis asiatica* is only represented. Similarly, among the herb layer species, it is represented by *Eupatorium adenophorum, Artemisia indica, Cheilanthus* sp. and *Barlelia cristata.*

Sample Plot No.13 (Access Road to Headworks)

This plot is managed by local CFUG. It is diversified plot with broadleaved tree species with the domination of *Boehmeria rugulosa, Bauhinia variegata, Wendlandia* sp. and *Syzyzium* sp. Other trees species with single representation are *Myrica esculenta, Ficus cunia* and *Albizzia sp.* The diameter value ranges from 0.07m to 0.54m. The tree height is limited to 13m. The basal area value is found to be 0.182 %. Among the shrubs, the plot is dominated by *Maesa macrophylla* and *Colebrokia oppositifolia* with the presence of *Maesa chisia.* The site is having dense herbaceous growth of different plants including *Eupatorium adenophorum, Artemisia indica, Nephrplepis cordifolia, Pteris* sp. with a small clump of *Thysanolaena maxima.*

Sample Plot No.14 (Spoil Disposal Area-6)

The plot is managed by local CFUG. It is also diversified plot with broadleaved tree species with the domination of *Ficus cunia, Boehmeria rugulosa, Mallotus philippinensis Toona ciliata* and *Wendlandia* sp. Other trees species with only representation are *Syzyzium* sp., *Bauhinia variegata* and *Bombax ceiba.* The diameter value ranges from 0.06m to 0.24m. The tree height is limited to 10m. The basal area value is also found to be very low i.e. 0.060 %. The site is extremely disturbed with heavy lopping of branches. Among the shrubs, the plot

is dominated by *Maesa macrophylla* with few representation of *Inula* sp. whereas *Caryopteris odorata and Berberis asiatica* is only represented. The site is having thick population of *Eupatorium adenophorum* with common species like *Cheilanthus* sp., *Cissamelos* sp. whereas *Clematis* sp., a climber, is also present as a rare species.

Sample Plot 15 (Access Road to Headworks)

This plot is under private ownership. This site is highly dominated by *Pinus roxburghii*. Other representative trees are *Wendlandia* sp. but they are very small in size. Similarly, *Englehardtia spicata* and *Phyllanthus emblica* are singly represented. *Myrica esculenta* is also present in this plot and is highly matured comparable to matured *Pinus roxburghii*. The diameter value of tree species ranges from 0.05m to 0.24m. The basal area value is found to be very low i.e. 0.038 %. Among the shrubs, the site is found to be composed of *Inula* sp., *Berberis asatica* and *Indigofera* sp. Similarly, among the herb layer species, this plot is represented by *Eupatorium adenophorum* and *Themeda* sp.

Sample Plot 16 (Spoil Disposal Area-7)

This plot is under private ownership and is composed of small size trees representing *Boehmeria rugulosa, Ficus cunia, Alnus nepalensis, Mallotus philippinensis, Bauhinia variegata, Wendlandia* sp. and *Syzyzium* sp. The diameter value ranges from 0.05m to 0.17m only. The basal area value is also found to be very low i.e. 0.025 %. Among the shrubs, the site is found to be composed of *Inula* sp., *Maesa macrophylla* and *Colebrokia oppositifolia.* Similarly, among the herb layer species, this plot is represented by *Artemisia indica, Eupatorium adenophorum* and *Cissampelos* sp.

Sample Plot 17 (Spoil Disposal Area-8)

This plot is under the management of community user's group. This plot is composed of small to medium size trees representing *Boehmeria rugulosa, Callicarpa arborea , Englehardtia spicata, Albizzia* sp. and *Desmodium ojinensis*. The diameter value ranges from 0.08m to 0.23m. The basal area value is found to be very low i.e. 0.046 %. Among the shrubs, the site is found to be composed of *Inula cappa, Maesa macrophylla and Rubus ellipticus.* Similarly, among the herb layer species, it is represented by *Crassocephalum crepidioides, Artemisia sp. and Sonchus* sp.

Sample Plot No. 18 (Access Road to Headworks)

The plot is under the management of community user's group. This plot is composed of small to medium size trees representing *Englehardtia spicata, Boehmeria rugulosa , Callicarpa arborea* and *Desmodium ojinensis*. However, the site is dominated by *Englehardtia spicata* and the diameter value reaches up to 0.51m. The basal area value is found to be 0.106 %, which is a bit higher in comparison to the growth status of the surrounding vegetation. Among the shrubs, the site is found to be composed of *Woodfordia fruiticosa, Colebrokia oppositifolia* and *Maesa macrophylla.* Similarly, among the herb layer species, it is represented by *Pteris* sp., *Artemisia* sp. *and Bidens pilosa.*

Sample Plot No. 19 (Access Road to Headworks)

The plot is under the management of community user's group. This plot is composed of small to medium size trees representing *Boehmeria rugulosa, Pinus roxburghii Wendlandia* sp. and *Desmodium ojinensis.* The diameter value ranges from 0.07m to 0.28m. The basal

area value is found to be very low i.e. 0.029 % only. The density of trees is also very thin (i.e. only 7 trees in 625m^2 plot). Among the shrubs, the site is found to be composed of *Inula cappa, Maesa macrophylla and Casearia* sp. Similarly, among the herb layer species, it is represented by *Artemisia* sp., *Barleria cristata* and *Crassocephalum crepidioides.*

Sample Plot 20 (Access Road to Headworks)

This plot also is under the management of by local community user's group. It is diversified plot with broadleaved tree species with the representation of *Boehmeria rugulosa, Pinus roxburghii, Wendlandia* sp., *Desmodium ojinensis* and Grewia optiva. The diameter value ranges from 0.06m to 0.29m. The tree height is limited to 7m only except one tree (24m). The basal area value is also found to be very low i.e. 0.049%. Among the shrubs, the plot is dominated by *Inula cappa, Maesa macrophylla* whereas *Casearia* sp. *and Rubus ellipticus* are only represented. Among the herbs, *Artemisia* sp. is more populated and other spp. like *Barleria cristata, Crassocephalum crepidioides* and *Sonchos* sp., are found in lesser population.

Sample Plot No.21 (Access Road to Headworks)

The plot is managed by community user's group. It is diversified plot with broadleaved tree species with the domination of *Schima wallichii, Toona ciliata, Myrica esculenta Syzyzium* sp., with other trees species such as *Englehardtia spicata, Ficus cunia, Wendlandia* sp, *Prunus cerasoides* and *Grewia optiva.* The diameter value ranges from 0.09m to 0.29m. The tree height is limited to 11m only. Similarly, the basal area value is also found to be very low i.e. 0.060 %. Among the shrubs, the plot is represented by *Phyllanthus* sp., *Kydia* sp. with the presence of few individuals of *Casearia* sp. and *Maesa macrophylla.* Similarly, among the herb layer species, the plot is represented by *Oxalis* sp., *Artemisia indica, Pteris* sp. and *Carex* sp.

Sample Plot 22 (Adit 3)

This site is mainly dominated by *Pinus roxburghii* and *Schima wallichii* reaching the diameter up to 0.48cms and the height is up to 18m. Other associated tree species are *Wendlandia* sp., *Boehmeria rugulosa and Rhododendron arboreum.* The basal area value is found to be. 0.165 %. Among the shrubs, the plot is dominated by *Rubus ellipticus* with lesser amount of *Maesa macrophylla* whereas *Inula cappa* is found in higher population. Among the herbs, this site is highly dominated by grasses like *Themeda triandra and Carex* sp. with few individuals of *Eupatorium adenophorum.*

Sample Plot No.23 (Spoil Disposal Area-14)

This plot is under the management of community user's group. This site is little diversified but is mainly dominated by *Englehardtia spicata and Toona ciliata* reaching the diameter up to 0.19m and height up to 10m. Other associated tree species are *Bombax ceiba, Albizzia* sp., *Schima wallichii, Boehmeria rugulosa, Phyllanthus emblica* and *Wendlandia* sp. with moderate growth condition. There are more regenerating species of *Toona* and *Englehardtia.* The basal area alue is found to be 0.100. Among the shrubs, the plot is dominated by *Phyllanthus* sp. and *Colebrokia oppositifolia* is frequent and lesser number of *Casearia* sp. and *Sida* sp. Similarly, among the herb layer species, *Oxalis* sp., *Artemisia indica, Bidens pilossa* and *Carex* sp. are more common.

Sample Plot No.24 (Quarry Site-3)

The site for quarry site -3 located near Tungbar terrace is managed by community user's group. The main constituent species of this site is *Shorea robusta* having moderate to good growth condition reaching the diameter up to 0.29 m and height up to 13m. Other associated tree species are *Englehardtia spicata, Schima wallichii, and Wendlandia* sp. reaching the diameter from 0.06m to 0.21m only. The basal area value is also found to be very low i.e.0.063% only. The shrubs and herbs of this locality are *Desmodium* sp., *Sida* sp., *Osyris* sp., *Asparagus racemosus*, *Pogonantherum* sp. and *Barleria cristata*.

Sample Plot No.25 (Access Road to Headworks)

This part of the Access Road to headworks is managed by community user's group. Though this site is dominated by *Shorea robusta* (diameter reaching up to 0.32m and height 15m), there is significant presence of other species such as *Pinus roxburghii, Boehmeria rugulosa, Schima wallichii*, whereas *Rhododendron arboreum* and *Desmodium oojeinense* are only represented. However, their diameter and height reaches up to 0.27m and 12m in maximum. The basal area value is found to be 0.092. The shrubs and herbs of this locality are *Inula cappa, Rubus ellipticus, Dedsmodium* sp., *Cheilanthus* sp., *Themeda triandra* and *Asparagus racemosus*,

Sample Plot 26 (Adit -4)

This plot is under the management of community user's group. This site is mainly dominated by *Shorea robusta* reaching the diameter up to 0.31cm and the height up to 15m. Other associated tree species are *Wendlandia* sp., *Bauhinia variegata, Macaranga pustulata and Mallotus philippinensis* with moderate growth condition while *Boehmeria rugulosa* has comparative growth with *Shorea robusta* though it is in less number. The basal area value is found to be. 0.157 %. Among the shrubs, the plot is populated by *Colebrokia oppositifolia, Desmodium* sp. and *Phyllanthus* sp. Among the herbs, this site is populated with grass like *Pogonantherum with some numbers of Cheilanthus* sp and few individuals of *Cissampelos* sp. and *Asparagus racemosus.*

Sample Plot No.27 (Access Road to Surge Shaft)

This plot is representative to access road, which is under the management of community user's group. This site is mainly dominated by *Shorea robusta* and Pinus *roxburghii*. The diameter reaches up to 0.55m for *S. robusta* and 0.33m for *P. roxburghii*. Similarly, the height reaches up to18m for both of the species. Other associated tree species are *Phyllanthus emblica, Wendlandia* sp. and *Syzyzium* sp. The density of trees is found relatively higher (i.e. 47 trees in 625m^2 plot). The basal area value is found to be 0.311 %, which reflects forest of better quality. Among the shrubs, the plot is represented by *Rubus ellipticus Indigofera* sp., *Desmodium* sp. and *Inula cappa.* Similarly, among the herb layer species, the plot is more populated by *Eupatorium adenophorum, Cissampelos* sp., *Carex* sp. and *Asparagus racemosus.*

Sample Plot No.28 (Access Road to Surge Shaft)

The plot is under the management of community user's group. This plot also is highly dominated by *Shorea robusta*. Other associated species are *Terminalia alata, Boehmeria rugulosa, Phyllanthus emblica, Syzyzium sp., Desmodium ojinensis, Wendlandia sp. and Mallotus philippinensis*. The diameter value reaches up to 0.40m in case of *Shorea robusta*.

The basal area value is found to be 0.145 %, which is lesser than Sample Plot No.27, but relatively fair as compared to other studied plots. Among the shrubs, the site is found to be composed of Woodfordia *fruiticosa, Desmodium sp.* and *Rubus sp.* Similarly, among the herb layer species, the plot is represented by *Eupatorium adenophorum*, *Barleria cristata* and *Carex* sp.

Sample Plot 29 (Adit Portal to Surge Tank)

This plot is representative to Surge Shaft/ Adit Portal, which is under the management of community user's group. This site is dominated by *Shorea robusta* reaching the D up to 0.48cm and height up to 22m with higher tree density (55 trees in 625 sq.m. area). Other associated tree species with significant number are Terminalia *alata, Boehmeria rugulosa, Syzyzium* sp., *Phyllanthus emblica, Pinus roxburghii* with almost the same growth status while *Terminalia alata, Phyllanthus emblica, Wendlandia* sp. and *Syzyzium* sp. *Desmodium oojeinense* and *Mallotus philippinensis* are found in less number with moderate growth status. The site is having very good regeneration of Sal trees with frequent regeneration of other tree species. The value of basal area is found to be. 0.236 % indicating presence of matures trees in compassion to other surveyed plots. Among the shrubs, the plot is populated by various spp. such as *Inula* sp, *Desmodium* sp., *Woodfordia fruiticosa, Casea*ria sp. and *Rubus* sp. Among the herb layer species, *Eupatorium adenophorum Pogonantherum* sp., *Barleria cristata* and *Carex* sp. are more common.

Sample Plot 30 (Air Vent Tunnel)

This plot is under the management of community user's group. This plot is dominated by *Shorea robusta*. The other associated species are *Terminalia alata, Boehmeria rugulosa, Phyllanthus emblica, Syzyzium* sp. and *Mallotus philippinensis.* The diameter value reaches up to 0.38m. In case of *Shorea robusta*, the basal area value is found to be very low i.e. 0.074 % only. Density of trees also is relatively thin (i.e. only 15 trees in 625m^2 plot) in comparison to surrounding vegetation. Among the shrubs, the site is found to be composed of *Casearia* sp., *Inula* sp. *Desmodium* sp. and *Rubus* sp. Similarly, among the herb layer species, it is represented by *Pogonantherum* sp., *Carex* sp. and *Eupatorium adenophorum.*

Sample Plot 31 (Switchyard)

This plot is privately owned forest. This site is little diversified but is mainly dominated by *Shorea robusta* reaching the diameter up to 0.32m and height up to 18m. Other associated tree species are *Aesandra butyracea*, *Mangifera indica, Mallotus philippinensis, and Ficus lacorand Trichilia connoroides* with moderate growth condition. There are encouraging numbers of regenerating seedlings of *Shorea robusta* in this plot. The basal area value is found to be 0.228%. Among the shrubs, the plot is dominated by *Murrya* sp, *Sarcococca* sp. *and Colebrokia oppositifolia.* Among the herb layer species, *Urtica dioca, Eupatorium adenophorum, Bidens pilossa are more frequent.*

Sample Plot 32 (Spoil and Muck Disposal Area-26)

This plot is privately owned and has moderate slope topography. *Shorea robusta* is the dominant tree species of this plot with diameter ranging from 0.05m to 0.31m and height from 2m to 18m. *Mallotus philippinensis* is the other associated tree species with diameter ranging from 0.07m to 0.12m and height from 3 to 5m. This plot is also marked with numerous regenerating seedlings of *Shorea robusta.* The basal area value is found to be

0.132%. The dominating shrub species are *Murrya* sp and *Colebrokia oppositifolia* whereas the herb layer species comprises of mainly *Bidens pilossa, Cheilanthus* sp whereas *Urtica dioca* and *Eupatorium adenophorum* are represented individually.

Sample Plot No.33 (Monitoring Plot)

This plot is located on the right bank of Trishuli river at upper hill and is managed by Community Forest User's Group and is about 75m upstream of weir site. This plot also has the similar situation with the Sample Plot No.4. The diameter ranges from 0.08m to 0.27m and the height of tree is limited up to 12m only. The representative tree species are *Englehardtia spicata, Wendlandia* sp., *Macaranga pustulata, Grewia optiva* and *Ficus* sp. The basal area value is found only 0.103 %. This plot is dominated as shrub by *Coriaria nepalensis* and *Debregeasia* sp. Similarly, this plot is dominated by *Dryopteris cochleata, Equisetum* sp., *Boehmeria* sp. and *Sonchus* sp. in decreasing order among the herb layer species.

Sample Plot No.34 (Monitoring Plot)

The plot is about 160m upstream of weir site on the right bank of Trishuli river and is situated at upper hill. The forest area is again managed by the community forest users group. This site mainly consists of *Alnus nepalensis* forest patch with optimum diameter and height as 0.21m and 19m respectively. This plot is composed of young to relatively matured trees of *Pinus roxburghii* with optimum diameter and height as 0.41m and 21m correspondingly. This plot also consists of few trees of *Schima wallichii* ranging from 0.20m to 0.45m in diameter with moderate height. The basal area value is found to be 0.191% only. The plot is dominated by *Coriaria nepalensis* and *Rubus* sp. among the shrubs. This plot is highly dominated by *Eupatorium adenophorum.* The Other common species among the herb layer are *Achyranthus bidentata* and *Equisetum* sp. *Asparagus racemosus* is only represented.

Sample Plot No.35 (Monitoring Plot)

This sample plot is located within Spoil and Muck Disposal Area-2 where principal vegetation is represented by limited number of trees of *Pinus roxburghii*. The site is representative to newly regenerated pine species having very low diameter range (0.06m-0.15m).The height reaches up to 5m only. The basal area value is also found to be low i.e. 0.020% only which is almost negligible. Due to the small size of trees and very low tree density, there is no significant crown cover. The plot is dominated by *Woodfordia fruiticosa* among the shrub layer species and *Casearia* sp. is only represented. Similarly, among the herb layer species, this plot is dominated by *Eupatorium adenophorum* with few individuals of *Pteris* sp and *Artemisia* sp. whereas *urtica dioca* is only represented.

Sample Plot No.36 (Monitoring Plot)

This plot is located south of Spoil Disposal Area-6 and is under private ownership. This site is completely dominated by *Alnus nepalensis*. The diameter value ranges from 0.07m to 0.23m. The tree height is limited to 16m. The basal area value is found to be low i.e. 0.059 %. Among the shrubs, the plot is dominated by *Colebrokia oppositifolia and Sida* sp. along with single individual of *Inula sp*. Similarly, among the herb layer species, it is represented by *Ageratum conyzoides, Artemisia indica, Bidens pilosa* and *Cassia* sp.

Sample Plot No.37 (Monitoring Plot)

This plot is located immediately south of Adit-1, Buchet Phant nearby river bank and is managed by community user's group. It is diversified plot with broadleaved tree species with the domination of *Syzyzium* sp. Though *Schima wallichii, Toona ciliata* and *Englehardtia spicata* are represented in few numbers, they are highly matured reaching up to 25m in height in optimum. Other trees species such as *Desmodium ojinensis*, *Prunus cerasoides* and *Grewia optiva* are also represented but they are rather small in size. The diameter value of the plant species in this plot ranges from 0.08 to 0.63m and basal area value is found to be 0.172 %. Among the shrubs, the plot is dominated by *Inula cappa* with few individuals of *Maesa chisia and Rubus ellipticus.* Similarly, among the herb layer species, this plot is represented by *Artemisia* sp,. *Achyranthus bidentata, Eupatorium adenophorum and Dryopteris cochleata.*

Sample Plot No.38 (Monitoring Plot)

This plot is located immediately east of Buchet Phant and is under the management of community user's group. This site is dominated by *Pinus roxburghii* forest patch and the maximum diameter value reaches up to 0.45m and the height reaches up to 26m. Other associated tree species are *Wendlandia* sp. and *Desmodium ojinensis* with moderate growth condition. The basal area value is found to be. 0.121 %. The representative shrubs of the site are *Maesa macrophylla, Colebrokia oppositifolia* and *Mimosa* sp. Similarly, among the herb layer species, this site is represented by *Artemisia sp., Eupatorium adenophorum* and *Barleria cristata*

Sample Plot No.39 (Monitoring Plot)

This plot is located immediate north of Buchet Phant, which is under the management of community user's group. This site is mainly dominated by *Englehardtia spicata* reaching the diameter up to 0.48m and height up to 22m. Other associated tree species are *Desmodium ojinensis, Wendlandia* sp., *Albizzia* sp. and *Callicarpa arborea* with moderate growth condition. The basal area value is found to be 0.129%. Among the shrubs, the plot is dominated by *Colebrokia oppositifolia and Woodfordia fruiticos whereas Indigofera* sp is only represented. Among the herbs, *Artemisia* sp. is dominant and other spp. such as *Bidens pilosa, Sonchos* sp. and *Pteris* sp. etc. are less common.

4.2.1.7 Plants under Different Threat Categories

The following plants under different protection categories have been observed or reported in the project area and the adjacent region.

Table 4.10: Plants under Different Protection Categories

SN	Scientific name	GoN	IUCN	CITES
	Dioscorea deltoidea	-	T	II
	Berginia ciliata	-	T	-
	Cythea spinulosa	-	-	II
	Oroxylon indicum	-	EN	-
	Oberonia sp.			III
	Valeriana jatamansii	P	-	-
	Coelogyne ochracea			III
	Coelogyne sp.1			III
	Michelia champaca	P	EN	
	Bombax ceiba	P		
	Shorea robusta	P		

Note:
IUCN Category: T- Threatened, EN-Endangered, R-Rare, CR-Critically Endangered, V-Vulnerable
CITES Category: Appendix I, II, III (Classified according to the threat due to trade)
GoN Category: P- Protected

4.2.1.8 Ecological Significance of Forest and Vegetation

It has been already mentioned that the site of project construction for UT-1 lies in the transitional zone between tropical and sub-tropical bioclimatic region of Nepal where a luxuriant growth of vegetation can be expected. But the presence of rocky environmental setting, on both sides of the river, and poor edhaphic conditions have been found as the major limiting factors for the good growth of forest vegetation in the present case. The study results obtained from the quadratic survey of some 39 forest plots show that the diameter of tree varies from 0.04m to 0.99m and wood volume is found to be 0.17m3 to 30.80 m3. Similarly, the basal area % varies from 0.020% to 0.487%. All these results are self explanatory to determine the growth status and their ecological significance in the particular habitat. In an average, the biomass stock, diameter range and basal area covered by the stem(in relation to ground area) are found much below than the similar sites of forest growth in similar altitudinal ranges in other parts of Nepal. In comparison to other sites the growth status of the forest is found better in buffer zone area of LNP where pondage area and weir are located. Thereafter the whole project construction activities have been shifted to the right side of the river and the anticipated loss from the government forestland consisting of buffer zone area has been avoided. Though the loss of forest biomass from the project execution seems less significant in comparison to the total forest area occupied by the project, but it bears high importance for maintaining the fragile ecosystem of the area. Therefore, significant assistance from the project for greenery development and afforestation programme in the remaining degraded forest areas is highly recommended as a corporate social responsibility.

4.2.2 Wild Animal

The project area is located nearby the LNP. LNP is famous for the Red panda and religious shrines like Gosainkunda. The numbers of faunal species found in the LNP include 46 mammals- including eight protected species, 345 species of birds, 11 species of reptiles, 30 species of fishes and 58 species of butterflies. Forest ranges from Sal forest to Alpine forest. The number of vascular plants recorded in the Park is 1,043. The area harbours protected faunal species such as Red Panda, Snow Leopard, Assamese Monkey, Musk Deer, Leopard Cat, Clouded Leopard, Grey Wolf, Himalayan Monal and Satyr Tragopan. (Resource Book of LNP, 2012).

Trishuli River flows between the buffer zone of LNP and the project area. Thinly scattered tree vegetation, steep rocky terrain, agricultural fields, settlements made the project area less favourable for wild animals to live as compared to nearby LNP. Therefore, the core habitats for terrestrial wild animals lie on LNP. Most of the wild animals occasionally visit the project area; some visit especially during crop raising and harvesting seasons.

In the present survey, a total of 23 species of mammals, 62 species of birds, 20 species of herpetofauna, 4 species of fishes and 40 species of butterflies were reported from the project area.

'High interest' mammals includes *Felis chaus, Panthera pardus, Lutra lutra, Ursus thibetanus, Semnopithecus hector, Macaca mulatta, Macaca assamensis* and *Naemorhedus goral;* avifauna includes *Psittacula himalayana, Asio flammeus, Otus spilocephalus, Bubo bubo, Milvus migrans, Gyps himalayensis, Circus cyaneus, Aquila chrysaetos, Aquila chrysaetos, Falco tinnunculus* and *Falco peregrines* and herpetofauna includes *Haplobatrachus tigerinus.* They are categorized 'high interest' as they are listed in CITES Appendix or/and IUCN Red Data Book or/and Protected Species under NPWC Act 1973.

4.2.2.1 Mammals

Consulting with the local people, members of National Park and field visits indicate that animals such as monkey, hare, rat, mouse, mongoose, etc. were frequently seen in the area. Animals such as flying squirrel, porcupine, martin, jackal, leopard, deer, jungle cat, black bear, otter, Assamese monkey occasionally seen in the area in a thin numbers. The black bear, porcupine, jackal, leopard, mouse, wild boar and species of monkey are pest animals for farmers as they destroy crops and domestic animals. The leopard kills cattle baby, martin kills chicken and so as to wild cat. Species of monkeys, porcupine, mouse and black bear, wild boar destroy rice and corn. Therefore, the villagers drive away the nuisance animals and sometime react by killings the wild animals. This is the major reason for park people conflict in the project area

However, the project construction area is not the core habitat or migratory route of conservational or economical important mammals or any other animal life, though a few of conservation significance animals seasonally visit the project vicinity forests. A list of mammalian diversity reported to be found in the project region is presented in Table 4.11.

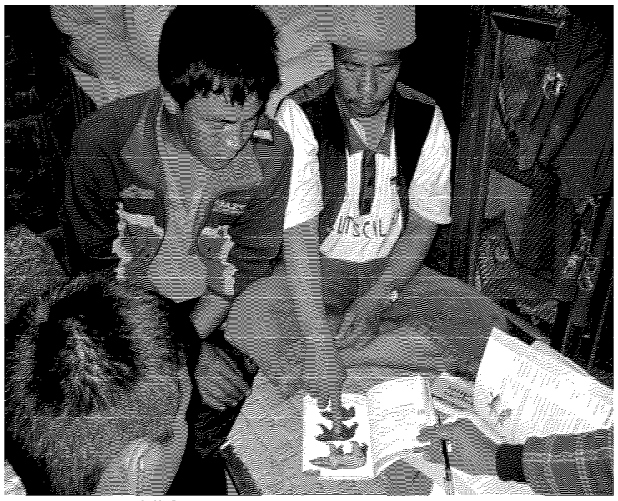


Figure 4-28: Local People Participating in Wildlife Survey



Figure 4-29: Faecal matter of Golden Jackal (Canis aureus)

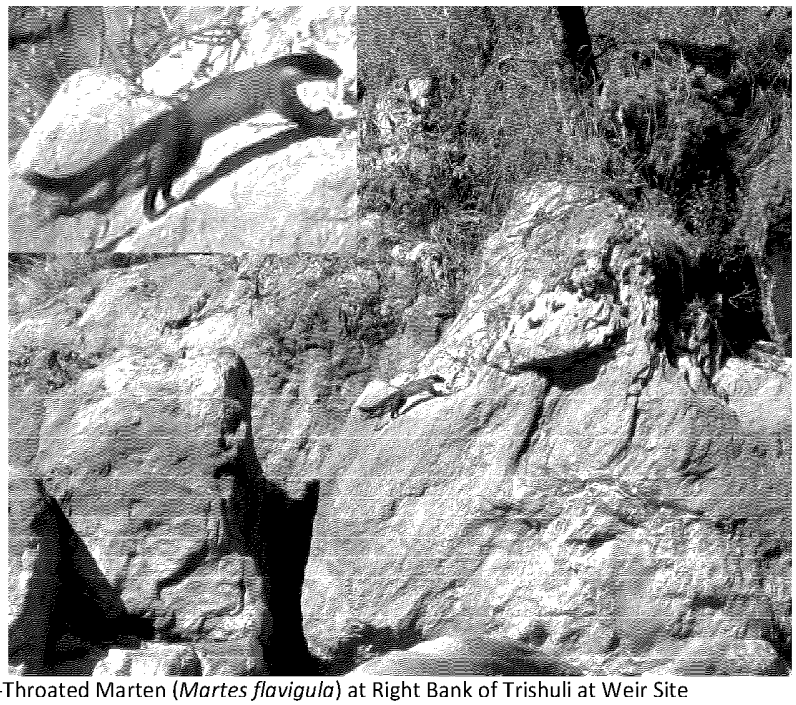


Figure 4-30: Yellow-Throated Marten (*Martes flavigula*) at Right Bank of Trishuli at Weir Site

Table 4.11: Mammals Recorded in Project Sites (Participatory Information from Local People)

Synod.	Nepali Name	Common Name	Scientific Name	Status of occurrence			Habitat					Migratory Status/ season		Reported location
				C	S	R	F	B	O	A	Wa	M/R/V	S	
1	Khairo Kharayo	Indian Hare	*Lepus nigricollis*	√			√	√	√			R		F
2	Rato Rajpankhi Lokharke	Red Giant Flying Squirrel	*Petaurista petaurista*		√		√					R		F
3.	Lampuchre Khet Muso	Long-tailed Field Mouse	*Apodemus sylvaticus*	√							√	R		F
4.	Khaki-range Muso	Fawn-coloured Mouse	*Mus cervicolor*	√					√	√		R		A
5	Ghar Muso	House Rat	*Rattus rattus*	√						√		R		A, Set.
6	Jure Dumsi	Indian Crested Porcupine	*Hystrix indica*		√		√					R		F,A
7	Ban Biralo	Jungle cat	*Felis chaus*		√		√					R		F
9	Chituwa	Common Leopard	*Panthera paradus*		√		√					M	Wi	F
10	Sano Nyaurimuso	Small Indian Mongoose	*Herpestes auropunctatus*	√				√		√		R		A
11	Syal	Golden Jackal	*Canis aureus*		√		√					M	Su	F
12	Kalo Bhlu	Asiatic Black Bear	*Ursus thibetanus*		√		√					M	Wi	F
13	Kalo Oot	Eurasian Otter	*Lutra lutra*		√						√	R		Wat
14	Malsapro	Yellow-Throated Marten	*Martes flavigula*	√			√					R		F
15	Pahadi Pani-chuchundro	Himalayan Water Shrew	*Chimarrogale himalayica*	√							√	R		Wat
16	Ghar Chuchundro	Asian House Shrew	*Suncus murinus*	√								R		Set
17	Blandford ko Falahari Chamero	Blandford's Fruit Bat	*Sphaerias blanfordi*	√			√					R		F
18	Tarai Langur	Tarai Grey Langur	*Semnopithecus hector*	√			√					R		F,A
19.	Rato Bandar	Rhesus Macaque	*Macaca mulatta*	√			√					R		F,A

Synod.	Nepali Name	Common Name	Scientific Name	Status of occurrence			Habitat					Migratory Status/ season		Reported location
				C	S	R	F	B	O	A	Wa	M/R/V	S	
20.	Pahare Bandar	Assam Macaque	*Macaca assamensis*		√		√					R		F,A
21.	Bandel	Eurasian Wild Boar	*Sus scrofa*	√			√					R		F
22.	Ratuwa /Rato Mirga	Barking Deer	*Muntiacus muntjak*	√			√					R		F
23.	Ghoral	Common Goral	*Naemorhedus goral*			√	√					R		F

Source: EIA Field Survey, 2011
Note:
C= Common; S= Sparse; R= Rare
Habitats = F- forest, B – Bush, O- Open grass land, a – Agricultural land, WA – Water
Migratory Status and Season = M – Migratory, R = Resident, V = Visitor occasionally, S – migration season, Su- Summer visitor, Wi – Winter Visitor
Reported Location: F- Forest, A- Agricultural Land, Set- Settlement, Wat – Water

Table 4.12: Distribution of Mammals in Project Sites (Participatory information from Local People)

Synod.	Nepali Name	Common Name	Scientific Name	Reported from		
				Around Headworks Area	Between Headworks and Powerhouse Area	Around Powerhouse Area
1	Khairo Kharayo	Indian Hare	*Lepus nigricollis*	√	√	√
2	Rato Rajpankhi Lokharke	Red Giant Flying Squirrel	*Petaurista petaurista*	-	√	√
3.	Lampuchre Khet Muso	Long-tailed Field Mouse	*Apodemus sylvaticus*	√	√	√
4.	Khaki-range Muso	Fawn-coloured Mouse	*Mus cervicolor*	√	√	√
5	Ghar Muso	House Rat	*Rattus rattus*	-	√	√
6	Jure Dumsi	Indian Crested Porcupine	*Hystrix indica*	√	√	√
7	Ban Blralo	Jungle cat	*Felis chaus*	√	√	-
9	Chituwa	Common Leopard	*Panthera paradus*	√	-	√
10	Sano Nyaurimuso	Small Indian	*Herpestes*	√	-	-

Synod.	Nepali Name	Common Name	Scientific Name	Reported from		
				Around Headworks Area	Between Headworks and Powerhouse Area	Around Powerhouse Area
		Mongoose	*auropunctatus*			
11	Syal	Golden Jackal	*Canis aureus*	√	√	√
12	Kalo Bhlu	Asiatic Black Bear	*Ursus thibetanus*	√		
13	Kalo Oot	Eurasian Otter	*Lutra lutra*	-	-	√
14	Malsapro	Yellow-Throated Marten	*Martes flavigula*	√	√	√
15	Pahadi Pani-chuchundro	Himalayan Water Shrew	*Chimarrogale himalayica*	√	√	-
16	Ghar Chuchundro	Asian House Shrew	*Suncus murinus*	√	√	√
17	Blandford ko Falahari Chamero	Blandford's Fruit Bat	*Sphaerias blanfordi*	√	√	√
18	Tarai Langur	Tarai Grey Langur	*Semnopithecus hector*	√	√	√
19.	Rato Bandar	Rhesus Macaque	*Macaca mulatta*	√	√	√
20.	Pahare Bandar	Assam Macaque	*Macaca assamensis*	√	-	-
21.	Bandel	Eurasian Wild Boar	*Sus scrofa*	√	√	
22.	Ratuwa /Rato Mirga	Barking Deer	*Muntiacus muntjak*	√	-	-
23.	Ghoral	Common Goral	*Naemorhedus goral*	-	√	√

Source: EIA Field Survey, 2011

Status of Mammals

A total of 23 species of wild mammals were recorded from the project area. Of which, eight species were listed on CITES Appendixes, three species on IUCN Red Data List and one species on Protected Species under NPWC Act, 1973 (**Table 1.13**).

Table 4.13:Status of Mammals Recorded in Project Sites

S. No.	Nepali Name	Common Name	Scientific Name	CITES Appendix	IUCN Red List	Protected Under NPWC Act, 1973
1.	Ban Biralo	Jungle cat	*Felis chaus*	II	-	-
2.	Chituwa	Common leopard	*Panthera pardus*	I	CR	-
3.	Kalo Oot	Eurasian Otter	*Lutra lutra*	I	-	-
4.	Kalo bhalu	Himalayan black bear	*Ursus thibetanus*	I	V	
5	Tarai Langur	Tarai Grey Langur	*Semnopithecus hector*	I	-	-
5.	Rato Bandar	Rhesus Macaque	*Macaca mulatta*	II	V	-
6.	Pahare Bandar	Assam Macaque	*Macaca assamensis*	II	-	Protected
7.	Ghoral	Common Goral	*Naemorhedus goral*	I	-	-

Source: www.iucnnepal.org.com; CITES, 2003; Nepal Biodiversity Strategy, 2002.
Key to the IUCN Codes
CR: Critically Endangered, V= Vulnerable, I= Intermediate

4.2.2.2Avi-fauna

The habitat for avifauna at the project area is mainly composed of forest with *Alnus, Pinus*, *Rhododendron*, *and Shorea* along with bushes, grassland, agricultural land and water. The birds are attracted with the fruiting, flowerings and young leaves bearing trees for their food, shelter and nesting. Both wild and birds acquainted with the human habitation have been recorded in the project region. **Table 4.14** presents the lists of birds found in the project region.

Table 4.14: Avi-fauna Recorded for Project Sites (Participatory Information from Local People)

S.N.	Nepali Name	Common Name	Scientific Name	Status of occurrence			Habitat					Migratory Status		Reported location
				Common	Sparse	Rare	F	B	O	A	Wa	M/R/V	S	
1.	Luinche	Red Junglefowl	*Gallus gallus*		√		√	√				R		Forest
2.	Kalij	Kalij Pheasant	*Lophura leucomelanos*	√			√					R		Forest
3.	Kasthakut	Fulvous-breasted Woodpecker	*Dendrocopos macei*	√			√					R		Forest
4.	Kolo-chati Kastakut	Rufous-bellied Wookpecker	*Dendrocopos hyperythrus*	√			√					R		Forest
5.	Kalo-gardane Kathphor	Grey-headed Woodpecker	*Picus canus*		√		√					R		Forest
6.	Nyauli	Great Barbet	*Megalaima virens*	√			√					R		Forest
7.	Kuklung	Golden-throated Barbet	*Megalaima franklinii*	√			√					R		Forest
8.	Kuthruke	Blue- throated Barbet	*Megalaima asiatica*	√			√					R		Forest
9.	Phapre Chara	Common Hoopoe	*Upupa epops*	√					√	√		R		Agricultural land
10.	Pahadi Biu Kuhiyo	Large Hawk Cuckoo	*Hierococcyx sparverioides*	√			√					M	Su	Forest
11.	Kafal Pakyo	Indian Cuckoo	*Cuculus micropterus*	√			√					M	Su	Forest
12.	Kukku Koili	Eurasian Cuckoo	*Cuculus canorus*	√			√					M	Su	Forest
13.	Koili	Asian Koel	*Eudynamys scolopacea*	√			√			√		R		Forest
14.	Madana Suga	Alexandrine Parakeet	*Psittacula himalayana*		√		√			√		M	su	Ag. Land
15.	Chichika Gaunthali	Himalayan Swiftlet	*Collocalia brevirostris*	√			√		√			R		Forest
16.	Khairo	Common Swift	*Apus apus*		√		√		√			M	S	Forest

S.N.	Nepali Name	Common Name	Scientific Name	Status of occurrence			Habitat					Migratory Status		Reported location
				Common	Sparse	Rare	F	B	O	A	Wa	M/R/V	S	
	Gaunthali												u	
17.	Laghu- karna Latkoshero	Short-eared Owl	*Asio flammeus*		√		√					M	Wi	
18.	Lekali Uluk	Mountain Scoops Owl	*Otus spilocephalus*	√			√					R		Forest
19.	Hapsilo	Eurasian Eagle Owl	*Bubo bubo*	√			√					R		Forest
20.	Kochal-gande Latkoshero	Spotted Owlet	*Athene brama*	√			√					R		Forest
21.	Malewa	Rock Pigeon	*Columba livia*	√					√	√		R		Settlement
22.	Himali Malewa	Snow Pigeon	*Columba leuconota*	√			√					√		Forest
23.	Tame Dhukur	Oriental Turtle Dove	*Streptopelia orientalis*	√			√			√		R		Ag. Land
24.	Kurle Dhukur	Spotted Dove	*Streptopelia chinensis*	√			√			√		R		Ag. Land
25.	Thulo Chaha	Eurasian Woodcock	*Scolopax tusticola*	√			√					R		Forest
26.	Kalo Chil	Black Kite	*Milvus migrans*	√					√			R		settlement
27.	Himali Gidda	Himalayan griffon	*Gyps himalayensis*	√					√			R		Open grass land
28.	Challachor Bhui-chil	Hen Herrier	*Circus cyaneus*	√					√			M	Wi	Open grass land
29.	Suparna Maha-chil	Golden Eagle	*Aquila chrysaetos*		√				√			R		Open land
30.	Baudai	Common Kestrol	*Falco tinnunculus*		√				√			R		Open grassland
31.	Shahi Baj	Peregrine Falcon	*Falco peregrinus*		√						√	R		Water
32.	Bhadrai	Laong-tailed Shrike	*Lanius schach*	√				√				R		Bushes
33.	Sun-thude Lampuchre	Yellow-billed Blue Magpie	*Urocissa flavirostirs*		√		√					R		Forest
34.	Kalo Kag	Large-billed Crow	*Corvus macrorhynchos*	√			√		√	√		R		Settlement Ag. Land

S.N.	Nepali Name	Common Name	Scientific Name	Status of occurrence			Habitat					Migratory Status		Reported location
				Common	Sparse	Rare	F	B	O	A	Wa	M/R/V	S	
35.	Gajale Sunchai	Eurasian Golden Oriole	*Oriolus oriolus*	√			√			√		M	Wi	Ag. Land
36.	Lampuchre ranichari	Long-tailed Minivet	*Pericrocotus ethologus*	√			√					R		Forest
37.	Kalo Chibe	Black Drongo	*Dicrurus macrocercus*	√						√		R		Oen land
38.	Kalchaude	Blue Whistling Thrush	*Myophonus caeruleus*	√			√				√	R		Water
39.	Dhyanse Arjunak	Dark-sided Flycatcher	*Muscicapa sibrica*	√				√				M	Su	Bushes
40.	Seto Aakhibhau Arjunak	Snowy-browed Flycatcher	*Ficedula hyperythra*	√			√	√				R		Bushes
41.	Sano Niltava	Samll Niltava	*Niltava magrigoriae*	√			√	√				R		Bushes
42.	Setotauke Jalkhanjari	White-capped Water Redstart	*Chaimarrornis leucocephalus*	√							√	R		Water
43.	Nilambar Jalkhanjari	Plumbeous Water Redstart	*Rhyacornis fuliginosus*	√							√	R		Water
44.	Jhek Jhek Jhapsi	Common Stonechat	*Saxicola torquata*	√				√				R		Bushes
45.	Murari Putalichara	Wallcreeper	*Tichodroma muraria*	√						√		M	Wi	Ag. Land
46.	Hariyo Chichilkote	Green-blacked Tit	*Parus monticolus*	√			√	√				R		Forest
47.	Pandu Chichilkote	Black-lored Tit	*Parus xanthogenys*	√			√					R		Forest
48.	Kalikanthe Chichilkote	Black-throated Tit	*Aegithalos concinnus*	√			√					R		Forest
49.	Ghar Gaunthali	Barn Swallow	*Hirundo rustica*	√						√	√	R		Ag. Land

S.N.	Nepali Name	Common Name	Scientific Name	Status of occurrence			Habitat					Migratory Status		Reported location
				Common	Sparse	Rare	F	B	O	A	Wa	M/R/V	S	
50.	Dharke Jureli	Striated Bulbul	*Pycnonotus striatus*	√			√					R		Forest
51.	Julfe Jureli	Himalayan Bulbul	*Pycnonotus leucogenys*	√			√	√				R		Ag. Land
52.	Kailopete Jureli	Mountain Bulbul	*Pycnonotus mcclellandii*	√			√					R		Forest
53.	Bakhre Jureli	Black Bulbul	*Hypsipetes leucocephalus*		√		√					R		Forest
54.	Ratotauke Jhadifisto	Grey-sided Bush Warbler	*Cettia brunnifrons*	√				√				M	Wi	Bushes of Forest
55.	Godhuli Fisto	Dusky Warbler	*Phylloscopus fuscatus*	√				√				M	Wi	Bushes of Forest
56.	Tumulkari Fisto	Grey-hooded Warbler	*Seicercus xanthoschistos*	√				√				R		Bushes
57.	Tikiuri Toriganda	Variegated Laughingthrush	*Garrulax variegates*	√				√				R		Bushes of forest
58.	Kali-kanthe Bunge Chara	Black-throated Sunbird	*Aethopyga saturate*	√			√					R		Bushes of forest
59.	Ghar Bhangera	House sparrow	*Passer domesticus*	√						√		R		Agricultural land
60.	Rukh bhangera	Tree sparrow	*Passer montanus*	√						√		R		Agricultural land
61.	Pahelo Tiktike	Yellow Wagtail	*Motacilla flava*	√					√			M	Wi	Ag. Land
62.	Rukh Chuinya	Olive-blacked Pipit	*Anthus hodgsoni*	√			√					M	Wi	Forest

Source: EIA Field Survey, 2011

Note: *Habitats = F- forest, B – Bush, O- Open grass land, A – Agricultural land, Wa – Water Migratory status and season = M – Migratory, R = Resident, V = Visitor occasionally, S – migration season, Su- Summer visitor, Wi – Winter visitor*

Table 4.15: Avi-fauna Recorded in Project Sites

S.N.	Nepali Name	Common Name	Scientific Name	Reported From		
				Around Headworks Area	Between Headworks and Powerhouse Area	Around Powerhouse Area
1.	Luinche	Red Junglefowl	*Gallus gallus*	-	-	√
2	Kalij	Kalij Pheasant	*Lophura leucomelanos*	√	√	√
3.	Kasthakut	Fulvous-breasted Woodpecker	*Dendrocopos macei*	-	√	√
4.	Kailo-chati Kastakut	Rufous-bellied Wookpecker	*Dendrocopos hyperythrus*	√	-	-
5.	Kalo-gardane Kathphor	Grey-headed Woodpecker	*Picus canus*	-	√	√
6.	Nyauli	Great Barbet	*Megalaima virens*	√	√	√
7	Kuklung	Golden-throated Barbet	*Megalaima franklinii*	√	√	√
8	Kuthruke	Blue- throated Barbet	*Megalaima asiatica*	-	√	√
9	Phapre Chara	Common Hoopoe	*Upupa epops*	√	√	√
10	Pahadi Biu Kuhiyo	Large Hawk Cuckoo	*Hierococcyx sparverioides*	√	√	√
11	Kafal Pakyo	Indian Cuckoo	*Cuculus micropterus*	√	√	√
12	Kukku Koili	Eurasian Cuckoo	*Cuculus canorus*	√	√	√
13	Koili	Asian Koel	*Eudynamys scolopacea*	-	√	√
14	Madana Suga	Alexandrine Parakeet	*Psittacula himalayana*	√	√	√
15	Chichika Gaunthali	Himalayan Swiftlet	*Collocalia brevirostris*	√	√	√

S.N.	Nepali Name	Common Name	Scientific Name	Reported From		
				Around Headworks Area	Between Headworks and Powerhouse Area	Around Powerhouse Area
16	Khairo Gaunthali	Common Swift	*Apus apus*	√	-	-
17	Laghu- karna Latkoshero	Short-eared Owl	*Asio flammeus*	-	√	√
18	Lekali Uluk	Mountain Scoops Owl	*Otus spiloccphalus*	√	-	-
19	Hapsilo	Eurasian Eagle Owl	*Bubo bubo*	-	√	√
20	Kochal-gande Latkoshero	Spotted Owlet	*Athene brama*	-	√	√
21	Malewa	Rock Pigeon	*Columba livia*	√	√	√
22	Himali Malewa	Snow Pigeon	*Columba leuconota*	√	-	-
23	Tame Dhukur	Oriental Turtle Dove	*Streptopelia orientalis*	√	√	√
24	Kurle Dhukur	Spotted Dove	*Streptopelia chinensis*	√	√	√
25	Thulo Chaha	Eurasian Woodcock	*Scolopax tusticola*	√	√	√
26	Kalo Chil	Black Kite	*Milvus migrans*	√	√	√
27	Himali Gidda	Himalayan griffon	*Gyps himalayensis*	-	√	-
28	Challachor Bhui-chil	Hen Herrier	*Circus cyaneus*	√	√	-
29.	Suparna Maha-chil	Golden Eagle	*Aquila chrysaetos*	√	-	-
30.	Baudai	Common Kestrol	*Falco tinnunculus*	√	-	-
31.	Shahi Baj	Peregrine Falcon	*Falco peregrinus*	-	√	√
32.	Bhadrai	Laong-tailed Shrike	*Lanius schach*	√	√	√

S.N.	Nepali Name	Common Name	Scientific Name	Reported From		
				Around Headworks Area	Between Headworks and Powerhouse Area	Around Powerhouse Area
33.	Sun-thude Lampuchre	Yellow-billed Blue Magpie	*Urocissa flavirostirs*	√	-	-
34.	Kalo Kag	Large-billed Crow	*Corvus macrorhynchos*	√	√	√
35.	Gajale Sunchai	Eurasian Golden Oriole	*Oriolus oriolus*	√	√	√
36.	Lampuchre ranichari	Long-tailed Minivet	*Pericrocotus ethologus*	√	√	-
37	Kalo Chibe	Black Drongo	*Dicrurus macrocercus*	-	√	√
38	Kalchaude	Blue Whistling Thrush	*Myophonus caeruleus*	√	√	√
39	Dhyanse Arjunak	Dark-sided Flycatcher	*Muscicapa sibrica*	√	√	√
40	Seto Aakhibhau Arjunak	Snowy-browed Flycatcher	*Ficedula hyperythra*	√	√	√
41	Sano Niltava	Samll Niltava	*Niltava magrigoriae*	√	√	√
42	Setotauke Jal-khanjari	White-capped Water Redstart	*Chaimarrornis leucocephalus*	√	√	√
43	Nilambar Jalkhanjari	Plumbeous Water Redstart	*Rhyacornis fuliginosus*	√	√	√
44	Jhek Jhek Jhapsi	Common Stonechat	*Saxicola torquata*	√	√	√
45	Murari Putalichara	Wallcreeper	*Tichodroma muraria*	√	√	√
46	Hariyo Chichilkote	Green-blacked Tit	*Parus monticolus*	√	√	√
47.	Pandu Chichilkote	Black-lored Tit	*Parus xanthogenys*	√	√	√
48.	Kalikanthe	Black-throated Tit	*Aegithalos*	-	√	√

S.N.	Nepali Name	Common Name	Scientific Name	Reported From		
				Around Headworks Area	Between Headworks and Powerhouse Area	Around Powerhouse Area
	Chichilkote		*concinnus*			
49.	Ghar Gaunthali	Barn Swallow	*Hirundo rustica*	√	√	√
50.	Dharke Jureli	Striated Bulbul	*Pycnonotus striatus*	-	√	√
51.	Julfe Jureli	Himalayan Bulbul	*Pycnonotus leucogenys*	√	√	√
52.	Kailopete Jureli	Mountain Bulbul	*Pycnonotus mcclellandii*	-	√	√
53.	Bakhre Jureli	Black Bulbul	*Hypsipetes leucocephalus*	√	√	√
54.	Ratotauke Jhadifisto	Grey-sided Bush Warbler	*Cettia brunnifrons*	√	√	√
55.	Godhuli Fisto	Dusky Warbler	*Phylloscopus fuscatus*	-	√	√
56.	Tumulkari Fisto	Grey-hooded Warbler	*Seicercus xanthoschistos*	√	√	√
57.	Tikiuri Toriganda	Variegated Laughingthrush	*Garrulax variegates*	√	√	-
58.	Kali-kanthe Bunge Chara	Black-throated Sunbird	*Aethopyga saturate*	-	√	√
59.	Ghar Bhangera	House sparrow	*Passer domesticus*	√	√	√
60.	Rukh bhangera	Tree sparrow	*Passer montanus*	√	√	√
61.	Pahelo Tiktike	Yellow Wagtail	*Motacilla flava*	-	√	√
62.	Rukh Chuinya	Olive-blacked Pipit	*Anthus hodgsoni*	√	√	√

Source: EIA Field Survey, 2011

Status of Avifauna

A total of sixty-two species of avifauna were recorded from the project area. Of which, nine species are listed on CITES Appendix **(Table 2.16).** No species listed on IUCN Red list and Protected under NPWC ACT was found.

Table 4.16: Status of Avifauna Recorded in Project Sites

S. No.	Local Name	Common Name	Scientific Name	CITES Appendix	IUCN Red List	Protected Under NPWC Act, 1973
1.	Madana Suga	Alexandrine Parakeet	*Psittacula himalayana*	II	-	-
2.	Laghu- karna Latkoshero	Short-eared Owl	*Asio flammeus*	II	-	-
3.	Lekali Uluk	Mountain Scoops Owl	*Otus spilocephalus*	II	-	-
4.	Hapsilo	Eurasian Eagle Owl	*Bubo bubo*	II	-	-
5.	Kalo Chil	Black Kite	*Milvus migrans*	II	-	-
6.	Himali Gidda	Himalayan griffon	*Gyps himalayensis*	II	-	-
7.	Challachor Bhui-chil	Hen Herrier	*Circus cyaneus*	II	-	-
8.	Suparna Maha-chil	Golden Eagle	*Aquila chrysaetos*	II	-	-
9	Baudai	Common Kestrol	*Falco tinnunculus*	II	-	-
10	Shahi Baj	Peregrine Falcon	*Falco peregrinus*	I	-	-

Source: www.iucnnepal.org.com; CITES, 2003; Nepal Biodiversity Strategy, 2002.

4.2.2.3 Herpeto-fauna

The list of herpeto-fauna reported in the project region is presented in **Table 4.17**. It consists of frog, toad, snakes, skink and lizards. Some frogs are poisonous and are neglected while the others have special food and medicinal value. According to local people, *Amolops formosus, Paa liebigii, Chaparana sikimensis, Megophrys parva* and *Bufo stomaticus* have special food and medicinal value. Pest of bone is used in fracture; flesh is used in diarrhoea, fever, secretion of milk in pregnant woman. These frogs are occasionally harvested for food and medicinal purpose but only in small quantity but not for economic purpose. According to local people, snake is considered harmful while lizards are useless.

Table 4.17: Herpetofauna Recorded in Project Sites (Participatory Information from Local People)

S.N.	Nepali Name	Common Names	Scientific Names	Status of occurrence			Habitat					Migratory Status/ season		Reported location
				Common	Sparse	Rare	F	B	O	A	Wa	M/R/V	S	
1	Khasre Bhaguto	Himalayan Toad	*Bufo himalayanus*	√			√		√			R		Settlement
2	Khasre Bhaguto	Black-spined Toad	*Bufo melanostictus*	√			√		√			R		Settlement
3	Khasre Bhaguto	Marbled Toad	*Bufo stomaticus*	√						√		R		Cultivated area
4	Dyang Paha	Myanmar Pelobatid Toad	*Megophrys parva*	√			√				√	R		Forest
5	Hariyo Paha	Beautiful Stream Frog	*Amolops formosus*		√						√	R		Forest
6	Rato Paha	Sikkimese Frog	*Chaparana sikimensis*	√			√				√	R		Forest
7	Tik-tike Paha	Skittering Frog	*Euphlyctis cyanophlyctis*	√					√		√	R		Open land
8	Sirke Paha	Indian bull frog	*Haplobatrachus tigerinus*	√						√		R		Agricultural land
9	Man Paha	Liebig's Frog	*Paa liebigii*	√							√	R		Water body
10	Cheparo	Common Garden Lizard	*Calotes versicolor*	√					√			R		Oend land
11	Pathar Chatuwa	Himalayan Rock Lizard	*Laudakia tuberculata*	√					√		√	R		Near Water
12	Hariyo Cheparo	Three-keeled mountain	*Oriotiaris tricarinatus*	√			√					R		Around fern plant
13	Mausuli	Saffron-billed wall gecko	*Hemidactylus flaviviridis*	√										House

S.N.	Nepali Name	Common Names	Scientific Names	Status of occurrence			Habitat					Migratory Status/ season		Reported location
				Common	Sparse	Rare	F	B	O	A	Wa	M/R/V	S	
14	Bhanumungre	Sikkim Skink	*Asymblepharus sikimmensis*	√			√		√			R		Open land
15	Bhanumungre	Brahminy Skink	*Mabuya carinata*	√			√		√			R		Open land
16	Lal Dhusur	Eastern Red sand boa	*Eryx johnii*			√	√			√		R		Forest
17	Chankhe Sarpa	Mountain Keelback	*Amphiesma platyceps*		√			√	√			R		Forest
18	Bayana	Himalayan trinket snake	*Elaphe hodgsonii*		√		√			√		R		Forest
19	Aandho Sarpa	Mountain Pit Viper	*Ovophis monticola*		√			√	√			R		Forest
20	Haryau Sarpa	White-lipped Pit Viper	*Trimeresurus albolabris*	√					√	√		R		Forest

Source: EIA Field Survey, 2011
Note:
Habitats = F- forest, B – Bush, O- Open grass land, A – Agricultural land, Wa – Water
Migratory status and season = M – Migratory, R = Resident, V = Visitor occasionally, S – migration season, Su- Summer visitor, Wi – Winter visitor

Table 4.18: Herpetofauna Recorded in Project Sites and Their Economic Value as per Local People

S.No.	Common Names	Scientific Names	Reported From			Economic value
			Around Headworks	Around Powerhouse	Between Headworks	
1	Himalayan Toad	*Bufo himalayanus*	√	-	√	
2	Black-spined	*Bufo melanostictus*	√	√	√	
3	Marbled Toad	*Bufo stomaticus*	√	√	√	Medicinal value,
4	Myanmar Pelobatid	*Megophrys parva*	-	√	√	Edible, Medicinal
5	Beautiful Stream	*Amolops formosus*	√	√	√	Edible, Medicinal
6	Sikkimese Frog	*Chaparana sikimensis*	√	√	√	Edible, Medicinal
7	Skittering Frog	*Euphlyctis cyanophlyctis*	√	√	√	N/A
8	Indian bull frog	*Haplobatrachus tigerinus*	√	√	√	N/A
9	Liebig's Frog	*Paa liebigii*	√	-	√	Edible, Medicinal
10	Common Garden	*Calotes versicolor*	√	√	√	N/A
11	Himalayan Rock	*Laudakia tuberculata*	√	√	√	N/A
12	Three-keeled	*Oriotiaris tricarinatus*	√	√	√	N/A
13	Saffron-billed wall	*Hemidactylus flaviviridis*	-	√	√	N/A
14	Sikkim Skink	*Asymblepharus sikimmensis*	√	√	√	N/A
15	Brahminy Skink	*Mabuya carinata*	-	√	√	N/A
16	Eastern Red sand	*Eryx johnii*	√	-	√	N/A
17	Mountain Keelback	*Amphiesma platyceps*	√	-	√	N/A
18	Himalayan trinket	*Elaphe hodgsonii*	√	-	√	N/A
19	Mountain Pit Viper	*Ovophis monticola*	-	√	√	
20.	White-lipped Pit	*Trimeresurus albolabris*	√	√	√	

Source: EIA Field Survey, 2011

Status of Herpetofauna

A total of twenty species of herpetofauna were recorded from the project area. Of which, one species is listed on CITES Appendix **(Table 4.19).**

Table 4.19: Status of Herpetofauna Recorded in Project Sites

S. No.	Local Name	Common Name	Scientific Name	CITES Appendix	IUCN Red List	Protected Under NPWC Act, 1973
1.	Sirke Paha	Indian bull frog	*Haplobatrachus tigerinus*	II	-	-

Source: www.iucnnepal.org.com; CITES, 2003; Nepal Biodiversity Strategy, 2002.

4.2.2.4 Habitat Condition for Terrestrial Wild Animals

The project area lies outside the Langtang National Park (LNP) within Haku, Dhuche and Ramche VDCs. Thinly scattered vegetation, steep slopes, agricultural fields, settlements made the project area less favourable for wild animals to survive as compared to nearby LNP. Therefore, the core habitats for terrestrial wild animals lie only in LNP. Most of the wild animals occasionally visit the project area especially during crop raising and harvesting seasons.

a. Around Weir and Headworks Area

The headworks area is situated near the confluence of Bhote Koshi and Trishuli river and is far from the settlement area. Additionally, the weir site at left bank is situated within the buffer zone of National Park, which has resulted to the less disturbed condition of wildlife habitat. In the left bank, *Englehardtia spicata, Alnus nepalensis, Schima wallichii, Macaranga pustulata, Toona ciliata* are the dominant tree species along with shrubs and herbs such as *Debregeasia* sp., *Woodfordia fruiticosa*, *Maesa chisia, Eupatorium adenophorum, Achyranthus bidentata* and thickets of *Arundinaria* sp.

In the right bank, the key tree species are *Alnus nepalensis, Pinus roxburghii* whereas the common shrub and herb species are *Coriaria nepalensis*, *Rubus* sp., *Eupatorium adenophorum, Achyranthus bidentata, etc.* This area is less accessible due to rocky terrain and steep topography. Furthermore, the thinly scattered vegetation made this area less favourable for terrestrial wild animals.

The wild mammals such as *Hystrix indica, Ursus thibetanus, Martes flavigula, Semnopithecus hector, Macaca mulatta, Sus scrofa, Muntiacus muntjak, etc.* and avifauna like *Otus spilocephalus, Milvus migrans, Circus cyaneus, etc.* frequently visit the area for feeding and resting purpose. Furthermore, mammals such as *Felis chaus, Panthera paradus, Canis aureus, Macaca assamensis* and avifauna *Psittacula himalayana, Aquila chrysaetos, Falco tinnunculus* occasionally visit the area.

Similarly, herpetofauna such as *Bufo stomaticus, Chaparana sikimensis, Haplobatrachus tigerinus, Paa liebigii* frequently seen and *Eryx johnii, Amolops formosus* occasionally seen around water body and moist area.

b. Camp Area I and Spoil Disposal Area I

Pinus roxburghi, Schima wallichi, Macaranga pustulata are commonly found tree species nearby Camp Area I and Spoil disposal Area I. Besides these, agricultural land and settlements are located within the vicinity of these areas. Due to presence of settlements, agricultural land and usual intervention of human, the area seems to be unfavourable ground for wildlife species. However, the burrows of *Hystrix indica* and *Canis aureus* were observed nearby campsites.

Canis aureus occasionally visit the area where as *Macaca mulatta, Semnopithecus hector* frequently visit during crop raising and harvesting periods. Avifauna such as *Milvus migrans, Falco tinnunculus* and herpetofauna namely *Bufo stomaticus, Megophrys parva* are reported in this site.

c. Adit I and Nearby Access Road

These area are situated in close proximity to settlements and represents tree species such as *Pinus roxburghii, Schima wallichii, Mallotus philippinensis, Syzyzium* sp., *Wendlandia* sp., *Englehardtia spicata, Boehmeria rugulosa , Myrica esculenta, etc.* The common shrub and herb species are *Rubus ellipticus, Cythula tomentosa, Berberis asiatica, Coriaria nepalensis, Colebrokia oppositifolia, Eupatorium adenophorum, Thysanolaena maxima, Artemisia indica, Urtica dioca, etc.*

Due to presence of settlements, agricultural land and usual intervention of human, the area also seems to be unfavourable ground for wildlife species. However, the wild mammals such as *Hystrix indica, Felis chaus Canis aureus, Martes flavigula, Semnopithecus hector, Macaca mulatta, Sus scrofa;* avifauna like *Asio flammeus, Circus cyaneus* visit the area for feeding and resting purpose. Similarly, herpetofauna namely *Bufo stomaticus, Megophrys parva, Chaparana sikimensis* are commonly seen around the moist places of the area.

Canis aureus occasionally visit the area where as *Macaca mulatta, Semnopithecus hector* frequently visit during crop raising and harvesting season. In other season, most of them move to the buffer zone of LNP at left bank of Trishuli. According to local people, monkeys cross the river through suspension bridge at Hakubesi or through narrow gorge located downstream of Hakubesi suspension bridge for their movement.

d. Access Road from Ghatte Khola to Buchet Phant

The forest stretch is sparse with varying composition of tree species. *Wendlandia* sp. *Pinus roxburghii, Alnus nepalensis, Ficus cunia, Boehmeria rugulosa, Bauhinia variegate* along with the herbs and shrubs such as *Colebrokia oppositifolia, Rubus ellipticus, Eupatorium adenophorum, Artemisia* sp.

The wild mammals such as *Hystrix indica, Martes flavigula, Semnopithecus hector, Macaca mulatta;* avifauna such as *Asio flammeus, Milvus migrans, Circus cyaneus;* and herpetofauna *Megophrys parva, Amolops formosus, Chaparana sikimensis* are occasionally seen in this site.

e. Access Road from Buchet Phant to Adit 3

This area is represented by rocky barren terrain almost devoid of tree vegetation. Tree species *Schima wallichii, Pinus roxburghii;* herb and shrub species *Inula cappa*, *Rubus ellipticus, Eupatorium adenophorum* form the vegetation composition.

The wild mammals such as *Naemorhedus goral, Canis aureus, Martes flavigula, Macaca mulatta;* avifauna like *Asio flammeus, Milvus migrans, Circus cyaneus* are occasionally seen and are less in number in the area. Due to rocky barren terrain, animals use this area occasionally for movement and resting. At the moist area near the bank of Trishuli River, herpetofauna such as; *Megophrys parva, Chaparana sikimensiss, Calotes versicolor, Laudakia tuberculata* were reported.

f. Access Road from Adit 3 to Adit 4 and Adit 4 Area

The vegetation composition of this area includes, tree species *Shorea robusta, Englehardtia spicata, Toona ciliate, Pinus roxburghii, Wendlandia* sp. and herb and shrub species *Desmodium* sp. *Colebrokia oppositifolia, Phyllanthus* sp. *Cheilanthus* sp. *Eupatorium adenophorum Carex* sp. etc.

The wild mammals such as *Hystrix indica, Felis chaus, Panthera paradus, Canis aureus, Martes flavigula, Sphaerias blanfordi, Semnopithecus hector, Macaca mulatta, Sus scrofa, Muntiacus muntjak, Naemorhedus goral* are reported in the area. These species also use this area for feeding and resting purposes.

The avifauna *Lophura leucomelanos, Psittacula himalayana, Asio flammeus, Bubo bubo, Scolopax tusticola, Milvus migrans, Gyps himalayensis, Circus cyaneus, Falco peregrinus* etc. are frequently seen in the area. Many of these species use this area for food or shelter purpose whereas *Lophura leucomelanos* use this area for nesting purpose.

Herpetofauna species are seen around water body, moist area around tree and among fern plants. The commonly seen herpetofauna includes *Bufo stomaticus, Megophrys parva, Amolops formosus, Chaparana sikimensis, Haplobatrachus tigerinus,* etc.

g. Access Road to Surge Shaft, Switchyard, Adit portal to Surge shaft, Air Vent Tunnel and Powerhouse Area

At this area, tree species *Shorea robusta, Boehmeria rugulosa, Terminalia alata*; herb and shrub species *Inula* sp., *Murrya* sp., *Eupatorium adenophorum, Bidens pilossa* basically form the vegetation composition.

The mammalian species include *Hystrix indica, Felis chaus, Panthera paradus, Canis aureus, Lutra lutra, Martes flavigula, Sphaerias blanfordi, Macaca mulatta, Semnopithecus hector, Naemorhedus goral;* avifauna include *Gallus gallus, Lophura leucomelanos, Psittacula himalayana, Asio flammeus, Bubo bubo, Scolopax tusticola, Milvus migrans, Falco peregrinus* etc. and herpetofauna includes *Bufo stomaticus, Megophrys parva, Amolops formosus, Chaparana sikimensis, Haplobatrachus tigerinus, Paa liebigii, Eryx johnii.*

Due to settlements, human intervention, agricultural land, wild life habitats seem to be disturbed. Most of the animal species use this area during their movement. *Macaca*

mulatta, Semnopithecus hector, Psittacula himalayana etc. frequently visit the area during crop raising and harvesting period. These are pest animals, which damage the crops.

4.2.2.5 Fish Species

1. Sampling Sites

To unravel the baseline status of aquatic fauna, survey was conducted in five sampling sites along the Trishuli and Bhote Koshi. Each sampling station (site) extends to a length of about 275 to 300m river stretch, covering the potentially impacted section of the River **(Table 4.20).**

Table 4.20: Description of Sampling Stations of Upper Trishuli-I Hydroelectric Project Affected Sites

S. No.	Station Nos.	Sites	District	VDC	Length of sampling station	River Bank
1	I	At Bhote Koshi; upstream of the confluence between Bhote Koshi and Trishuli Rivers	Rasuwa	Gatlang and Syaphru	300m	Left
2	II	At Trishuli; upstream of the confluence between Bhote Koshi and Trishuli River	Rasuwa	Syaphru and Dhunche	300m	Both Left and Right
3	III	Upstream of weir or at confluence between Trishuli and Bhote Koshi River	Rasuwa	Haku and Dhunche	275m	Left
4	IV	Downstream of weir and upstream of Powerhouse area	Rasuwa	Haku and Dhunche	300m	Left
5	V	Downstream of Powerhouse area	Rasuwa	Ramche and Haku	300m	Left and Right

Source: EIA Field Survey, 2011

2. Habitat Conditions and Sampling Sites

Trishuli is a fast flowing river. The water current of the river is very strong and turbulent declining from upstream to downstream. Trishuli River and its tributaries in the project site are favourable for different species of fish. This section of the river offers plenty of insects, prey, mollusks, phytoplankton, zooplanktons, etc. The river is blue green in colour. Its bed is clean and is composed of pebbles, cobbles and boulders. Healthy growth of algae, aquatic insects, markings of grazing algae by fish on rock indicates the productive ecological habitat. Between the boulders, probable spawning and rearing grounds for fishes were seen. The water temperature at the end of winter season is recorded as 10^0C.



Figure 4-31: Plankton Sampling at Weir Site

The Trishuli River upstream and downstream (up to Gogane) of proposed weir site are the pristine natural habitat for aquatic life. Around the proposed powerhouse area is the degraded aquatic habitat due to human interference in various ways such as extracting river boulders, release of various agrochemicals, excessive harvesting of fishes etc. Despite human interference activities, the river maintains good habitat for the aquatic fauna.



Figure 4-32: Bamboo Basket (Dhadiya)- Fishing Gear



Figure 4-33: Cast Net -Fishing Gear

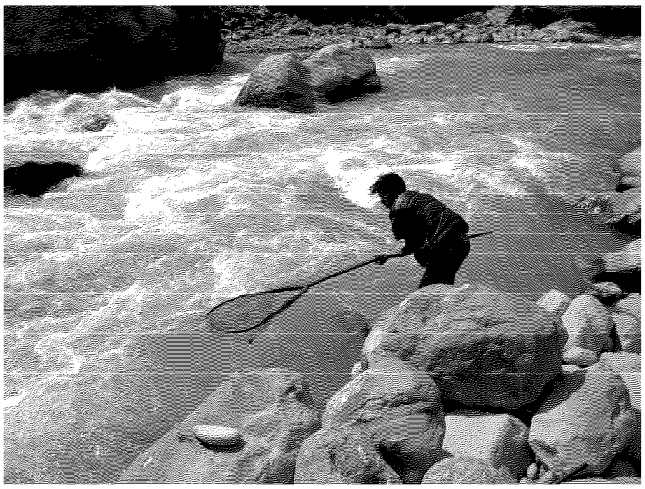


Figure 4-34: Ghorlang- Fishing Gear

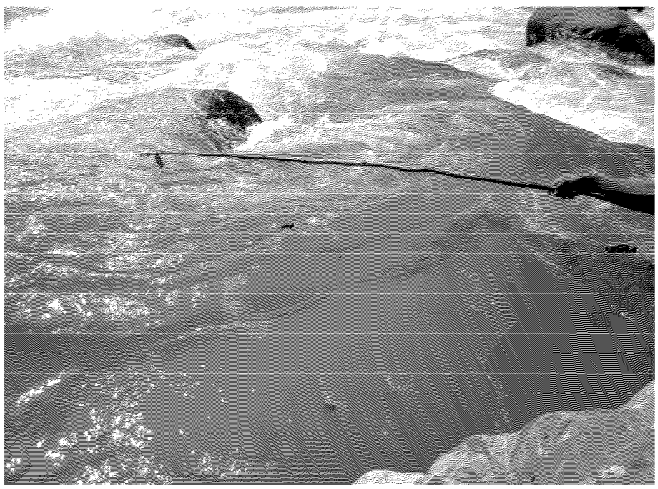


Figure 4-35:Gill Net (Mahajal)- Fishing Gear

Table 4.21: Aquatic Habitat Characterization of Trishuli River in the Directly Project Affected Area

Station No	Name of Sampling site	Habitat Characterization (Estimated)	Major spawning area	Rearing Ground
I	At Bhote Koshi; upstream of the confluence between Bhote Koshi and Trishuli River	Run type of water Rapid flow (80 %) Run (10 %) Deep and shallow pools (5 %) Riffle (5 %)	Five large spawning areas were observed.	Three rearing ground were observed along the bank of rivers.
II	At Trishuli; upstream of the confluence between Bhote Koshi and Trishuli River	Run type of water Rapid flow (80 %) Run (10 %) Deep and shallow pools (5%) Riffle (5 %)	Single spawning area was observed	One rearing ground 100m above the confluence point was observed
III	Upstream of Weir or at confluence between Trishuli and Bhote Koshi	Run type of water Rapid (70 %) Run (15 %) Deep and shallow pools (10%) Riffle (5 %)	Four spawning areas of medium size were observed	Two rearing ground under the big boulder of river bank
IV	Downstream of Weir and upstream of Powerhouse area	Run type of water Rapid flow (65 %) Run (15 %) Deep and shallow pools (15%) Riffle (5 %)	Five small and two large spawning areas were observed	Four major rearing grounds were observed.
V	Downstream of Powerhouse area	Run type of water Rapid (75 %) Run (10 %) Deep and shallow pools (10%) Riffle (5 %)	No remarkable spawning grounds were observed	One rearing ground was observed.

Source: EIA Field Survey October, 2011

3. Fish Species

The present survey, conducted at the end of winter season, sampled only two fish species i.e. *Schizothorax richardsonii* (Buchhe Asala) and *Schizothoraichthys progastus* (Chuchche Asala). Interactions with the local communities, fisherman and observation of dried specimen revealed the presence of additional two fish species from the project area; namely *Pseudecheneis sulcatus* (Kabre)* and *Noemacheilus botia*. In total, four fish species have been reported from the project area. Fish diversity in the Trishuli River is reported to vary with season. **Table 4.22** present observed and reported fish species from different sampling stations at the end of winter season only and reflects the diversity of that season only. However, repeated sampling in different season is envisaged to unravel the fish diversity of the Trishuli River in totality.

Table 4.22: Fish Species Observed and Recorded in Sampling Stations

S. No.	Scientific Name	Nepali	Station I		Station II		Station III		Station IV		Station V	
			Obs. Sp.	**Rep. Sp.**	**Obs. Sp.**	**Rep. Sp.**	**Obs. Sp.**	**Rep. Sp.**	**Obs. Sp.**	**Rep. Sp.**	**Obs. Sp.**	**Rep. Sp.**
1	*Schizothorax richardsonii*	Buchche Asala	+	+	+	+	+	+	+	+	+	+
2	*Schizothoraichthys progastus*	Chhuche Asala	+	+	+	+	+	+	+	+	+	+
3	*Pseudecheneis sulcatus**	Kabre	-	-	-	-	-	-	+	+	-	+
4	*Noemacheilus botia*	Gadela	-	-	-	-	-	-	-	+	-	+
Number of Species			2	2	2	2	2	2	3	4	2	4

*Note: Obs. Sp. = Observed Species and Rep. Sp. = Reported Species, * Dry specimen is collected*
Source: EIA Field Survey, 2011

Table 4.23: Number of Fish Species Recorded and Observed in the Sampling Stations

Station No.	**Station**	**Unit**	**Field Visit**	
			Total Observed	**Total Recorded**
I	At Bhote Koshi; upstream of the confluence between Bhote Koshi and Trishuli River	No.	2	2
II	At Trishuli; upstream of the confluence between Bhote Koshi and Trishuli Rivers	No.	2	4
III	Upstream of Weir or at confluence between Trishuli and Bhote Koshi Rivers	No.	2	4
IV	Downstream of Weir and upstream of Powerhouse area	No.	3	4
V	Downstream of Powerhouse area	No.	2	4

Source: EIA Field Survey, 2011

4. Key Fish Species of the Project Area

a. Snow Trout - ***Schizothorax richardsonii*** (Blunt–nosed Asala) and ***Schizothoraichthys progastus*** (Pointed nose-Asala)

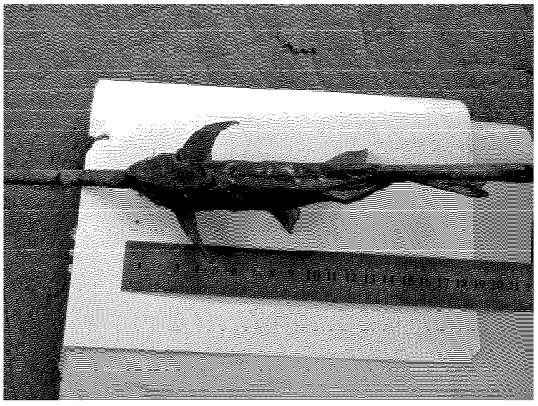


Figure 4-36: Dry specimen of Kabre (Pseudecheneis sulcatus), Dorsal view

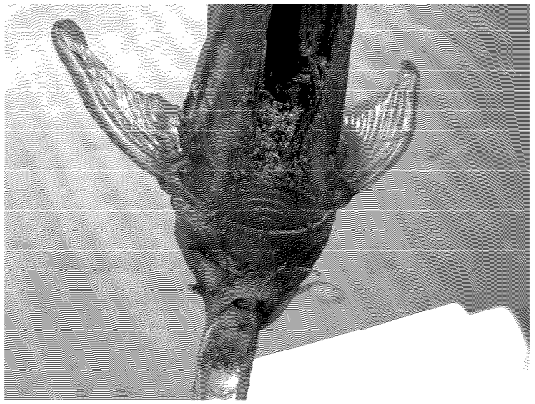


Figure 4-37: Dry specimen of Kabre (Pseudecheneis sulcatus), Ventral view

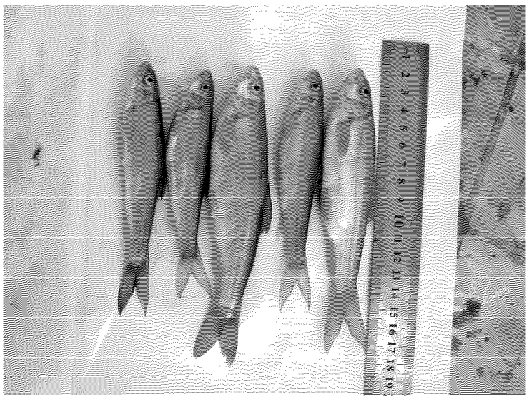


Figure 4-38: Snow Trout in Collection

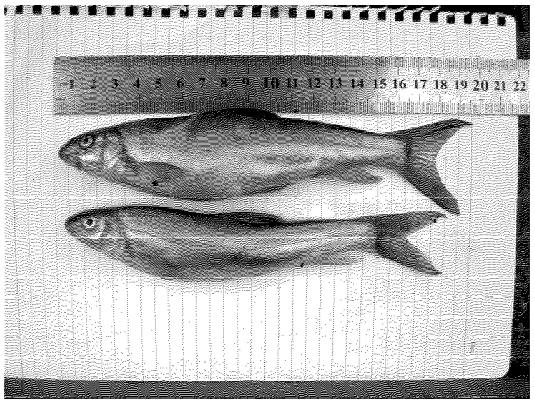


Figure 4-39: Snow Trout -Schizothorax richardsonii above and Schizothoraichthys progastus below

i) Description

Snow trout is a common and dominant fish in the Project area. They are commonly known as Asala. It is good sport fish as well as delicious to eat. They prefer to live in clear and fast flowing rivers within the temperature range of 8 to 22^0. Altitude ranges from 300-1440 m. They have slender, elongated and strong body covered with minute silvery scales. ***Schizothorax richardsonii*** and *Schizothoraichthys progastus* can easily be separated from their snout. *S. richardsonii* have blunt snout and *S. progastus* have pointed snout. These species prefers rapids, pools and riffle types of habitat.

ii) Feeding Habit

Asala is a phytophagous fish, with its mouth adapted to scraping attached algae from the surfaces of stones. It feeds on attached algae including *Spirogyra, Ulothrix, Oedogonium,* as well as on the benthic insect larvae of mayflies, caddis flies, ephemeropterans, etc. Fry feed on larvae of chironomids and caddis flies, but also on microscopic algae.

iii) *Spawning*

Asala spawns when two years old, depending on food supply. Mature Asala has a change in colour during the breeding time. Mature males develop tubercles on either side of the snout, faint yellow colour of the body, and reddish colour of fins. Females spawn in natural as well as in artificial environments. Asala can spawn naturally or by stripping the wild/cultured mature female during the spawning season. It spawns in September/October and March/April.

Sexually mature Asala spawn naturally when they reach 18-24 cm length. They attach eggs to the substrate. Fry stay on sand and gravel bottom. Asala spawn naturally in clear water on gravelly/stony grounds or on fine pebbles at 1-3 m depth (www.fao.org). Water current of 2.8-4 m/sec, pH 7.5, dissolved oxygen concentrations of 10-15 mg/L, and gravel size of 50-80 mm are the optimal conditions for spawning (www.fao.org).

iv) *Migration*

Snow trout is a mid-distance migratory fish, which enters tributaries for breeding. The presence of weir blocks its migrations. It migrates downstream during winter and upstream during early June when water becomes turbid. The migration pattern also depends on the volume of water in rivers and on water temperature and turbidity.

v) *Potential*

Asala is considered as an economically important high value fish. Artificial culture of Asala needs proper supply of food in right composition and this is a major task for research. The required habitat for Asala is present in the area so, potentiality of artificial culture seems on the project area but it requires good research and huge amount of financial budget.

Two species of Asala have been studied at the Fisheries Research Centre, Trishuli since 1971. Culturing of these species is still not fully developed due to the problem of developing appropriate feed.

5. Species Composition and Diversity

A total of 39 fishes of two species *Schizothorax richardsonii* (Buchche Asala) and *Schizothoraichthys progastus* (Chuchche Asala) were collected from the sampling stations of Trishuli River. Interactions with the local communities and fisherman of the area revealed the presence of additional two species from the project area; namely *Pseudecheneis sulcatus (*Kabre) and *Noemacheilus botia* (Gadela). In total, four fish species have been reported from the project area. Fish diversity in the Trishuli River is reported to vary with season. ***Table (4.24).*** *Schizothorax richardsonii* (Buchche Asala) is the dominant fish species in the area.

Table 4.24: Species Composition and Diversity Observed During Field Visit

S.N.	Scientific Name	Local name	Field visit	
			No. of fish caught by hired Fishermen used Cast net	
			Number of fish caught	No. of fish caught %
1	*Schizothorax richardsonii*	Buchche Asala	23	58.97
2.	*Schizothoraichthys progastus*	Chuchche Asala	16	41.03

Source: EIA Field Survey, 2011

6. Fish Abundance Trend in the Study Area

The abundance status of different fish species in the study area throughout the year is not clearly known. According to local fisherman, the maximum diversity in the fish in the river stretch occurs in the monsoon month, with almost all species reported to be present in the river. The fish diversity declines in autumn through summer, however, the catch weight increases in this period. The change is the river environment, probably reflects the decline in number.

The sampling result of 2011 show that percentage of fish caught is not identical throughout the river stretch. Stations III and IV, i.e. above and below weir areas recorded highest percentage of fish catch i.e. 30.77% (by number). The less fishing activity due to steep slopes at river bank, low human population at the area, low intervention with aquatic life, good aquatic habitat, etc. are the likely reason of recording higher fish number in these areas. The consultation with local fisherman also revealed that stations III and IV to have higher fish species even during other seasons of the year.

Table 4.25: Percentage Abundance at Sampling Stations (Caught by cast net)

Station	Sites	Number of Fish Caught	Total Weight of Fish Caught (gm.)	Number of Species	Catch%	Percentage of fish caught by Weight
I	At Bhote Koshi; above confluence between Bhote Koshi and Trishuli	7	215	2	17.95	15.41
II	At Trishuli; above confluence between Bhote Koshi and Trishuli	1	60	2	2.56	4.30
III	Above weir or at confluence between Trishuli and Bhote Koshi	12	325	1	30.77	23.30
IV	Below weir and above Powerhouse area	12	420	2	30.77	30.11
V	Below Powerhouse area	7	375	2	17.95	26.88
Total		39	1395		100.00	100.00

Source: EIA Field Survey, 2011

7. Catch per Unit Effort (CPUE)

A total of 39 fishes were caught at 5 sampling stations of the project area. The catch per unit effort for stations no II and IV, are the highest i.e.1:0.06 followed by station V,I and II respectively ***(Table 4.26).***

Table 4.26: Catch per Unit Effort (CPUE) at Different Sampling Stations

Station No.	Sites	Level of Effort	No. of Fish caught	Catch per unit effort (CPUE)	Attempt Catch Ratio
I	At Bhote Koshi; above confluence between Bhote Koshi and Trishuli	200	7	0.035	1:0.035
II	At Trishuli; above confluence between Bhote Koshi and Trishuli	200	1	0.005	1:0.005
III	Above weir or at confluence between Trishuli and Bhote Koshi	200	12	0.060	1:0.060
IV	Below weir and above Powerhouse area	200	12	0.060	1:0.060
V	Below Powerhouse area	200	7	0.035	1:0.035
Total		1000	39	.039	1:0.039

Source: EIA Field Survey, 2011

8. Fish Length and Weight in the Study Area

In general, longer the length higher is the weight of the fish caught in the area. **Table 4.27** presents the average length and weight of the fish species in the different sampling station of the project area. Average length and weight of *Schizothorax richardsonii* is highest in station II followed by station V, I, IV and III respectively. Similarly, *a*verage length and weight of *Schizothoraichthys progastus* is highest in station V, followed by station IV, I and III respectively. The average length and weight of fishes in the month of March is found to be 15.36 cm and 37.82 gm. respectively.

Table 4.27: Average Fish Length and Weight in the Study Area

Station No.	Scientific Name	Nepali Name	Total						
			Grand No. of fish caught	Grand Total Wt. (gm.)	Length		Weight		No. of fish caught %
					Range cm	AV Length cm	Range gm.	AV wt. gm.	
I	*Schizothorax richardsonii*	Buchche Asala	3	110	14.1-16	15.43	30-40	36.67	7.69
	Schizothoraichthys progastus	Chuchche Asala	4	105	12.1-15.4	13.53	20-35	26.25	10.26
II	*Schizothorax richardsonii*	Buchche Asala	1	60	19.8	19.8	60	60	2.56
III	*Schizothorax richardsonii*	Buchche Asala	7	205	4.8-22.4	11.8	10-80	29.29	17.95
	Schizothoraichthys progastus	Chuchche Asala	5	120	5.0-16.6	12.14	10-40	24	12.82
IV	*Schizothorax richardsonii*	Buchche Asala	8	265	10.5-19.1	14.83	15-55	33.13	20.51
	Schizothoraichthys progastus	Chuchche Asala	4	155	13.1-17.80	16.15	25-45	38.75	10.26
V	*Schizothorax richardsonii*	Buchche Asala	4	245	10.8-20.5	17.5	20-65	49.0	10.26
	Schizothoraichthys progastus	Chuchche Asala	3	130	15.5-18.1	17.07	35-50	43.33	7.69
Total			**39**	**1395**	**4.8-22.4**	**15.36**	**10-80**	**37.82**	**100.00**

Source: EIA Field Survey, 2011

9. Fish Migration and Migratory Pattern

Fishes undertake upstream and downstream migration for spawning, feeding and for searching suitalble habitat. Some fish species of migratory nature were observed on the basis of interactions with the local fishermen, direct observation and relevant literatures. Among four fish species, two species were found as medium distance migratory species and the rest were residence species. Medium distance migratory fish species were Schizothorax richardsonii and Schizothoraichthys progastus. Resident species observed were Pseudecheneis sulcatus and Noemacheilus botia. Table 4.28 and 4.29 represents the migration period and upstream and downstream migration for the medium distance migratory fish species.

Table 4.28: Migratory Pattern of Fish Species

SN	Scientific Name	Local Name	Migratory species
1.	*Schizothorax richardsonii*	Buchche Asala	MM
2.	*Schizothoraichthys progastus*	Chuchche Asala	MM
3.	*Pseudecheneis sulcatus*	Kabre	R
4.	*Noemacheilus botia*	Gadela	R

Source: EIA Field Survey, 2011
(Note: MM - Mid Distance Migratory Fish Species, R - Resident Fish Species)

Table 4.29:Migration Pathways of Migratory Fish Species in Different Seasons

Fish species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Schizothoraichthys progastus			↑	↑	↑				↓	↓	↓	
Schizothorax richardsonii			↑	↑	↑				↓	↓	↓	

Source: EIA Field Survey, 2011 and www.fao.org.
(Note: ↑ upstream migration, ↓ downstream migration)

10. Vulnerable, Endangered, Rare and Endemic Fish Species

None of the fish species listed for the project area belongs to the category of IUCN and CITES lists of endangered fish species. Biodiversity Profile Project (1995, HMG and Government of Netherland) studied all scattered accounts of fish species recorded from Nepal including their conservation and distribution status and prepared a status account of fish species of Nepal. Out of 186 listed species recorded in Nepal, the report categorise 90 species as commonly/occasional recorded, 62 species insufficiently known and 34 as threatened species (Vulnerable 9, endangered 1 and rare 24).

Though the riverine fishes of Nepal are categorised into various conservation categories by individual researchers, there is no general consensus among the researchers in Nepal. **Table 4.30** listing of the fishes found in the area into different conservation status is based on the Jeevan Shrestha's work for Biodiversity Profile Project (1995, HMG and Government of Netherland).

Out of four species recorded from the project area, as per Jeevan Shrestha's lists, two species *Schizothorax richardsonii and Schizothoraichthys progastus* are vulnerable while *Pseudecheneis sulcatus* and *Noemacheilus botia* are occasional and common species.
No endemic fish species is recorded in the project area.

Table 4.30: Conservation Status of the Fish Species of Project Area

S. No.	Scientific Name	Nepali Name	Status in terms of conservation
1.	*Schizothorax richardsonii*	Buchche Asala	V
2.	*Schizothoraichthys progastus*	Chuchche Asala	V
3.	*Pseudecheneis sulcatus*	Kabre	O
4.	*Noemacheilus botia*	Gadela	C

Source: Jeevan Shrestha, 1995

11. Fish Habitat Preferences and Feeding

The fish species found in the project area have differential habitat and feeding preferences. **Table 4.31** presents the habitat and feeding preferences of fish species found in the project area.

Table 4.31: Fish Habitat Preference and Feeding

SN	Scientific Name of Fish	Fish Feed preferences	Fish Habitat Preference
1.	*Schizothorax richardsonii*	Mostly green Algae, Fish Fry, Crustaceans fingerlings, tadpole, etc.	Rapids, pools and riffle
2.	*Schizothoraichthys progastus*	Fish Fry, Crustaceans fingerlings, tadpole, etc.	Rapids, pools and riffle
3.	*Pseudecheneis sulcatus*	Aquatic insects and Zooplanktons	Mostly Rapid
4.	*Noemacheilus botia*	Aquatic insect, algae, fish fry	Run and rapid

Source: Jeevan Shrestha, 1995; T.K. Shrestha, 1995

12. Spawning Ecology

Table 4.32 presents the details of spawning, feeding and other behavioural features of the fish species of the project area.

Table 4.32: Spawning Ecology of the Reported Fish Species of the Project Area

SN	Scientific Name	Spawning Season	Spawning Substrate	Age at Spawning	Behaviour
1.	*Schizothorax richardsonii*	Sept - Oct and March – April	Gravel beds	2 year (size 25-35 cm)	Seen in group during spawning , grazing and creeping
2.	*Schizothoraichthys progastus*	Sept - Oct and March – April	Gravel beds	1 year (size 25-35cm)	Seen in 20-40 fishes during spawning, females are circled by males
3.	*Pseudecheneis sulcatus*	May-June	Gravel, sand and Pebbles	2 year	Live in cohesive mass, exhibit mass migration to falling springs and creeks.
4.	*Noemacheilus botia*	April –May	Gravel beds	1 year	Seen in-group during spawning.

Source: Jeevan Shrestha, 1995; T.K. Shrestha, 1995

13. Fishing Activity and Economic Importance

The households living nearby the Trishuli River in the project area practice fishing but mainly as recreational purpose. About 28 people practice fishing in the river and many of them practice occasionally. The regular or excessive fishing activity is reported in powerhouse area. **(Table 4.33).**

Table 4.33: List of People Practicing Fishing in the Project Area

SN	Name	Address	Family Member				Occupation		Fishing Gear Use	Fish harvest per year in Kg
			Total	Male	Female	Children	Major	Other		
	Sunam Funjo lopche	Haku V.D.C-3	7	3	4	2	Agriculture	-	Hook	60 kg
	Norke Lopche	Haku V.D.C.-3	6	4	2	2	Agriculture	-	Hook and Paaso	60 kg
	Damai Singh Syanbo	Haku V.D.C.-3	9	5	4	3	Agriculture	-	Hook and Paaso	60 kg
	Mingma Syanbo	Haku V.D.C.-3	6	3	3	3	Agriculture	-	Hook and Paaso	50-60 kg
	Lokse Bi.Ka	Haku V.D.C.-3	5	3	2	3	Agriculture	-	Hook and Paaso	40 kg
	Subisingh Lopche	Haku V.D.C.-3	6	3	3	4	Agriculture	-	Hook and Paaso	30 kg
	Marlang Dimdung	Haku V.D.C.-3	6	3	3	4	Agriculture	-	Hook and Paaso	30 kg
	Harpa Lopche	Haku V.D.C.-3	6	2	4	2	Agriculture	-	Hook and Paaso	10-15 kg
	Fai siring Tamang Waiba	Haku V.D.C.-3	7	3	4	2	Agriculture	-	Hook and Paaso	12-13 kg
	Bum Bahadur Tamang	Haku V.D.C-7	8	4	4	2	Agriculture	President of Dharan Bhumidevi Krisi Sahakari Sastha	Tihari,net,Hook,Dhadiya	30-40 kg
	Kami Tamang	Haku V.D.C-7	10	2	8	5	Agriculture	-	Tihari,net,Hook,Dhadiya	50-60 kg
	Dharma Singh Tamang	Haku V.D.C-7	17	7	10	7	Agriculture	-	Tihari,net,Hook,Dhadiya	100-200 kg
	Man	Haku	7	2	5	3	Agriculture	-	Tihari,net,Hook,Dhadiya	100-200 kg

SN	Name	Address	Family Member				Occupation		Fishing Gear Use	Fish harvest per year in Kg
			Total	Male	Female	Children	Major	Other		
	Bahadur Tamang	V.D.C-7								
	Mingma Tamang	Haku V.D.C.-7	7	3	4	4	Agriculture	-	Tihari,net,Hook,Dhadiya	10-20
	Som Bahadur Tamang	Haku V.D.C.-9	5	3	2	-	Agriculture	-	Hook,Paaso,Mahajaal,Tihari	20-25 kg
	Pancha Tamang	Haku V.D.C.-9	9	4	5	2	Agriculture	-	Hook,Paaso,Mahajaal,Tihari	20-25 kg
	Dirgha Bahadur Tamang	Haku V.D.C-9	7	3	4	-	Agriculture	-	Hook,Paaso,Mahajaal,Tihari	20-25 kg
	Fairam Tamang	Haku V.D.C-9	11	5	5	3	Agriculture	-	Hook,Paaso,Mahajaal,Tihari	20-25 kg
	Bodh Bahadur Tamang	Haku V.D.C-9	7	4	3	-	Agriculture	-	Hook,Paaso,Mahajaal,Tihari	20-25 kg
	Mane Tamang	Haku V.D.C-9	8	4	4	-	Agriculture	-	Hook,Paaso,Mahajaal,Tihari	20-25 kg
	Hum Bahadur Tamang	Haku V.D.C-9	4	2	2	-	Agriculture	-	Hook,Paaso,Mahajaal,Tihari	20-25 kg
	Subh Bahadur Tamang	Haku V.D.C 9	1	1	-	-	Agriculture	Fishing	Hook,Paaso,Mahajaal,Tihari	20-25 kg
	Mangal Tamang	Haku V.D.C-9	13	6	7	-	Agriculture	-	Hook,Paaso,Mahajaal,Tihari	20-25 kg
	Gyan Singh Tamang	Haku V.D.C-9	3	2	1	-	Agriculture	-	Hook,Paaso,Mahajaal,Tihari	20-25 kg
	Maal	Haku	9	5	3	1	Agriculture	-	Hook,Paaso,Mahajaal,Tihar	20-25 kg

SN	Name	Address	Family Member				Occupation		Fishing Gear Use	Fish harvest per year in Kg
			Total	Male	Female	Children	Major	Other		
	Tamang	V.D.C-9							i	
	Amrit Tamang	Haku V.D.C-9	5	1	4	-	Agriculture	-	Hook,Paaso,Mahajaal,Tihari	20-25 kg
	Ram Bahadur Tamang	Haku V.D.C-9	9	4	5	2	Agriculture	-	Hook,Paaso,Mahajaal,Tihari	20-25 kg
	Kalu Tamang	Haku V.D.C-9	4	2	2	-	Agriculture	-	Hook,Paaso,Mahajaal,Tihari	20-25 kg

Source: EIA Field Survey, 2011

Normally used fishing implements are Big net (Mahajal), Cast net (Hate jal), D-net (Ghorlang), Rod and line, Paso and Khonga. The electro fishing, blasting, Duwali (fishing by blocking the river) and poisoning were not observed the area.

The best period of fishing in the river as reported by the local community is March to June and September to October. In this period, the fish catch and weight is reported to be higher than in the other seasons.

The average catch per day per fisherman is reported to be 1 to 3 kg. The proper fish market is absent in the project area. The fishes caught are mostly consumed by themselves. The excess fishes are preserved by smoking or sun drying for future use or sold in nearby community. People get no significant income from fishing as they only sell their fish catch when it is more than their household requirements. The cost of local fish at the nearby market varies from NRs. 400-450/kg.

Most of the fish species of the Trishuli and its tributaries are of high economic value, which is summarized in **Table 4.34.** All the fish species collected/reported during the field are edible and have considerable food value. These fishes can be grouped under three categories, High food value (H) which are large or moderate size fish with good taste. Medium food value (M) fishes are of medium size with inferior taste in comparison to high food value fish. Low food value (L) fish are generally small sized with inferior taste. The price of the fish varies according to the food value, i.e. higher the food value higher is the price.

Fishes like *Schizothoraichthys progastus* and *Schizothorax richardsonii* have high sport fishery value. Very little is known about the medicinal value of the fishes of Nepal as well as the study area.

Table 4.34: Economic Importance of the Fish of the Project Area

SN	Scientific Name of Fish	Local Name of Fish	Economic Importance
1.	*Schizothorax richardsonii*	Buchche Asala	1,H
2.	*Schizothoraichthys progastus*	Chuchche Asala	1,H
3.	*Pseudecheneis sulcatus*	Kabre	1,M
4.	*Noemacheilus botia*	Gadela	1,L

Note:
1= Food Value: L = Low food value, H = High food value, M = Medium food value
2 = Medicine
3 = Aquarium
Source: Jeevan Shrestha, 1995; T.K. Shrestha, 1995, Field survey, 2011

14. Fishing implements at Project Site

Gill Net: Gill net is locally known as *Mahajaal*. This net is rectangular and tied across the water and is fixed horizontally. Stones and floats made from slipper are used to fix it horizontally. Rod is used to set the gill net in river and is left overnight. Next morning the fishes are collected. More than two fishermen operate the net.

Cast net (diameter 1.45 m, mesh size 1.9 cm). It is rounded in shape and locally known as *Jaal*. The net is operated by one person.

Ghorlang (oval, maximum diameter 60 cm and minimum diameter 38 cm): It is used in fast flowing water even in rainy season. It is operated by one person by holding the handle, dipping the net in water and rapidly lifting it out.

Bamboo traps: A rectangular bamboo trap (*Dhadiya*) (about 48 cm long and 34 cm diameter at mouth) is used for collecting small fish. The trap is left in a stream in a fixed position. Their size varies from place to place. They are used in very fast waters.

Rod and line: The hook for the line is usually made from the metal. The hooks are attached to the line. Bait is small pieces of may fly or stone fly or fish, earthworms, bread or flour or fish fry. A single man may operate several rods at the same time.

Looping: Looping is locally called `paso'. The loop is made up of nylon thread. The size of loop regulates the size of catch. A coloured lead weight functions as bait. Live bait such as fish, shrimp, earthworms, stonefly and may fly larvae are also used in looping. When a fish detects the slowly moving coloured lead, it mistakes it for insect larva, approaches the lead and enters into the loop where it gets stuck by its dorsal and pectoral fins. Fish are looped in the afternoon and evening, when fish up to 6 kg may be captured.

Use of explosive, poisoning and electro-fishing is not observed in the project area.

4.2.2.6 Plankton

Planktons play important role for biological productivity in aquatic environment. It is the major part of food chain in aquatic ecosystem which provide sources of food for fish species, aquatic insects, amphibian, reptiles and others inhabiting in aquatic environment. There are two types of plankton i.e. phytoplankton and zooplankton. Phytoplankton's are of plant origin while zooplanktons are of animal origin. They both are unicellular free floating unit. Different species of phytoplankton's and zooplankton's belongings to different Class were recorded from different sampling sites of Trishuli River which is presented in Table 4.35 and Table 4.36.There are altogether 5 different sites sampled for planktons which is different from fish sampling sites .

Table 4.35: Sampling Sites for the Analysis of Planktons in Trishuli River

S.N	Sites
I	Above power house area
II	Below powerhouse area
III	At confluence between Bhotekoshi and Trishuli
IV	At Bhotekoshi above confluence
V	At Trishuli above confluence

1. Phytoplankton

50 species of phytoplankton's belonging to 4 Class were recorded from 5 different sampling sites of Trishuli River. Among them 17, 3, 22 and 8 species of phytoplankton belongs to Class **Chlorophyceae, Xanthophyceae, Bacillariophyceae** and **Myxophyceae/Cynophyceae**. Similarly, 28, 42, 41, 38 and 37 species of phytoplankton's were recorded from Sampling sites **I, II, III, IV** and **V**.

Table 4.36: Phytoplankton's Recorded at Different Sampling Sites of Trishuli River

S.N.	Species	Sampling Sites				
		V	IV	III	II	I
	A. Class. Chlorophyceae					
	Order. Chlorococcales					
1	Ankistrodesmus falcatus	-	+	+	+	-
2	Pediastrum simplex	-	-	+	+	+
3	Treubaria crassispina	+	+	+	+	-
	Order Ulothrichales					
4	Microspora floccosa	+	+	+	+	+
5	Ulothrix implexa	+	-	+	+	+
6	Ulethrix zonata	+	+	+	+	+
	Order. Chaetophorales					
7	Chaetophora incrassata	+	+	+	+	-
8	Leptosira mediciana	-	-	+	+	+
9	Pseudochaete spp.	+	+	+	-	-
	Order. Conjugales					
10	Closterium venus	+	+	+	-	-
11	Closterium parvulum	+	-	+	-	+
12	Cosmarium quadram	+	-	-	+	+
13	Geniularia elegans	-	+	+	+	-
14	Micrasterias radiata	-	+	+	-	-
15	Spirogyra rhizobrachialis	+	-	+	+	-
	Order. Charales					
16	Characium limneticum	+	+	+	+	+
17	Characiopsis acuta	-	+	+	+	-
	B. Class. Xanthophyceae					
	Order - Heterococcales					
18	Goniochloris sculpta	-	+	+	+	-
	Order - Heterotrichales					
19	Tribonema affine	+	+	+	+	-
20	Tribonema valgari	-	-	+	+	-
	C. Class. Bacillariophyceae					
	Order. Centrales					
21	Cyclotella spp.	+	+	-	-	-
22	Melosira granulata	+	+	+	+	+
23	Melosira varians	+	+	+	+	+
	Order. Pennales					
24	Amphora ovalis	+	+	+	+	+
25	Cymatopleura solea	+	+	+	+	+
26	Cymbella tumida	+	+	+	+	+
27	Cymbella cistula	+	+	+	+	+
28	Fragilaria verescens	+	+	+	+	+
29	Fragilaria capucina	+	+	+	+	+
30	Gyrosigma acuminatum	+	-	-	-	+
31	Meridion circulare	-	+	+	+	-
32	Merismopedia sp.	-	-	-	+	+
33	Navicula amphibola	+	+	+	+	+
34	Navicula pusilla	+	+	+	+	+
35	Nitzschia denticula	+	+	-	-	-

S.N.	Species	Sampling Sites				
		V	IV	III	II	I
36	Pinnularia gentilis	+	+	+	-	-
37	Pinnularia gibba	+	+	+	+	+
38	Stauroneis anceps	+	+	+	+	+
39	Surirella capronii	+	-	-	+	-
40	Surirella elegans	+	+	+	+	+
41	Synedra acus	+	+	+	+	+
42	Synedra ulna	+	+	+	+	+
	D. Class. Myxophyceae/ Cynophyceae					
	Order. Chroococales					
43	Merismopedia sinica	-	+	+	+	+
	Order - Nostocales					
44	Hormidium subtile	-	-	+	+	-
45	Lyngbya limnetica	+	+	+	+	+
46	Microchate sp.	+	+	+	+	+
47	Nostochopsis labatus	+	+	+	+	-
48	Oscillatoria limosa	+	+	+	+	+
49	Oscillatoria tenuis	+	-	-	+	-
50	Phromidium valderiae	-	+	+	-	-

'+' = Presence, '-' = Absent

2. Zooplankton

11 species of zooplankton's belonging to 3 Class were recorded from 5 different sites of Trishuli River. Among them 6, 2 and 3 species belongs to Class **Rotifera, Copipoda** and **Cladocera**. Similarly 6, 7, 6, 6 and 8 species of zooplanktons were recorded from sampling sites **I, II, III, IV** and **V**.

Table 4.37: Zooplankton's Recorded at Different Sampling Sites of Trishuli River

S.N.	Species	Sampling sites				
		I	II	III	IV	V
A	*Rotifera*					
1	Cephalodella exigua	+	+	+	+	+
2	Keratella valga	+	+	+	+	+
3	Asplanchana sp.	+	+	-	-	+
4	Brachionus sp.	-	+	+	-	-
5	calurella uncinata	+	-	-	-	+
6	Chromogaster ovalis	-	+	+	+	+
B	Copipoda					
7	Eucyclops sp.	-	-	+	+	+
8	Cyclops sp.	-	+	+	+	+
C	Cladocera					
9	Bosmina sp.	+	+	-	-	+
10	Moina sp	-	-	-	+	-
11	Alona sp.	+	-	-	-	-

'+' = Presence, '-' = Absen

4.2.2.7Butterfly

Present survey reported 40 species of butterflies. The list and characters of butterflies are as follows:

Table 4.38: Butterfly of Project Area

S.N	Scientific Name	Common Name	Description
1	*Aglais cashmirensis*	Indian Tortoise Shell	It is the most common species of butterfly found in Nepal and in this region too. This appears all year round and distributed to the higher altitude of this region
2	*Albulina lehana*	Common Mountain Blue	It flies all year round and distributed up to altitude of 2730 meter in the region.
3	*Athyma opalina*	Himalayan Sergeant	It appears until November and commonly distributed up to altitude 2880 meter.
4	*Aulocera loha*	Doherty's Satyr	It is seen at the end of June to the end of October in the study area.
5	*Byasa alcinous*	Chinese Windmill	It is common in the region distributed up to an altitude of 2425 meter.
6	*Byasa latreillei*	Rose Windmill	It has wingspan of 95mm. This species ranges from 1100m to 2820m. This butterfly is mostly found in the forest.
7	*Catopsilia pomona*	Lemon Emigrant	This popular migrant species with has wingspan of 65mm. This is common butterfly distributed to altitude of 3940m
8	*Catopsilia pyranthe*	Mottled Emigrant	This species occurs all year round and found in other parts of world.
9	*Celastrina argiolus*	Hill Hedge Blue	This species flies up to an altitude of 3635 metres in Langtang National park and this species has the wingspan of 28mm
10	*Celatoxia marginata*	Margined Hedge-blue	It is very common species in the project area with wing span 26-30 mm.
11	*Childrena childreni*	Large Silver Stripe	A common species of butterfly observed in this region and has the wingspan of 75-85mm.
12	*Colias erate*	Pale-clouded Yellow	It is common in Himalaya. These were once common but scarce these days in the region.
13	*Colias fieldii*	Dark Clouded Yellow	It is common in Himalaya. These were once common but scarce these days in the region.
14	*Cyrestis thyodamus*	Common Map	It is found in the lower altitude of the regions up to an altitude of 2580 meter.
15	*Danaus chrysippus*	Plain Tiger	It appears until the end of November and distributed up to 2400 meter in the study area.
16	*Delias belladonna*	Hill Jezebel	This species emerges out in April and appears until the end of November. This species is found distributed up to an altitude of 2730m.
17	*Dodona dipoea*	Lesser punch	It has the wingspan of 35-40mm and distributed 2730 in the region.
18	*Gonepteryx rhamni*	Common Brimstone	It is a common species found up to 3640m in the Himalayas.
19	*Heliophorous androcles*	Green Sapphire	It is a common species found up to an altitude of 3636 metres in the region. It flies from March to

S.N	Scientific Name	Common Name	Description
			October and has the wingspan of 32-34mm.
20	*Heliophorous epicles*	Purple Sapphire	It is common up to an altitude of 1575 meter. It flies until November and has the wingspan of 28-38mm.
21	*Issoria issaea*	Queen of Spain fritillary	It is not so common these days and flies to the higher limitations of 4680 meter.
22	*Melanitis leda*	Common evening Brown	It is found in the shady part of the jungle and distributed at the lower belt of the study area
23	*Mycalesis mineus*	Dark-brand Bush brown	It is very common species in the area with wing span 40-45 mm.
24	*Neope pulaha*	Veined labyrinth	It is common butterfly in the study area found until the end of the October.
25	*Neptis hylas*	Common sailor	It is a common species, which appears until December and flies to an altitude of 3030 meter. It has the wingspan of 45-57mm.
26	*Papilio machaon*	Common Yellow Swallowtail	This is a very common species in the region. It flies until November.
27	*Papilio polytes*	Common Mormon	This species is commonly found in Nepal. In Langtang, this species is located in the lower parts i.e. commonly located in the project region
28	*Papilio polyctor*	Common Peacock	This species has wingspan of 98mm and mostly seen in the damp patches of trails. This species has blue patch on hind wing.
29	*Parantica tytia*	Chestnut tiger	This butterfly species is commonly found in the lower belt of Himalayas, up to 2850 metres and has the wingspan of 94mm
30	*Phalanta phalantha*	Common Leopard	This species found in the lower part i.e. in the project areas and it appears until the end of December.
31	*Pieris brassicae*	Large cabbage white	This is most abundant species found in Nepal. This flies year round up to an altitude of 3640m.
32	*Pieris canidia*	Indian Cabbage White	It is very common species in the area with wing span 60-65 mm.
33	*Pontia daplidice*	Bath white	It has wing span of 40mm and flies up to 2730 meters in Langtang region.
34	*Precis almana*	Peacock Pansy	It has the wing span of 45-50mm and common species flies up to 2120 meters in the region.
35	*Terias brigitta*	Small grass yellow	It is a common species and flies year round in the project area.
36	*Terias hecabe*	Common grass yellow	This species has wingspan of 40mm and most common species in the region.
37	*Vanessa cardui*	Painted Lady	It is a common butterfly found up to an altitude of 4680 meters and can be seen all year round.
38	*Vanessa indica*	Indian Red Admiral	It has wingspan 55-60mm and can be seen all year round.
39	*Ypthima sakra*	Himalayan Fivering	
40	*Zophoessa sidonis*	Common Wood Brown	The wingspan is 52mm and common butterfly. This ranges from temperate to Himalayan regions.

Source: EIA Field Survey, 2011 and Smith, C. 1994

1. Status of Butterfly

No species listed on CITES Appendixes, IUCN Red Data List and protected species under NPWC Act, 1973 was found.

4.2.2.8 Concluding Remark on wildlife

In the present survey, a total of 23 species of mammals, 62 species of birds, 20 species of herpetofauna, 4 species of fishes and 40 species of butterflies were reported and recorded from the project area. Trishuli River flows between the buffer zone of LNP and the project area. Thinly scattered tree vegetation, steep rocky terrain, agricultural fields, settlements made the project area less favourable for wild animals to live as compared to nearby LNP. Therefore, the core habitats for terrestrial wild animals lie on LNP. Most of the wild animals occasionally visit the project area particularly during crop raising and harvesting seasons. The project area is not the core habitat or migratory route of conservational or economical important mammals or any other animal life, though a few of conservation significance animals visit seasonally and occasionally. The recorded Snow trout is the most common fish species found in many rivers of Nepal. Similarly, the reported species of herpetofauna and birds are very common species, which are commonly available on other regions of Nepal as well. Furthermore, the areas where the project structures and facilities are located are not unique in terms of the habitat commonly found in the region.

4.3 Socio-Economic and Cultural Environment

4.3.1 Project Affected District - Rasuwa

The proposed Upper Trishuli-I Hydroelectric Project (216MW), is located in Rasuwa District of Nepal. Rasuwa district lies in the Himalayan region of Nepal, which is about 100kms north of Kathmandu.

The district comprises an area of 1544 Sq. Kms covering 1.05% of total area of Nepal. The district is surrounded by Sindhupalchok district (at east), Dhading district (at west), Nuwakot and Sindhupalchok Districts (at South) and China (at North).

Rasuwa district comprises of 1 constitution, 9 Ilaka, 18 administrative VDCs namely Bhorle, Bridhim, Chilime, Dandagoun, Dhunche, Gatlang, Goljung, Haku, Jibjibe, Laharepouw, Langtang, Ramche, Saramthali, Syafru, Thulogoun, Thuman, Timure and Yarsa. Haku, Dhunche and Ramche VDCs are the project affected VDCs. and 162 wards.

The district is located within an altitude of 905 metres - 7408 metres. The major Himalayan peaks situated in the district are Ganesh Himal (7408m), Langtang Himal (7247m), Gosaikunda (5122m), etc. Similarly, the major rivers are Bhote Koshi, Chilime, Langtang, Melung, Trishuli, Ghatte, Kinitang, etc.

The important rivers and rivulets in Rasuwa district are Trishuli River, Bhote Koshi River, Chilime Khola, Lamntang Khola, Phalakhu Khola, Ghattekhola (Haku), Guye Khola, Kadosang Khola, Masangchurti Khola, Vimali Khola, Ghatte Khola (Ramche) and Mailun Khola. Some famous lakes of district are Gosaikund Lake System and Naukund Lake System.

The major lakes and ponds are Bhairav Kunda, Dudh Kunda, Ganesh Kunda, Gosai Kunda, Jogesor Kunda, Kalo Seto Kunda, Saraswati Kunda, Surya Kunda, etc. The Climate of district ranges from sub-tropical to temperate to alpine.

The distinguishing land use of district is forest, grazing land and agricultural land. Langtang National park, which is a one of the conservation area of Nepal, is situated in the district.

Table 4.39: Land Use of Rasuwa District (Ha)

Physical Condition	Agricultural Land		Grazing	Forest	Others	Total
	Cultivated	Non Cultivated				
High Himalaya	0.00	0.00	8.89	2.10	36.55	47.54
High Mountain	3.09	2.03	6.44	32.09	6.07	49.72
Mid-Mountain	1.10	0.65	0.59	0.40	0.01	2.74
Total	4.19	2.68	15.92	34.59	42.63	100.00

Source: VDC Profile, 2063

4.3.1.1 Demography

a. Population

The total population of Rasuwa district is 44,731 (52.21% male and 47.79% female) with 8696 households and average household size of 5.14. The population growth rate and population density are 0.19 and 29 respectively.

Table 4.40: Demography of Rasuwa District

District	Male	Female	Total	Total HH	Average HH Size	Population Growth Rate	Population Density
Rasuwa	23355	21376	44731	8696	5.14	0.19	29

Source: CBS, 2001

b. Ethnicity

Rasuwa district is popularly known as "Land of Tamangs" which clearly indicates the higher population of Tamangs in the district. Tamangs are one of the indigenous groups of Nepal whose distributions are common in the mountain areas. The major ethnic group of the districts are Tamang (64.80%) and Brahmin (15.91%).



Figure 4-40: Tamang Women with Traditional Outfit

Table 4.41: Ethnic Composition of Rasuwa District

VDC	Ethnic Group									
	Tamang	Brahmin	Chhetri	Gurung	Magar	Newar	Tharu	Dalit	Other	Total
Bhorle	8.90	2.68	0.17	1.05	0.13	0.15	0.01	0.47	0.03	13.60
Bridhim	1.20	0.01	0.01	0.02	0.00	0.01	0.00	0.02	0.02	1.281
Chilime	3.20	0.05	0.01	0.04	0.02	0.03	0.01	0.06	0.05	3.467
Dandagoun	3.35	0.74	0.13	0.51	0.02	0.00	0.01	0.03	0.02	4.812
Dhunche	2.64	0.59	0.22	0.77	0.10	0.33	0.01	0.24	0.41	5.311
Gatlang	3.78	0.05	0.00	0.01	0.01	0.00	0.01	0.08	0.02	3.964
Goljung	2.18	0.10	0.07	0.05	0.00	0.13	0.05	0.05	0.05	2.697
Haku	5.32	0.02	0.00	0.19	0.00	0.03	0.00	0.13	0.02	5.712
Jibjibe	2.83	6.20	0.47	0.32	0.30	0.11	0.00	0.63	0.42	11.29
Laharepouw	3.52	4.67	0.92	0.15	0.55	0.61	0.02	0.70	0.56	11.7
Langtang	1.01	0.00	0.00	0.01	0.00	0.01	0.03	0.01	0.12	1.188
Ramche	4.73	0.04	0.03	0.00	0.00	0.00	0.03	0.05	0.03	4.908
Saramthali	6.99	0.34	0.38	0.00	0.00	1.21	0.01	0.29	0.15	9.364
Syafru	4.21	0.10	0.09	0.09	0.02	0.03	0.00	0.06	0.28	4.88
Thulogoun	0.89	0.27	0.12	1.88	0.00	0.02	0.01	0.24	0.02	3.447
Thuman	2.10	0.01	0.01	0.11	0.00	0.01	0.00	0.01	0.00	2.25
Timure	0.95	0.02	0.05	0.00	0.02	0.14	0.00	0.00	0.01	1.178
Yarsa	6.97	0.02	0.00	1.52	0.00	0.01	0.00	0.21	0.22	8.956
Total	64.80	15.91	2.66	6.72	1.17	2.84	0.20	3.27	2.43	100.00

Source: VDC Profile, 2006

c. Religion

In Rasuwa district, Buddhist (66.67%) are the dominant religious group followed by Hindu (31.96%).

Table 4.42: Religion Composition of Rasuwa District

VDC	Buddhist	Hindu	Islam	Kirat	Jain	Christian	Sikh	Bah a'i	Unknown	Total
Bhorle	8.35	5.23	0	0	0	0.01	0	0	0	13.59
Bridhim	1.29	0.02	0	0	0	0	0	0	0	1.31
Chilime	3.21	0.16	0	0	0	0.09	0	0	0	3.46
Dandag	3.2	1.61	0	0	0	0.07	0	0	0	4.88
Dhunche	3.58	1.68	0	0	0	0.03	0	0	0.01	5.31
Gatlang	3.49	0.09	0	0	0	0.3	0	0	0.08	3.96
Goljung	2.34	0.29	0	0	0	0.07	0	0	0	2.69
Haku	5.56	0.14	0	0	0	0	0	0	0	5.71
Jibjibe	3.21	8.02	0	0	0	0	0	0	0.02	11.26
Laharep	3.32	8.37	0	0	0	0	0	0	0	11.69
Langtang	1.13	0.06	0	0	0	0	0	0	0	1.19
Ramche	4.78	0.13	0	0	0	0	0	0	0	4.9
Saramth	6.97	2.38	0	0	0	0	0	0	0	9.36
Syafru	4.45	0.33	0	0	0	0.09	0	0	0	4.88
Thulogo	0.55	2.89	0	0	0	0	0	0	0	3.44
Thuman	1.61	0.06	0	0	0	0.58	0	0	0	2.25
Timure	1.08	0.09	0	0	0	0	0	0	0	1.18
Yarsa	8.54	0.41	0	0	0	0	0	0	0	8.95
Total	66.67	31.96	0.01	0	0.01	1.23	0	0	0.11	100.00

Source: VDC Profile, 2006

d. Language

Of the 18 VDCs in Rasuwa district, about 10 major languages are spoken as mother tongue along with some other minor languages. VDC profiles reveal Tamang language as the most common language of the entire district. About 61.05% people speak Tamang language in the district followed by Nepali (30.98%). Other languages spoken in the district are Gurung, Newari, Maithili, Batawa, Sherpa, Tharu.

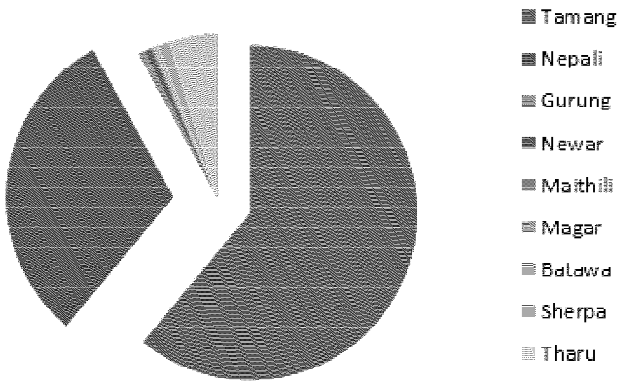


Figure 4-41: Major Languages of Project District

Table 4.43: Linguistic Status of Rasuwa District

VDC	Tamang	Nepali	Gurung	Newar	Maithili	Magar	Batawa	Sherpa	Tharu	Tibetan	Other	Total
Bhorle	8.55	4.49	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	13.59
Bridhim	0.18	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.10	1.32
Chilime	3.24	0.10	0.00	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	3.40
Dandag	1.58	3.27	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.01	4.88
Dhunche	3.45	1.23	0.07	0.29	0.06	0.04	0.04	0.03	0.00	0.00	0.10	5.31
Gatlang	3.87	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	3.96
Goljung	2.25	0.18	0.00	0.13	0.00	0.00	0.00	0.03	0.03	0.00	0.08	2.70
Haku	5.58	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.71
Jibjibe	3.26	7.79	0.00	0.04	0.05	0.11	0.00	0.00	0.00	0.00	0.02	11.27
Laharep	3.51	7.82	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.20	11.70
Langtang	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.12	0.07	1.19
Ramche	4.70	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	4.91
Saramth	6.23	2.73	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.38	9.36
Syafru	4.27	0.27	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.09	4.88
Thulog	0.88	2.45	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	3.45
Thuman	0.83	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.39	2.25
Timure	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.08	1.18
Yarsa	8.65	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	8.95
Total	**61.05**	**30.98**	**0.68**	**0.67**	**0.17**	**0.15**	**0.04**	**0.31**	**0.03**	**1.12**	**4.80**	**100.00**

Source: VDC Profile, 2006

4.3.1.2 Health and Education Institution

There are altogether 22 numbers of health institutions in the district with 1 hospital, 1 primary health centre, 9-health post, 9 sub-health posts, 1 Ayurvedic centre and 1 Ayurvedic dispensary (*DHO, 2062/63*). Similarly, the education institutions in the district includes 2 pre-primary school, 105 primary school, 12 lower secondary schools, 9 secondary schools, 3 higher secondary schools and 1 campus (*DEO, 2062/63*).

4.3.1.3 Infrastructure (Road/Bridge)

Development of transport facilities has been a challenge in project district due to hilly terrain, complex river systems and poor resource base. Nevertheless, some progress has been made in this sector in recent years. The District Road, Nuwakot-Dhunche road is 48km long, which provides ample facility to the district people in transportation. Other five important road of the district are 16km Dhunche-Sapro; 57km Dhunche-Somdang; 9km Sapru-Goldhunga; 9km Goldhunga-Gatlang and 5km Dhaibung-Bhorle.

4.3.1.4 Communication

Radio/television, postal service, newspaper and telephone are the means of communication in Rasuwa district. Nepal Telecom has been providing telephone service in the district. All 18 VDCs of the district are well connected by communication services. Currently, 480 telephone lines have been distributed by NTC of which 175 lines are of C.dot system, 2 lines of VHF system, 4 lines of V-SAT system and 299 lines are of CDMA system.

4.3.1.5Energy

Rasuwa district is rich in water resources. Two major snow fed rivers Bhote Koshi and Trishuli, originating from the Himalayan range, are flowing with high volume of water across the region. The perpetual nature of the rivers together with the steep gradient of the topography provides ideal conditions for hydroelectric development in the district. Nearly 25 % of the total households (2167) in the district have been using electricity service extended through national transmission line. However, it also indicates that 75% of the population in the district compelled to live in darkness.

Chilime Hydroelectric Company Limited (CHPCL) was established in 1996 with an objective of promoting the utilization of resources within the country for the development of hydroelectric project. Chilime Hydroelectric project with installed capacity of 22.1 MW and located at Rasuwa district was built and commissioned by this company on August 25, 2003 (2060/05/08 BS). The project has delivered 528.63 GWh of electrical energy to NEA since August 2003. CHPCL is now executing four more hydroelectric projects, which are at various stages of development.

The trend of biogas plants and solar panels are widely used in the country as the alternative energy. With the help of donor agencies, 180,000 biogas plants and 93,000 solar panels are established in the country (AEPC). Among them, 112 Biogas Plants were established in Rasuwa district

4.3.1.6 Economy

Economy of a region has many facets influenced by geo-climate and presence of natural resources in the surrounding. Rural economies in particular are dominated by distinctiveness of the surrounding environment. A tropical environment generally will have different economic characteristics from temperate environment where as mountain-based economies will starkly differ from sea-based economies. Such characteristics alterations are brought by people's nature of exploiting available resources.

In context of Nepal, two major resource exploitations are common especially in rural areas: land resource exploitation and forest resource exploitation. Land resource exploitations have largely been resulted into agricultural production whereas forest resource exploitations have contributed in meeting energy demands of the rural population.

According to ADB (2008), agriculture in Nepal contributes approximately 40% in GDP with about 80% of total population involved in it. FAO (2008) revealed that forest consumption for fuel wood reached 1.2702 × 104 cubic metres in Nepal in the year 2007.

Rasuwa District, a mountainous district of Nepal, has entrenched from mid-hills in south to Himalayan range in north. The climate hence varies from sub-tropical to alpine in turn varying economic dependences of the local inhabitants. District Profile Report 2004 of Rasuwa District revealed that majority of the population (84.29%) depending on agricultural activities for their livelihoods. However, inadequate productions (Field Survey, 2011) from agriculture have pushed many to pursue other occupations apart from agriculture. Thus, the environmental characteristics and their manifestation have largely shaped the socio-

economic characteristics of Rasuwa districts. The microclimatic variability is manifested by the climatic niche existing in the mountains making specific areas suitable to specific activities like cultivation, manufacturing, establishment of tourist centres etc.

Table 4.44: Occupational Status of Rasuwa District

Occupation	Age above 10 (%)
Agriculture and Forestry	84.29
Fishing	0.03
Mining and Quarrying	0.01
Manufacturing and Recycling	2.31
Electricity, Gas and Water Supply	1.55
Construction	1.05
Wholesale and Retail Trade	4.11
Hotels & Restaurants	0.90
Transport, Storage and Communications	0.82
Financial Intermediation	0.23
Real State, Renting and Business Activities	0.01
Public Administration and Social Security	1.62
Education	1.84
Health & Social Work	0.58
Other Community, Social and Personal Service	0.58
Extra-territorial; Organizations and Bodies	0.07
Total	100.00

CBS, 2001

4.3.1.7 Migration

Migration is one of the major components of population change. Any change in the volume and flow of migration will change the size, growth, and other characteristics of the population both in sending and in receiving areas. Migration within a country does not affect the total size of the population and growth rate but it affects regional and sub-regional population and growth rate within the country (KC, 2003). According to KC (2003), Rasuwa district has an in-migration of 6.30% of district population. According to CBS (2001), rural-rural migration in Rasuwa district was found to be 92.2 % and urban-rural migration as 7.8 % of the total internal migration. This trend, however, has substantially changed after increasing trend of out-migration for labour works in the Middle East countries.

4.3.2 Project Affected VDCs

The project structures and facilities are located within the boundary of Haku, Dhunche and Ramche VDCs and consequently, the construction and implementation of proposed project has major influence on them. Therefore, these 3 VDCs are termed as project affected VDCs. These 3 VDCs are closely located to each other of which Haku VDC comprises largest portion of the proposed project. Dhunche and Ramche VDCs are located at the left bank of Trishuli River within Langtang National park and its buffer zone where as Haku VDC is located at the right bank of river and is not enclosed by the boundary of Langtang National park and its buffer zone. Ramche VDC is the least affected VDC from the perspective of construction of proposed hydroelectric project because of its far-off location from the infrastructure and facilities of the project. Ramche VDC will be affected mainly by the dewatering stretch of the proposed project during operation stage.

4.3.2.1Demography

a. Population

The total population of project affected VDCs is 6986 (53.63% male and 46.37% female) with 1426 households and average household size of 5.00. The average population growth rate and population density of these VDCs are 1.85 and 53.87 respectively.

The population of Haku VDC is higher among the project affected VDCs. In all project affected VDCs, the male population is slightly higher than female population. Ramche VDC is smaller in area and population compared to other two project-affected VDCs though with higher population density. On the other hand, Dhunche VDC being the main economic centre of Rasuwa District due to frequent inflow of tourists for the Himalayan trekking, has the highest number of households.

Table 4.45: Population Distribution of Project Affected VDCs

VDCs	Population			Total HH (Nos.)	HH Size	Population Growth Rate	Population Density
	Male	Female	Total				
Haku	1312	1194	2506	455	5.51	1.98	49.6
Dhunche	1315	1015	2330	574	4.06	1.36	29.9
Ramche	1121	1032	2153	397	5.42	2.20	82.1
Total (Nos.)	3748	3241	6989	1426			
Total (%)	53.63	46.37	100				
Average					5.00	1.85	53.87

Source: VDC Profile, 2006

b. Age and Sex Composition

The study of Age composition plays a major role in determining population characteristics. Age compositions are such an important population indicator that sometime they are called the demographic variables (Bogue, 1969). Changes in age distribution of a population have consequences for educational, political, and economic life (Keyfitz and Flieger 1971). In an project affected VDCs, the highest population is recorded for age group of 0-14 (23.48%) and 15-24 (22.19%) whereas the least is recorded in age group above 65 years (3.59%) and 55-64 (5.64%). The figure indicates higher number of young population in the area. The male and female composition is proportional in every age group.

Table 4.46: Age and Sex Composition of Project Affected VDCs

VDCs	Population	Age-Group							Total
		0-14	15-24	25-34	35-44	45-54	55-64	>65	
Haku	Male	1.50	4.61	4.96	4.45	1.56	1.03	0.66	18.77
	Female	1.72	4.35	3.61	3.22	1.89	1.32	0.99	17.08
Dhunche	Male	4.71	4.24	3.56	3.06	1.72	1.12	0.41	18.82
	Female	5.31	2.86	2.62	1.67	1.23	0.62	0.21	14.52
Ramche	Male	6.11	3.09	2.15	1.80	1.32	0.80	0.77	16.04
	Female	4.14	3.05	2.98	1.86	1.45	0.76	0.54	14.77
Total	Male	12.32	11.93	10.67	9.31	4.59	2.95	1.85	53.63
	Female	11.16	10.26	9.20	6.75	4.56	2.69	1.75	46.37
	Male and Female	23.48	22.19	19.87	16.07	9.16	5.64	3.59	100.00

Source: VDC Profile, 2006

c. Ethnicity

Tamang (79.73%) is the major ethnic group of the project affected VDCs followed by Gurung (6.01%) and Brahmin (4.09%). The presence of Tamang is dominant in Haku and Ramche VDCs with more than 90% where as their number is only about 50% in Ramche VDC. As Dhunche being the district capital and major economic centre, various ethnic groups are residing from various VDCs of district that has resulted diversified ethnic groups in the VDC.

Table 4.47: Ethnic Composition of Project Affected VDCs

VDC	Ethnic Group									
	Tamang	Chhetri	Brahmin	Gurung	Magar	Newar	Tharu	Dalit	Other	Total
Haku	93.18	0.04	0.40	3.31	0.00	0.56	0.04	2.19	0.28	**100.00**
Dhunche	49.79	4.12	11.03	14.46	1.97	6.22	0.17	4.55	7.68	**100.00**
Ramche	96.47	0.56	0.88	0.00	0.00	0.09	0.51	0.93	0.56	**100.00**
Total	79.73	1.56	4.09	6.01	0.66	2.30	0.23	2.59	2.83	**100.00**

Source: VDC Profile, 2006

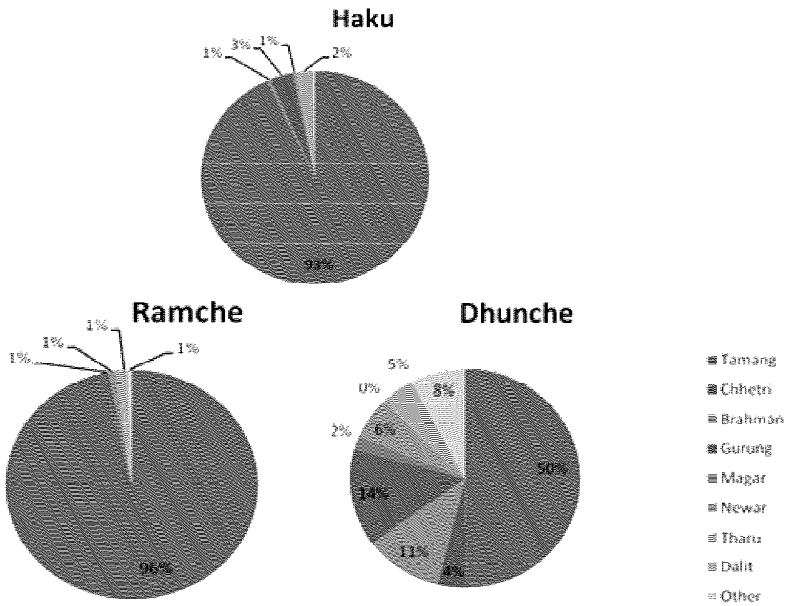


Figure 4-42: Ethnic Composition of Project Affected VDC

d. Religion

Buddhism (87.45%) is the major religion of the project affected VDCs as Buddhism is followed by more than 97% of the population in Haku and Ramche VDCs where as the figure for the same is less than 70% in Dhunche VDC. Hinduism is followed by noticeable number of population in Dhuche VDC (31.67%) where as the figure following Hinduism is very less in Haku and Ramche VDC.

Table 4.48: Religion of Project Affected VDCs

VDC	Hindu	Buddhist	Islam	Kirat	Jain	Christian	Sikh	Baha'i	Unknown	Total
Haku	2.51	97.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Dhunche	31.67	67.47	0.09	0.04	0.04	0.56	0.00	0.00	0.13	100.00
Ramche	2.60	97.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Total	12.26	87.45	0.03	0.01	0.01	0.19	0.00	0.00	0.04	100.00

Source: VDC Profile, 2006

e. Language

Tamang (86.22%) is the dominant language of project affected VDCs. More than 95% population of Haku and Ramche VDCs speak Tamang as their mother tongue.

Table 4.49: Linguistic Status of Project Affected VDCs

VDC	Tamang	Nepali	Gurung	Newar	Maithili	Magar	Batawa	Sherpa	Tharu	Tibetan	Other	Total
Haku	97.77	2.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Dhunche	64.94	23.13	1.33	5.49	1.20	0.82	0.69	0.56	0.00	0.00	1.85	100.00
Ramche	95.82	2.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.04	100.00
Total	86.22	9.17	0.44	1.83	0.40	0.27	0.23	0.19	0.00	0.00	1.24	100.00

Source: VDC Profile, 2006

4.3.2.2 Literacy and Educational Status

Literacy is the primary indicator of educational status. An individual is considered literate if she/he can read and write in at least one language (In case of Nepal, reading and writing Nepali language is considered as the minimum requirement for literacy). The literacy rate of project impact VDCs are generally on the lower side. The literacy status of project affected VDCs is poor with figure showing more than 60% of illiterate population. The illiterate population is comparatively higher in Ramche VDC (87.97%) and lower in Dhunche VDC (49.01%). The excessive illiteracy rate in Ramche VDC in particular is mainly due to lack of awareness among people regarding educating their children as well as difficulty in accessing educational institutions. Dhunche VDC, in other hand, has higher literacy rate mainly due to presence of higher level educational institution like college as well as easier access and awareness for education. In project affected VDCs, the population with education level above SLC is extremely low (2.13%).

Table 4.50: Educational Status of Project Affected VDCs

SN	VDCs	Illiterate	Literate (read & write)	<SLC	>SLC	> PCL	> Bachelors	> Masters	Total
1	Haku	58.66	24.86	15.04	1.04	0.40	0.00	0.00	100.00
2	Dhunche	49.01	35.36	11.97	2.58	0.86	0.21	0.00	100.00
3	Ramche	87.97	7.94	2.79	0.93	0.37	0.00	0.00	100.00
Total		64.47	23.15	10.24	1.52	0.54	0.07	0.00	100.00

Source: VDC Profile, 2006

4.3.2.3 Educational Institution and Educational Scenario

The number of educational institutions in the project affected VDCs is very low. There are altogether 15 educational institutions (13 primary, 1 lower secondary, 1 secondary and 1 higher secondary) in the project affected VDCs. Majority (80%) of educational institutions of the project affected VDCs are limited to primary level (12 out of 15). Only Dhunche VDC is facilitated with higher secondary education level. There are 7 schools in Haku VDC that covered only primary education except one, which is providing education of lower secondary level. Apart from these schools, few private schools are operation in Dhunche VDC.

Table 4.51: Educational Institution of Project Affected VDCs

S.N	VDCs	Primary	Lower Secondary	Secondary	Higher Secondary	Total
1	Haku	6	1	0	0	7
2	Dhunche	3	0	0	1	4
3	Ramche	3	0	1	0	4
Total		12	1	1	1	15

Source: District Education Profile 2006/ District Education Office & Field Survey, 2011



Figure 4-43: Two classes of Grade 4 and 5 in a Single Room in Hakubesi Primary School, Haku VDC

During the field visit and through the consultation meeting, it was observed that students of two different grades were obligated to attain their classes in a single room. Apart from this, students were found to attend their classes in yards and grounds, which clearly state the miserable condition of school infrastructures. The primary level schools are somehow more abundant and hence accessible within half an hour from any of the villages but for the lower secondary level and above they have to walk for about an hour to 4 hours to get the school. The students from all these VDCs have no options than Rasuwa Uchcha Ma V located in Dhunche for their secondary level and higher secondary level education. Thus, the upgrading of schools in VDCs is seen essential.

Table 4.52: Status of School of Project Affected VDCs

VDC	Name of School	Location	Total Rooms	Room Needed	Remarks
Dhunche	Sarashwoti Ni Ma V	Thade	9	3	**
	Rastriya Gaon Farka Pra V	Bokejhunda	6	2	#
	Vimali Pra V	Vimale	5	3	#
	Rasuwa Uchcha Ma V	Dhunche	15	5	**
	Nau Devi Bal Sikshya	Nabu	3	1	*
	Bal Mandir	Dhunche	3	-	Fair
	Namuna Evergreen EBS	Dhunche	-	-	Private
	Highland EBS	Dhunche	-	-	Private
Haku	Haku Besi Pra V	Haku Besi	6	3	#
	Bal Udaya Pra V	Mailun Besi	6	1	*
	Goshainkunda Pra V	Sano Haku	5	2	**
	Haku Ni Ma V	Haku	9		#
	Kalika Pra V	Gogane	5	1	*
	Parwati Pra V	Neising	6	1	*
	Tiru Pra V	Tiru	6	-	Fair
Ramche	Grang Pra V	Grang	5	3	#
	Palep Pra V	Palep	6	1	*
	Setibhumi Ni Ma V	Ramche	10	3	***
	Temrang Pra V	Temrang	6	1	*

Source: Field Survey, 2011

The school enrolment status enables to know the awareness on education among people. Higher number of enrolments is an indicator of increasing rate of literacy rate. District educational profile, 2006 showed highest number of school enrolments in Dhunche VDC whereas Ramche VDC had the lowest. The populations eligible for school enrolments are assumed to be in age group of 5-14.

The presence of higher secondary school in Dhunche VDC is one of the major reasons of its higher literacy. Enrolments in school are very common due to the presence of well-facilitated schools at Dhunche and dropouts are rare compared to Haku and Ramche VDCs. People of Dhunche are more aware about educating their children and majority of students regularly attend the class.

In Ramche and Haku VDCs, the enrolments are very low and drops out are very common. Moreover, according to the locals, even the available schools are not maintained well in these VDCs.

Table 4.53: Overall Educational Scenario of Project Affected VDCs

VDCs	Type of School	Indicators (in %)					
		Enrolment	Regular Class	Annual Result	Dropout within year	Drop out end of year	Class Repeat
Haku	Primary	80	70	80	4	8	8
	Lower Secondary	65	60	55	3	4	33
	Secondary	10	90	60	2	1	7
	Higher Secondary	5	95	40	1	0	59
Dhunche	Primary	90	70	80	4	3	13
	Lower Secondary	75	70	70	5	5	20
	Secondary	60	90	65	2	5	28
	Higher Secondary	45	55	40	2	2	56
Ramche	Primary	80	70	75	4	5	16
	Lower Secondary	65	60	55	10	5	30
	Secondary	10	90	60	14	7	19
	Higher Secondary	5	95	40	12	8	40

Source: District Education Profile 2006/Interaction in District Education Office & Field Survey, 2011

Likewise, the population not attending school at eligible age is highest in Haku VDC. Haku and Ramche VDC also comprises of low female enrolments in school, which is a strong indicator of gender discrimination.

Table 4.54: School Enrolment Status in Project Affected VDCs

VDC				Currently Attending			Currently not Attending		
				Total	Male	Female	Total	Male	Female
Haku	286	195	90	898	437		461		
Dhunche	495	279	216	413	203		210		
Ramche	237	151	85	784	375		409		

Source: District Education Profile 2007/interaction in District Education Office & Field Survey, 2011

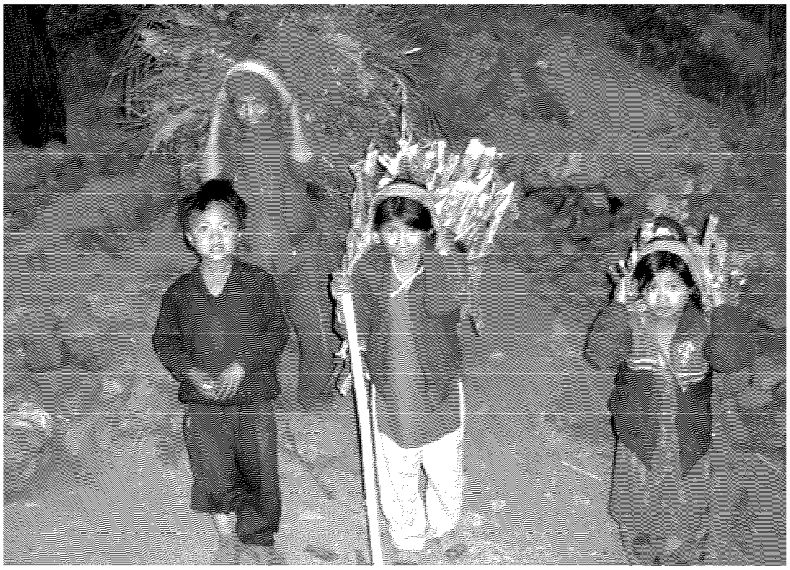


Figure 4-44: Children Collecting Fodder and Firewood, Haku VDC



Figure 4-45: Student of Lower Secondary School in Haku VDC

4.3.2.4 Health Status

Health plays an important role for a prosperous society. Improved health conditions and sanitary facilities are one of the major requisites of public health policies. Public health emphasize on preventing disease, prolonging life and promoting health through organized efforts of society (Holland, 2005). Information from field surveys and secondary sources were collected in order to identify the status of health conditions of the project affected VDCs.

Dhunche VDC is facilitated with 1 district level hospital and 1 health post. Three doctors and one staff nurse are currently working in the District hospital. Nearly 44000 patients from Rasuwa district take medical services from the hospital in a year. Diarrhoea, chicken pox, malaria, tuberculosis, STD, ENT, ARI, Skin Problems, uterus prolapsed are the main diseases reported in the hospital. The medical services provided by the hospital as a regular programme are Extended Programme on Immunization, Dropout rate, nutrition

Programme, ARI Programme, CDD Programme, Safe Motherhood Programme, Family Planning Programme, Tuberculosis Control Programme, Leprosy Control Programme, etc. However, the district hospital is not well equipped. . Therefore, during the accidental cases and other major illness, people have to travel to Trishuli and Kathmandu in case of emergencies.

Similarly, both Haku and Ramche VDCs are facilitated with one sub-health post. However, the available treatment facilities of both Haku and Ramche VDC are exceptionally poor due to lack of proper health personnel, treatment technology and medicines. These VDCs are capable of treatment of only minor illness and diseases such as fever, cold & cough, diarrhoea, dysentery, etc. Local people of these 2 VDCs often visit the district hospital of Dhunche for the treatment of major illness and are also recommended for the same by the health personnel of these sub-health posts.

Table 4.55: Health Institution of Project Affected VDCs

SN	VDC	Health Post	Sub-health Post	Hospital
1	Haku	-	1	-
2	Dhunche	1	-	1
3	Ramche	-	1	-
Total		1	2	1

Source: Field Survey, 2011

The major diseases commonly found to occur in the three VDCs were Jaundice, Cold/cough, Tuberculosis, STD, uterus prolapsed, etc. Immunization coverage of children below 5 years of age was found excellent in Dhunche VDC where as it was below average in the other two VDCs. The presence of hospitals and other health institutions and higher mobility of people is one of the major reasons for higher COI (Coverage of Immunisation) in Dhunche compared to Haku and Ramche VDCs. As per the government service provided for the senior citizens, the senior citizens were found taking advantage of free medical facilities.

Annual Report of DPHO, 2007 and interactions with Female Community Health Volunteers (FCHV) indicated higher family size with higher number of children in all three VDCs. This also indicates less family planning practice in the project impact VDCs. During interactions with the local people through Participatory Rural Appraisals (PRA), it was found that people were less aware about contraceptives. Even when some shared their familiarity with contraceptives, they expressed their inability to use them because of unavailability and inaccessibility. On the other hand, the check-up during the pregnancy has risen up by 48%.

Table 4.56: Average Health Status of Project affected VDCs

Indicators	VDCs			
	Haku	Dhunche	Ramche	Remark
AFS	7	7	6	
AADC	3	2	2	
ANOCF	5	4	5	
KOCL *	4	3	4	
AAC **	+	+	+	
POC	5	5	5	
MOCA ***	E	E	E	
MD****	3,4,5,10,11	3,4,5,10,11	3,4,5,10,11	

Indicators	VDCs			
	Haku	Dhunche	Ramche	Remark
COI	4	1	4	

Source: Annual Report of DPHO 2007/interaction with FCHVs in local level & Field Survey, 2011
Note 2**: * 1-Very High, 2-High, 3-Moderate, 4-Low, 5-Very low, 6-Not known ** +-Positive, --Negative, x-Can't say A=Male Sterilization, B=Female sterilization C=Condom, H= natural method, F=Copper T,E=Depot provera, ****1)Diarrhoea, 2)Dysentery, 3)Jaundice, 4)Cold/cough, 5)Tuberculosis, 6)Headache/Nausea, 7)Skin rashes, 8)Infection disease, 9)HIV/AIDS, 10)STD, 11)Others (Utters Prolapsed)*

Disease-free society is a major component of nation's welfare. Infrastructures for disease treatment have always been a key agenda of development. In order to perceive the disease treatment practice among population of project-impact VDCs, various information were collected. Annual report of DPHO, interactions with FCHV and other stakeholders revealed information regarding on-going trends to treat disease in the region.

The study revealed that the majority of the population (45.67%) in project affected VDCs follow the traditional practice of treatment of *Dhamijhakri* (traditional and rural treatment of diseases based on myths). Local people still believe this superstitious practice of medical treatment. if diseases are incurable by Dhamijhakri, then the next option is to get treatment in health posts. Unless *Dhamijhakri* suggested treatment at health posts or hospitals, local people did not prefer to go to health posts or hospitals.

Similarly, about 20% of the population treats their illness through locally available medicine prepared from natural herbs. Less than 10% of the populations visit other health related institutions such as hospital, health post, sub-health post, medical shop, ayurvedic shop, etc.

Annual Report 2007 of DPHO revealed that awareness among people to treat diseases at hospitals was higher in Dhunche VDC. The higher number of medical shops also indicates practice of modern disease treatments in the region. However, people of Dhunche also prefer Dhamijhakri for treatments along with health posts and hospitals.

Table 4.57: Treatment Practice in Project Affected VDCs

Indicators	Haku	Dhunche	Ramche	Average
Hospital (%)	5.00	10.00	8.00	7.67
Health post (%)	7.00	6.00	8.00	7.00
Sub-health post (%)	10.00	0.00	10.00	6.67
Medical Shop (%)	8.00	9.00	7.00	8.00
Ayurvedic shop (%)	5.00	5.00	5.00	5.00
Dhamijhakri (%)	45.00	50.00	42.00	45.67
Traditional Medicine (%)	20.00	20.00	20.00	20.00
Total	100	100	100	100

Source: Annual Report of DPHO, 2007/Interaction with FCHVs in local level, 2011

4.3.2.5 Water Supply and Sanitation

Water is indispensable element of life, which therefore, has turned out to be a major indicator of social and economic development. Poverty is prevalent mostly in the areas with shortages of water (Salman and Mc. Inerney-Lankford, 2004). Water related issues such as access to drinking water and sanitations are closely linked with the poverty and are strongly advocated to prioritize in national policies (ADB, 2001). The issue of safe drinking water and

proper sanitation facilities are key areas of development as they are closely associated with the human health hence prosperity.

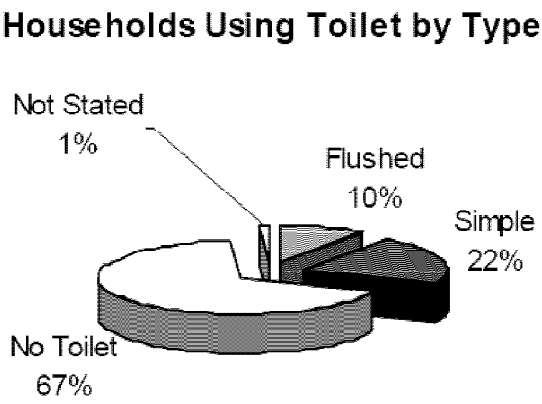


Figure 4-46: Toilet Facilities in Rasuwa District

Annual Report of DPHO 2007 and field visits along with interaction with local people revealed various information on the status of drinking water and sanitation of the project affected VDCs. More than 55% of the households of project affected VDCs have no access to safe drinking water. Similarly, 64.81% households of the project affected VDCs have not toilet facility.

Haku VDC had no access to safe drinking water, as water infrastructure was very poorly maintained. Local people stated that their drinking water came from random sources such as nearby stream, gully, etc, where water availability was hardly consistent. Haku VDC was found to have poor sanitation facilities as well. Most of the wards had insignificant numbers of toilets. Dhunche VDC had better access to water and sanitation facilities among project-impact VDCs as the VDC is urbanized being district capital Sanitation facilities were significant and apparently possessed highest number of toilets. In Ramche VDC, access of safe drinking water is found to be available in every ward. The sanitation facilities on the other hand were only available in few wards. Overall situation of sanitation in Ramche VDC could be considered poor in terms of facility and awareness among people.

Table 4.58: Drinking Water Status of Project Affected VDCs

Indicators	Haku	Dhunche	Ramche	Average
HH Access of safe drinking water	0.00	73.87	60.96	44.94
HH with No Access to safe drinking water	100	26.13	39.04	55.06
Total	100	100	100	100.00

Source: Annual Report of DPHO, 2007

Table 4.59: Sanitation Status of Project Affected VDCs

Indicators	Haku	Dhunche	Ramche	Average
HH with toilet	7.69	80.49	17.38	35.19
HH without toilet	92.31	19.51	82.62	64.81
Total	100	100	100	100

Source: Annual Report of DPHO, 2007

4.3.2.6 Energy

a. Lighting

Most of the mountain region of the country is marginalized due to difficult terrain and inaccessibility. Thus, the mountainous region has less infrastructure facilities, like electricity, road etc. hence, the government body with donor agencies promote alternative energy such as solar panel, biogas, solar cooker etc. in the area. In the project affected VDCs, about 87% households are supplied with electricity supply.

Interestingly, all the wards of Ramche and Dhunche VDCs have been facilitated with electricity supplied from National grid except in ward 9 of Dhunche VDC, whereas Haku VDC is not facilitated with the electricity supplied from National grid. Few households of Dhunche as well as Ramche VDCs are using Solar panel for lighting purpose. In Haku VDC, Peltric set and Solar panel is the only source of light in the area.

Table 4.60: Status of Lighting of Project Affected VDCs

Source	Haku	Dhunche	Ramche
Electricity (Peltric Set)	13.63	80.49	87.44
Solar Panel	32.97	19.51	12.56
Others (Kerosene, Battery)	53.41	0.00	0.00
Total	100	100	100

Source: EIA Field Survey, 2011

b. Cooking

Like most of the households in rural regions of the country, households in the project affected VDCs were also found to be dependent on firewood as cooking fuel. In project affected VDCs, Fuel wood (93.62%) is the major fuel used for cooking purpose.

As Dhunche, being the market hub, few households (9.76%) of Dhunche VDC use kerosene and LPG as a cooking fuel for commercial purpose at restaurant and hotels. Few households also use them as cooking fuel at household level. Similarly, some households (2.45%) of the project affected VDCs use biogas for cooking. The main source of fuel wood is nearby government, community and private forest.

Table 4.61: Energy Used for Cooking

VDC	Cooking Fuel			
	Fuel wood	Kerosene/LPG	Biogas	Total
Haku	97.58	0.00	2.42	100
Dhunche	87.80	9.76	2.44	100
Ramche	97.48	0.00	2.52	100
Total	**93.62**	**3.93**	**2.45**	**100.00**

Source: EIA Field Survey, 2011

4.3.2.7 Economy

Occupation

Majority of the population of project affected VDCs follow agriculture for their subsistence. The three project impact VDCs lie in temperate climatic zone. These VDCs have shown a similar trend of shifting occupations from agriculture to service based occupations for livelihood. These trends are so prevalent that agricultural productions have been on the

lower side in the region though followed as preferred occupation. According to District Profile Report, 2004 of Rasuwa District, agricultural products especially crops were observed to be imported from outside the district in recent years. The major shifts of occupation are seen towards service sectors. The serious poverty in the project impact VDCs, mainly due to geologic remoteness and illiteracy, has pushed local population to depend upon daily wages from labour works. Lowered agricultural productivity, migration of youth population in Middle East countries in labour occupations and incomes from tourisms, especially in Dhunche VDC, are major economic features of the project impact VDCs.

Economically Active Population

Economic studies of the project impact VDCs were mainly carried out through available secondary information and field questionnaire surveys. Economic indicators such as population distribution of economically active population and economic preferences in terms of occupation in every ward of the target VDCs were studied. Economically active population in context of this report means people involved in any means of earning. Occupational priority here means people's first preference or choice of adopting a means of earning excluding agriculture as agriculture is common for almost all population in rural Nepal and is not considered as earning in this section. Majority of the population (39.81%) of the project affected VDCs are solely dependent on daily wage income (labour works, carpenter, mason, small businesses such as hotel, retail shop, etc.). The subsequent prevailing means of sustaining livelihood is remittance obtained from foreign employment as a labour migrant to the Middle East countries.

Table 4.62: Economically Active Population of Project Affected VDCs

VDC	Economically Active Population						
	Service	Remittance	Daily Wages	Pension	Livestock	Trekking	Total
Haku	0.24	8.10	28.65	1.44	0.96	0.44	39.82
Dhunche	0.94	11.50	44.29	2.02	1.50	1.42	61.67
Ramche	0.60	13.66	47.93	2.18	1.49	2.32	68.18
Total	0.59	10.95	39.81	1.86	1.30	1.34	55.84

Source: EIA Field Survey, 2011

Occupational Priority

Occupational priority is simply people's choice or preference over a means of earning. For instance, an individual might have preference of working as a farmer over service sector jobs. These preferences are usually the outcomes of available resources, and other opportunities. These occupations are sorted in tables with the preference order of 1 to 7, 1 being the highest preference and 7, the lowest. Trekking as an occupation was used in case of Haku and Ramche VDC, whereas Tourism business is used in Dhunche VDC. Agriculture was found to be the highest preferred occupation among population in Project Affected VDCs followed by wage labour and foreign employment. This shows that people prefer food production and its trade as the most convenient means of income. This can be attributed to harder options of other means of income such as earning from trekking, which has been a seasonal affair and struggles to find labour works.

Though preferred, agriculture, however, has been difficult because of constraints in irrigation and poor knowledge of newer agricultural technologies as per locals in Haku VDC.

The higher urbanization in Dhunche VDC has readily affected people's preferences in various occupations. The urban population prefers tourism business and Himalayan trekking whereas the rural population have a preference for agriculture.

In Ramche VDC, the agricultural production has been on the lower side due to irrigation constraints and frequent landslides. Trekking is the second preferred occupation as the marginal benefit is higher, however, only in tourist seasons.

Table 4.63: Occupational Priority in Project Affected VDC

VDC	Agriculture	Service (Government)	Wage labour	Trekking	Livestock	Herbal collection	Service (Foreign)
Haku	1	7	2	6	4	5	3
Dhunche	1	7	2	6	3	5	4
Ramche	1	7	3	2	5	6	4

Source: EIA Field Survey, 2011

Agricultural Land Type

The agricultural land types of the project area are mainly Khet, Pakho (Khar Bari) & Bari and dominated by Pakho. The land area of Khet is limited as compared to Pakho and Bari.

[Note: Khet: Khet is irrigated land on which paddy and wheat are basically cultivated and has higher productivity; Bari: Bari is non-irrigated land near residential area with average productivity and maize & millet are generally cultivated; Pakho is dry or non-irrigated land with slopes and has lower productivity]

Land Possession

Land possession is an important indicator of economic prosperity. Higher the land, higher are the options of income, for instance, a household with higher land ownership can afford various activities which can generate substantial income. The study of land holding status gives a glimpse of people's strength of adapting to multiple income opportunities. Average land use per household was studied in various land types.

In project affected VDCs, an average household possesses land area of 9.83 Ropani (Khet-1.00 Ropani, Pakho-5.67 Ropani and Bari-3.17 Ropani). This figure hinted that the households possess a very few quantity (10.17%) of productive land (Khet) as well as the productive land (Khet) is incredibly limited in project affected VDCs.

Table 4.64: Land Possession

VDCs	Type of Land (Ropani)			
	Khet	Pakho	Bari	Total
Haku	0.50	5.50	3.00	9.00
Dhunche	1.50	6.50	4.00	12.00
Ramche	1.00	5.00	2.50	8.50
Average	1.00	5.67	3.17	9.83
Average (%)	10.17	57.63	32.20	100.00

Source: EIA Field Survey, 2011

Agricultural Production

Agriculture is one of the main occupational practices in project affected VDCs. Field survey and Annual report 2006 of Agricultural Development Office of Rasuwa District revealed that major cash crops produced in the project affected VDCs were: potato, cabbage, cauliflower, onion, garlic and carrot. The major crops produced were maize, wheat, millet, buckwheat, barley and beans. These crops are produced to sustain the needs of household. Major crops are not produced sufficiently for trade.

The average production of cash crops and cereal crops in the project affected VDCs are maize (3.38 Quintal /Ropani), wheat (2.10 Quintal/Ropani), millet (2.30 Quintal/Ropani), buckwheat (0.82 Quintal/Ropani), barley (1.30 Quintal/Ropani). Similarly, the average production of cash crops are potato (1.58 Quintal per Ropani), Cabbage (1.56 Quintal per Ropani), Cauliflower (1.57 Quintal per Ropani), onion (0.77 Quintal /Ropani), garlic (0.78 Quintal/Ropani), carrot (0.77 Quintal per Ropani) and Beans (1.98 Quintal/Ropani). The productivity of cereal crops is almost similar in these VDCs.



Figure 4-47: Women involve in Potato Farming

Table 4.65: Average Production of Common Cereal Crops in Project Affected VDCs

Type of Crops	Yield (Quintal/Ropani)			
	Haku	Dhunche	Ramche	Average of VDCs
Maize	3.50	3.15	3.50	3.38
Wheat	2.10	2.10	2.10	2.10
Millet	2.40	2.10	2.40	2.30
Buckwheat	0.70	0.70	1.05	0.82
Barley	1.30	1.30	1.30	1.30

Source: Annual Report, 2006 of District Agricultural Development Office

Table 4.66: Average Production of Vegetables in Project Affected VDCs

Type of Crops	Yield (Quintal/Ropani)			
	Haku	Dhunche	Ramche	Average of VDCs
Cabbage	1.56	1.56	1.56	1.56
Cauliflower	1.57	1.56	1.57	1.57

Type of Crops	Yield (Quintal/Ropani)			
	Haku	Dhunche	Ramche	Average of VDCs
Onion	0.77	0.77	0.77	0.77
Garlic	0.78	0.78	0.78	0.78
Carrot	0.77	0.77	0.77	0.77
Beans	2.10	2.10	1.75	1.98

Source: Annual Report, 2006 of District Agricultural Development Office

Agricultural Price

The average prices of crops in the project affected VDCs are Maize (Rs.1152/Quintal), wheat (Rs.1705 /Quintal), Millet (Rs. 1556/Quintal), Buckwheat (Rs.1219 per Quintal), barley (Rs.1210 per Quintal) and Bean (Rs.924/Quintal)

Table 4.67: Average Price of Agricultural Items

Type of Crops	Rate/Quintal			
	Haku	Dhunche	Ramche	Average of VDCs
Maize	1371	714	1371	1152
Wheat	2057	1000	2057	1705
Millet	1833	1000	1833	1556
Buckwheat	1371	1086	1200	1219
Barley	1385	769	1477	1210
Beans	629	1429	714	924

Source: Annual Report, 2006 of District Agricultural Development Office

Food Sufficiency

The living standard of people living in rural area is generally indicated by food sufficiency. The food sufficient status of project affected VDCs is very low as none of the households have sufficient food for 12 months or more from their own agricultural production. A large numbers of households (81.14%) of project affected VDCs have sufficient food for just 3 months where as a fewer (2.24%) households can feed themselves from their own agricultural production for the outsized period of 9 months. Among project affected VDCs, Haku VDC has poor living standard as the figure indicates more than 90% households have sufficient food for only 3 months.

Table 4.68: Food Sufficiency Status of Households in Project affected VDCs

VDC	Food Sufficiency					
	More than 12 Months	12 Months	9 Months	6 Months	3 Months	Total
Haku	0.00	0.00	0.44	7.91	91.65	100
Dhunche	0.00	0.00	4.88	20.56	74.56	100
Ramche	0.00	0.00	0.50	20.91	78.59	100
Total	0.00	0.00	2.24	16.62	81.14	100

Source: VDC Profile, 2006

Livestock and Poultry

Apart from agricultural farming, the project affected VDCs were involved in livestock and poultry farming as well. The rural setting of these VDCs, food dependency on meat for festivals, trade, etc. could be the associated reasons for livestock and poultry farming in the region.



Figure 4-48: Livestock Rearing

Annual Report 2006 of District Livestock Office showed that six types of livestock are common in the study area i.e. buffalo, cow, goat, sheep, yak, and chicken as poultry (**Table 4.66**). The Poverty Alleviation Fund of Government of Nepal has carried out livestock promotion in the region. Local people shared that the income from livestock are gradually increasing. However, lack of consistent market, i.e. poor market except in tourist season, has retarded the expected prospect of this mode of earning. The average production of milk, meat, ghee and egg are 330 litres, 555 kg, 185 kg and 378 respectively (**Table 4.67**).

It was found that buffalo and goat population in project affected VDCs were higher than other livestock. It could be mainly due to higher market of buffalo's milk and meat and goat's meat in the respective areas. Poultry farming mainly included chickens. The higher number of chickens in Dhunche VDC is the indicator of a strong demand for chicken's meat and eggs.

Table 4.69: Average Livestock and Poultry in the Project area

Livestock and Poultry	VDC		
	Haku	Dhunche	Ramche
Buffalo	320	380	280
Cow	180	220	190
Goat	410	305	240
sheep	80	95	75
Yak	48	110	62
Chicken	820	1135	568

Source: Annual Report of District Livestock office, 2006

Table 4.70: Average Monthly Production from Livestock and Poultry in the Project Affected VDCs

Dhunche			Haku		Ramche	
Production	Quantity (Lit/Kg/No)	Rate (Rs)/Lit or Kg	Quantity (Lit/Kg/No)	Rate (Rs)/Lit or Kg	Quantity (Lit/Kg/No))	Rate (Rs)/Lit or Kg
Milk	315 L	30	380 L	30	295 L	30
Meat	525 Kg	350	655 Kg	350	485 Kg	350
Ghee	180 Kg	280	210 Kg	280	165 Kg	280
Egg	365 No	7	545 No	7	315 No	7

Source: Annual Report of District Livestock Office, 2006

Income and Expenditure

The average annual income of all the households of the project affected VDCs range in between 1 to 3 lakhs. Majority of households (76.86%) have average annual expenditure range between Rs.1,50,000/- to Rs.2,50,000/-. Only 15.22 % of the total households of the project area have a personal saving ranging from Rs.50,000 to Rs.100,000/-.

Table 4.71: Average Income, Expenditure and Saving Trend in Project affected VDCs (HH)

VDCs	Average Annual Income\ HH (Rs. in Lakh) [%]			Average Annual Expense\ HH (Rs. ,000)				Average Annual Saving \ HH (Rs. ,000)		
	1 to 3	4 to 6	> 6	50 - 150	150 - 250	250- 400	Total	50 - 100	100 - 200	200 - 300
Haku	100	0	0	30.77	69.23	0.00	100	13.63		
Dhunche	100	0	0	20.21	79.79	0.00	100	16.72		
Ramche	100	0	0	18.64	81.36	0.00	100	14.86		
Total	100	0	0	23.14	76.86	0.00	100	15.22		

Source: VDC Profile, 2006

4.3.2.8 Gender

Gender refers to multiple levels at which male and female operate, the ways those differences create and are created by societal and cultural norms, expectations, patterns of behavior and ideology, and the inequalities that result (Scott 1986). Gender issues are crucial in social equity and hence one of the important means of development. The issue of gender equity is also one of the Millennium Development Goals. Gender issues in project impact VDCs were examined through the access of male and female in decision-making process through focused group discussion on various issues such as important household matter, family economy, ownership of private property, collection of fodder for cattle, rearing of cattle, herbal collection, contraceptive use, sale of domestic product, purchasing of daily use goods, etc.

Considering the average of VDCs in decision making process, Male has higher decision making right on majority of subjects such as important household matter, family economy, herbal collection, contraceptive use where as female has higher decision making right on fewer subjects such as collection of fodder for cattle, cattle rearing and ownership of private property. Thus, the result confirms that the male has upper hand in majority of decision making process.

Table 4.72: Decision Making Process within Project Affected VDCs

Matter	Decision Making Process (in %)							
	Haku		Dhunche		Ramche		Average of VDCs	
	Male	Female	Male	Female	Male	Female	Male	Female
Important Household Matter	60	40	60	40	60	40	60	40
Family Economy	60	40	70	30	70	30	67	33
Ownership of Private Property	50	50	40	60	50	50	47	53
Collection of Fodder for Cattle	20	80	30	70	30	70	27	73
Cattle Rearing	40	60	40	60	40	60	40	60
Herbal Collection	70	30	50	50	60	40	60	40
Contraceptive Use	70	30	50	50	70	30	63	37
Sale of Domestic Product	40	60	60	40	60	40	53	47
Purchasing of Daily Use Goods	60	40	50	50	40	60	50	50

Source: EIA Field Survey, 2011

4.3.2.9 Migration

The project impact VDCs comprises higher out-migration than in-migration (*VDC Profile, 2006*). Out-migrations for international labour in the Middle East countries were observed among young population at all of the three project impact VDCs. Haku VDC has the highest number of labour migrants. In-migration was also seen in three VDCs mainly for economic reasons. Out-of-district migration is prominent at the nearest larger market of Trishuli of Nuwakot District. Migrations within the district were high at Haku VDC whereas lowest in the Ramche VDC. Out of the total population, nearly 32 % has migrated from the project affected VDCs for wage labour. The migration outside country (16.78%) is relatively high as compared to within district (5.01%) and outside district (9.99%). The outmigration figure of Haku VDC is slightly higher than other 2 VDCs.

Table 4.73: Migration Trend of Project Affected VDCs

VDC	Population			
	Within District	Out of District	Out of the Country	Total
Haku	4.99	9.98	19.95	34.92
Dhunche	5.02	10.00	15.02	30.04
Ramche	5.02	9.99	15.00	30.00
Total	5.01	9.99	16.78	31.78

Source: VDC Profile, 2006

4.3.2.10 Communication

The communication facilities available in the project affected VDCs are in the form of CDMA, NTC and N-cell mobile facilities. Landline communication facility is also available in Dhunche and Ramche VDCs.

Table 4.74: Access of Communication in Project Affected VDCs

Description	Haku	Dhunche	Ramche	Total
CDMA	19	42	16	77
NTC	4	42	7	53
N-Cell	12	31	23	66
Total	35	115	46	196

Source: EIA Field Survey, 2011

4.3.2.11 Other Physical, Social and Cultural Infrastructures and Facilities

The project VDCs comprise of different physical, social and cultural infrastructures and Facilities such as watermill, suspension bridge, temple, gumba, police office, VDC building, etc. (**Table 4.72**). None of these structures and facilities is affected by the proposed project construction and implementation. There are vehicular roads in almost all wards of Dhunche. Similarly, road passes through Ward No. 4, 5, 6, 7, 8 and 9 of Ramche VDC;. In spite of the closer distance from the district headquarter (Dhunche), all wards of Haku VDCs are deprived of road facilities. However, foot tracks are present in all wards. There are two suspension bridges, one over Trishuli River at Ward No. 3 and other over Ghatte Khola in Ward No. 2 and 4 of Haku VDC. In Dhunche VDC, there are two bridges in main road and one suspension bridge over Godam Khola. Similarly, in Ramche VDC, there is one suspension bridge over Ghatte Khola.

Table 4.75: Physical, Social and Cultural Infrastructures and Facilities in the Project Affected VDCs

Particular	VDCs			
	Haku	Dhunche	Ramche	Remarks
Water mill	12	5	8	
Suspension bridge	2	0	0	
Temple	0	3	0	
Gumba	2	3	3	
VDC Building	1	1	1	
Police Post/District Police Office	1	1	0	Police Post in Haku VDC

Source: EIA Field Survey, 2011



Figure 4-49: Water Mill of the Project area

Table 4.76: Bridge, River and Trail within the Project Affected VDCs

S.N.	Name	Type	River	Trail	Left Bank	Right Bank
1	Gumbuchet	Suspension	Trishuli	Local	Dhunche	Haku Besi
2	Hakdung Bridge	Suspension	Ghatte	Local	Sano Haku	Thulo Haku
3	Dhunche	Bridge	-	Main	Dhunche	Dhunche
4	Dhunche	Bridge	-	Main	Dhunche	Dhunche
5	Godam Bridge	Suspension	Godam	Local	Dhunche	Dhunche
6	Ghatte Khola	Suspension	Ghatte	Local	Ramche	Ramche

Source: EIA Field Survey, 2011

4.3.2.12 Local Institutions INGOs and CBOs

Poverty Alleviation Fund (PAF), Ama Samuhas, child/youth clubs are some non-governmental and community-based organizations that are actively working in the project affected VDCs. Poverty Alleviation Fund has funded the local organization in the field of promoting economic activity, education/awareness and various community development activities. The focus areas are agriculture and livestock development, cultural heritage protection and promotion programme, community development and extension programmes and women empowerment. Among the CBOs in the project districts, Aama Samuhas and child/youth clubs are actively involved in various community welfare activities. There are 3 Aama Samuhas in Haku VDC comprising of a total of 63 members and 2 child/youth clubs with 24 members from different localities of the VDC. Similarly, in Dhunche VDC and Ramche VDC, there are 4 Aama Samuhas in each VDC consisting of 92 and 112 members respectively. In Dhunche VDC, there are four child/youth clubs of 102 members and in Ramche VDC, there are three child/youth clubs with 73 members. Major responsibilities of such organizations are maintenance of health and sanitation in the locality, creating awareness regarding women empowerment, organizing immunization campaign and mobilizing the collected funds etc.

Table 4.77: Local Institutions in the Project Affected VDCs

List of Organizations		
Name	**Location**	**Major Sector**
Sthania Yuva Samajik Samiti	Dhunche	Youth mobilization
Manav Adhikari tatha Samaj Sewa Kendra	Dhunche	Human Rights
Rasuwa Janasewa Yuva Club	Dhunche	Youth Mobilization
Dhunche Khanepani Upbhokta Samiti	Dhunche	Water Supply
Nepal Aama Samuha	Dhunche	Social Mobilization
Manekor Yuva Club	Dhunche	Social Mobilization
Hotel Bebasthapan Samiti	Dhunche	Hotel Management
Rasuwa Udhog Banijya Sangha	Dhunche	Industrial Dev.
Tulku chholing Gumba	Dhunche	Gumba Management
Hamro Yuva Club	Dhunche	Youth & Social Mobilisation
Rasuwa Nirman Bebasayi Sangh	Dhunche	Infrastructure Construction
Dhunche Samudayik Bidhut Bitaran Kendra	Dhunche	Energy Development
Rasuwa Samudayik Bikash Kendra	Dhunche	Community Development
Shree Rasuwa Apang Punarsthapana Kendra,	Dhunche	Child Proction
Shree Gosaikund Samudayik Sewa Kendra	Dhunche	Tourism Management
Shree Rasuwa Nagrik Samaj	Dhunche	Social Service
Shree Digo Uddham tatha Batawaran Bikash	Dhunche	Env. Protection
Nepal Krishi Ban Pratisthan	Dhunche	Income Generation

List of Organizations		
Name	**Location**	**Major Sector**
Mailun Chhetra Samudayik Bikash Samiti	Haku	Income Generation
Goppo Kunda Samaj Sewa Samiti	Haku	Social Service
Chauritala Samudayik Sanstha	Haku	Income Generation
Nayakund Samudayik Sanstha	Haku	Income Generation
Race Nepal	Haku	Income Generation
Sisam	Haku	Income Generation
Poverty Allevation Fund,	Rasuwa	Income Generation
Maneko Society	Dhunche	Education and social
Mahila Adhikar Munch	Dhunche	Women Rights
Dhunche Mahila Bachat tatha Rina Sahakari Sanstha	Dhunche	saving and Mobilization
Lamtang Chhetra Samranchan Sarokar Samaj	Dhunche	Biodiversity Conservation
Woman Entrepreneurs Association of Nepal	Dhunche	Women Empowerment

Source: District Development Committee, Rasuwa District

4.3.2.13 Places of Historical, Archaeological and Tourism Importance

a. Langtang National Park

Langtang National Park is the nearest park to Kathmandu was designated as the first Himalayan National Park in 1970-71 and was gazetted in March 1976. The protected area exceeds an altitudinal range of 6,450 m (21,160 ft) and covers an area of 1,710 km2 (660 sq mile) in the Nuwakot, Rasuwa and Sindhulpalchok districts of the central Himalayan region encompassing 26 Village Development Committees. The main purpose of the Langtang National Park is to preserve the natural environment and protecting endangered wildlife, at the same time allowing local people and tourists to follow traditional land use practices that are compatible with resource protection. Some of the most attractive areas of the park include the Langtang Valley, the holy lakes at Gosaikunda, and the forested hillsides above the village of Helambu.

The northern and eastern borders of the national park coincide with the international border to the Tibet Autonomous Region. The western boundary follows the rivers Bhote Koshi and Trishuli. The southern border lies 32 km (20 mile) north of the Kathmandu Valley. The rugged summits of Langtang Lirung with an elevation of 7,227 m (23,711 ft) and Dorje Lakpa (6,966 m (22,854 ft)) are included in the national park as well as the high altitude sacred lake of Gosainkunda. The Langtang National Park exhibits a high diversity of 14 vegetation types in 18 ecosystem types, ranging from upper tropical forests below 1,000 m (3,300 ft) m altitude to alpine scrub and perennial ice.

About 45 villages are situated within the park boundaries, but are not under park jurisdiction. In total about 3000 households depend on park resources, primarily for wood and pasture lands. Culturally the area is mixed, the home of several ethnic groups . The majority of people are Tamang, an ancient Nepalese race. The Tamangs, traditionally farmers and cattle breeders, are especially well known for their weaving. Their religion is related to the Bon and the pre-Buddhist doctrines of Tibet. Today this religion has merged with the newer teachings of Tibetan Buddhism. Three main trek routes; 1) Langtang Valley, 2) Helambu and 3) Gosaikunda Lake cover much of the Langtang National park and the

southern Helambu region. Langtang and Helambu regions are connected through Lauribina La.

Over the centuries, the dependence of people on natural resources has influenced the environment. The settlements, cultivation patterns, livestock grazing, and daily use of resources in combination with the diversity of flora and fauna and views to the Ganesh Himal, make Langtang an attractive national park.

The park represents a meeting point between indo-Malayan and Palearctic realms, and holds a rich biodiversity. Buffer zone management is a joint venture between the park office and the local communities. Local communities have a decision-making role in the management of such areas. Additionally, the local communities or the BZ receive 30 to 50 % of the park revenue for the better management of natural resources to ensure a sustainable supply of resources and community development.

b. Tamang Heritage Trail

The Tamang Heritage Trail (Dhunche VDC) gives an opportunity to experience the beauty of this mountain region and culture of the Tamang people who live there. The trail passes through traditional Tamang villages where life, culture, and crafts have remained unchanged since the beginning of the settlement. Warm traditional welcome hosted by the locals, their elaborate costumes, rich architecture of their mountain houses, and the ancient monasteries and places of prayer add colour to the experience of this trail. In addition to cultural experience, the trek also offers wilderness experience through beautiful landscapes of alpine terrain, flat meadows, and rhododendron forests.

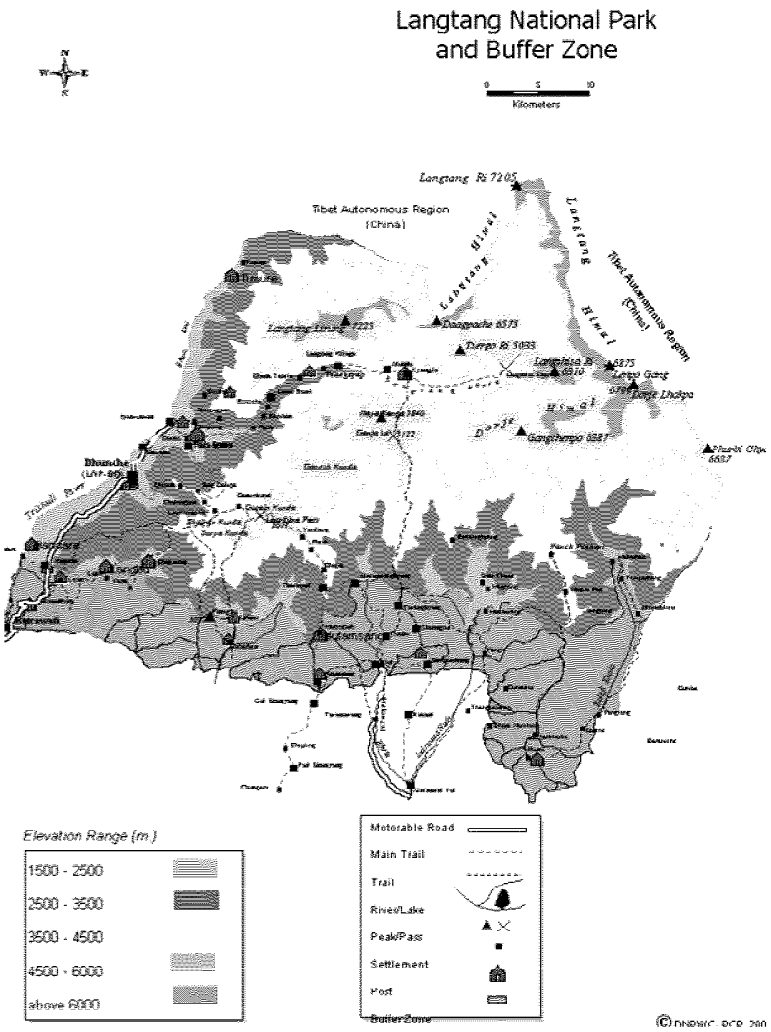


Figure 4-50: Langtang National Park with Buffer Zone
(Source: Department of National Parks and Wildlife Conservation)

4.3.3 Project Affected Settlement

Hakubesi, Gogane and Mailun are the settlements located within the project construction sites and are considered as project affected settlement. The following information is based on the socioeconomic field survey carried out for the EIA survey.

4.3.3.1Demography

The project affected settlements have 1066 population residing in 132 households with an average household size of about 8.14. Gogane has the highest household size compared to other two settlements Hakubesi-Hakubesi-Fulbariand Mailun. The percentage of male and female population in these settlements is more or less similar (49.67: 50.33). Tamangs are the major ethnic group reported in the settlements and comprises 93.94% of the total household while the remaining households i.e. 6.06% belong to Dalit. They are residing in the settlement from 4 generation to several generations and are believed to be migrated from the Besisahar village of Nuwakot District.

4.3.3.2 Mode of livelihood

Agriculture is the major mode of livelihood in the project affected settlements which means almost all families rely on agriculture for their livelihood. However, some family members of these households are also involved in foreign employment to support the livelihood since the production from the agriculture land is not sufficient for them to support their livelihood throughout the year. Additionally, one or two household in the settlements are also involved in small business.

4.3.3.3 Access to Facility

People in the project affected settlements fetch drinking water from the community tap although few households also have private tap. However, fetching water becomes a serious problem in the Gogane where all these community taps were run out off water from the last 2/3 years water. Similarly, except for 10 households in the Hakusbesi, rest of the households in the project affected settlements is without toilet and practice open defecation in barren or unused and open land.

Each of these settlements, except Mailun, has 1 primary (proposed lower secondary) school. However, these institutions lack other supporting facilities i.e. classroom, play ground, toilet, drinking water etc and the level of education is also medium. On top of that, numbers of teacher are also not sufficient. After the primary school, people have to go nearby area Trishuli or Dhunche or Thulo haku to attain the higher education. Because of difficult topographical condition, attain the higher education after completing the primary education is after quite difficult in the settlement and female student , compared to men student, become the victim of this as a result most of the female student left the school after completing the primary level school in the settlement. Lack of education institution with higher level is one of the main reasons for presence of lower number of educated people in the settlement. Few peoples are reported to pass the intermediate level.

Similarly, health institution is also not existed in these settlements. Like educational institution, people have to go nearby settlement or VDC i.e. Trishuli or Dhunche or Thulo haku for the treatment. Many households in the settlement still believe in traditional healer i.e. Dhhami and Dhakri and prefer for treatment before going to the health institution. Most prevalent disease of these settlements includes Diarrhoea, Dysentery, Typhoid, TB and cold. Most of these diseases are waterborne disease and indication of worse sanitation situation of the settlements. In addition, uterus collapse is most prevalent among the women in these settlements.

4.3.3.4 Pattern of Energy Used

Except in Hakubesi-Fulbari, in other two settlements namely Gogane and Mailun, almost all household use electricity for lighting. However, the source for electricity varies among the settlement. In Hakubesi-Fulbari, 38 HHs install solar panel and those households who do not have solar panel use diyo, tuki or tukimara for lighting. In Gogane, electricity is generated through peltric set and distributed to the households from 5 p.m to 6 a.m. Similarly, in Mailunbesi, peltric set is installed privately. Likewise, for cooking, almost all household use fuel wood.

Table 4.78: Comparative Study of Socio-Economic Condition of Project Affected Settlement

SN	Particular	Haku Besi	Gogane	Mailun Besi
1	Demography			
1.1	Total No of HH	70	60	2
1.2	Total Population	450	600	16
1.3	Household size	6.43	10	8
1.3	Male to Female Ratio	55:45	50:50	44:56
1.4	Ethnic Group			
	Tamang	62	60	2
	Dalit	8	-	-
1.5	Migration Pattern	From several generation	From 4 generation	From 7 generation
2	Mode of livelihood	Agriculture, Foreign Employment	Agriculture, Foreign Employment	Agriculture, Foreign Employment
3	Access to Facility			
3.1	Drinking water	Community Tap, Well	Community Tap	Private Tap
3.2	HH with Toilet	10	-	-
3.3	School	1	1	-
3.4	Health post	-	-	-
5	Major Disease	Diarrhoea, Cold	Typhoid, Diarrhoea, Wound	-
6	Pattern of Energy Use			
6.1	Lighting	Solar (38HH), Diyo, Tuki, Tukimara	Petric Set (100%)	Peltric Set
6.2	Cooking	Fuel wood, Gobar Gas, LPG	Fuel wood LPG	Fuel wood, LPG

Source: EIA Field Survey, 2011

4.3.3.5 Status of Women

Since in almost all households women depends on man for their living, status of women is quite weak compared to man. Most of the women are concentrated in unproductive work like in-house work i.e. cooking, washing, rearing children etc or farming. Still many women are the victim of domestic violence. However, local women group commonly known as Ama Samuha are actively involved in increasing awareness regarding the right of the women and their role in the community as well as in controlling the domestic violence. One of such example can be seen in Hakubesi where from last two or three years, men and women are equally participated in the in-house as well as community development work. Additionally, they are also play active role in controlling anti social activity such as alcohol drinking, gambling etc.

4.3.4 Project Affected People

Project affected families, generally termed, as PAFs are those families who lose their dwellings, land and other properties due to the acquisition of land by the project. From the household survey, it is revealed that 41 households (**Annex 4.5**) will lose their land and

assets due to acquisition of land by the project. Out of these 41 PAFs, 39 PAFs (95.12%) will lose their land while 2 families (4.88%) lose their both land and residential structures. The families losing housing structure are termed as SPAF (Seriously Project Affected Family). The entire PAFs are residing in Haku VDC. The following information was obtained from the household survey of 41 project affected families.



Figure 4-51: Project Affected Residential Structures, Baluwa Phant

4.3.4.1Demography

a. Population and Household

There are altogether 41 families to be affected by the project. The total population of PAFs are 313 (51.44% male and 48.56% female). The average household size of PAFs is 7.63. All the PAFs have been residing in the project area since their time of ancestors.

Table 4.79Table 4.76: Population and Household of PAFs

VDC	Nos. and %	M	F	Total	HH Nos.	Ave. HH Size
Haku	Nos.	161	152	313	41	7.63
	%	51.44	48.56	100	91.11	

Source: Household Survey, EIA, 2011

Among PAFs, the younger age people i.e. children (0-14) constitutes higher number of population (40.26%). The population of the age group (15-44) constitutes 40.58% of the population. Likewise, the presence of older age people is only 5.75%.

Table 4.80: Age Group Population and Sex Composition of Project Affected VDCs

VDCs	Population	Age-Group						
		0-14	15-24	25-34	35-44	45-54	55-64	>65
Haku	Male	19.49	7.35	6.07	7.99	2.88	5.11	2.56
	Female	20.77	7.03	4.47	7.67	2.88	2.56	3.19
Total		40.26	14.38	10.54	15.65	5.75	7.67	5.75

Source: Household Survey, EIA, 2011

b. Ethnicity

All the PAFs (100%) belong to Tamang ethnic group.

Table 4.81: Ethnicity of PAFS

Ethnic Group	Nos	%
Tamang	41	100.00

Source: Household Survey, EIA, 2011

c. Religion

Majorities of the PAFs (87.80%) follow Hinduism as their main religions. PAFs following other religion are Buddhism (6.67%) and Christian (4.44%). Conversely, the majority of population in the project affected VDCs follows Buddhism.

Table 4.82: Religion of PAFs

Religion	No.	%
Hinduism	36	87.80
Buddhism	3	7.32
Christian	2	4.88
Total	41	100

Source: Household Survey, EIA, 2011

d. Mother Tongue

Tamang is the main language of the PAFs. The entire PAFs speak Tamang as their main language. VDC profiles also reveal that Tamang is the most frequently used language of the entire VDCs and district.

4.3.4.2 Education

The educational status is very poor. Out of the total PAFs, none of the member of family was found to be enrolled in Bachelors level and above. Only 1.28% of the total population was found to have passed SLC examination. 34.82% of the total population had education of primary and lower secondary level. From the household survey, it was also revealed that the factors affecting poor education condition of PAFs are poverty, lack of awareness, lack of educational institutions near the villages, inadequate infrastructures (especially class rooms) in the existing schools, lack of educated persons within the community or the family, stress of agricultural works leading to drudgery and absence of governmental role in promoting their educational level.

Table 4.83: Education Level of PAFs

Education Level	Nos.	%
SLC	4	1.28
Primary	73	23.32
Lower Secondary Level	36	11.50
Total	113	36.10

Source: Household Survey, EIA, 2011

4.3.4.3 Health

From the household field survey, it is revealed that there is higher family size (7.63) with higher number of children in the PAFs comparing to the district and the national average. This indicates that family planning is less practiced in the PAFs. During interactions, it was

found that people are less aware about contraceptives. The leading factors in the PAFs for higher number in the family sizes are lack of awareness, unavailability of contraceptive devices and early marriage.

The major diseases found to occur among PAFs are Diarrhoea, Cold/cough, Jaundice, and Fever. Mixed answers are found from the community when they were asked what you do when your family members fall sick. Most of the common answer are visit to Lama and Dhami Jhakri and visit to the health post.

As far as PAFs are concerned, the health services providing institutions in the project VDC is very low. There is only 1 sub-health post in Haku VDC. There are not any medical shops. Some people in the area are found to be keeping Paracetamol, Brucett, M-jeet, and Jeevan Jal in their homes to use it in need.

4.3.4.4 Water Supply and Sanitation

Drinking water availability in all the PAFs was not satisfactory. All the PAFs have accessibility to the tap water. The people residing in Hakubesi bring water from Chuga Dhara, which is the main source of drinking water. People of Gogane use their local Kholsa. The people in Mailun village have Jalleri Kholsa for drinking purpose. Although there is adequate availability of drinking water, sanitation is unsatisfactory.

During the household survey, most of the PAFs reported that they have to collect polluted water from these available taps during monsoon season because the source of drinking water lies in the steep slopes, which have minor erosion and landslide. Only few toilet facilities are present in the PAFs families. Only 6 PAFs (14.63%) have toilet and the rest of the PAFs (85.37%) defecate in nearby forest, Bari and Pakho i.e. generally at open land. Open defecation in the vicinity is the main cause for water borne disease in the PAFs. The lower economic condition followed by lack of awareness is the main causes of poor sanitation practice.

Table 4.84: Sanitation Status of PAFs

HH with Toilet	HH without Toilet	Total
6	35	41
14.63	85.37	100.00

Source: Household Survey, EIA, 2011

4.3.4.5 Energy

PAFs were also found to be dependent on firewood as cooking fuel as other rural regions of the country. The main source of fuel wood is forest. The collection is done from either government forest or community forest in the vicinity. All PAFs use firewood for cooking. These forests are located at half an hour to an hour walking distance. PAFs use solar, battery light as well as electricity (generated from local Peltric Set) for lighting.

4.3.4.6 Economy

a. Occupation

Agriculture is the main occupation of PAFs. Besides agriculture, PAFs are engaged in daily wedges to run their daily life. As the project district has tremendous tourism potentials, very

few persons from the PAFs are partly engaged in tourism sectors. Further, Haku VDC is not the preferred spot of tourism. During the field survey, it was stated that, youth population are attracted to the Middle East countries in labour occupations. It is also found that 7 people (2.24% of the PAF Population) are working in the Gulf countries.

b. Agricultural Production and Productivity

PAFs mainly have Pakho (Khar Bari), Bari (Up land) and Khet (low land) respectively. The major crops cultivated in Bari (Non-irrigated land or Up land) are maize, millet and bean. Some vegetables such as radish, cauliflower, carrot, cabbage, green vegetables, chilli, tomato, pumpkin, etc. are also grown in very negligible quantity. The production of maize (4.20 Quintal /Ropani) was found to be better than that of VDC. Paddy, wheat, potato and mustard are cultivated in Khet (Irrigated land or low land). However, PAFs have not cultivated any crops or vegetables in Pakho and thus, the land has remained barren with remarkable coverage of bushes and weeds. The average production of major crops in non-irrigated land (Bari) and irrigated land (Khet) of PAFs is presented in **Table 4.82 and 4.83.**

Table 4.85: Agricultural Production of Non-Irrigated Land (Bari)

S.N	Name of Agricultural Crops	Production (Quintal/Ropani)
1	Maize	4.20
2	Millet	1.50
3	Bean (Masyang, Bhatmas)	0.53

Source: Household Survey, EIA, 2011; (Note: 1 Hectare=19.64 Ropani)

Table 4.86: Agricultural Production of Irrigated Land (Khet)

S.N	Name of Agricultural Crops	Production (Quintal/Ropani)
1	Paddy	2.75
2	Wheat	1.58
3	Potato	5.25
4	Mustard	0.79

Source: Household Survey, EIA, 2011; (Note: 1 Hectare=19.64 Ropani)

c. Land Ownership

The male population owns almost all of the land. In Fulbari, Hakubesi, the land is in the name of Soyambhunath Guthi. In the past, the government gave grants of its land (i.e. Raikar land) to people in different forms. In Guthi system, the land donated by the state or individuals for the purpose of religious or charitable institutions. Guthi lands were exempt from tax and not to be taken back by the donors. In some cases of PAFs, the sons, without proper documents are using land owned by the father separately. As the family sizes of each PAFs is greater, no lands has been rented out in Haku VDC.

d. Livestock

Apart from farming, PAFS are also involved in livestock and poultry. The rural setting of VDCs, food dependency of meat during festivals, trade, etc. is the associated reasons for livestock and poultry farming. It is found that buffalo and goat population of PAFs are higher than other livestock. It could be mainly due to higher market price of buffalo's milk and higher demand for meat of buffalo and goat. Poultry farming mainly included rearing local chickens.

e. Income and Expenditure

Earning usually depends upon available resources, knowledge and other opportunities. The main sources of income in the PAFs are found to be agriculture followed by daily wage. This is because all these PAFs have almost similar access on the available resources and the opportunities are almost the same. As the project area is in rural setting within the poor community, the main expenses of the income is on buying food items followed by daily uses items like salt, oil, sugar, tea, etc. Festival, clothing and education are also contributing to increase the expenses.

f. Food Sufficiency

Only 9.76% PAFs can feed them for 9 months from their own agricultural production, where as remaining PAFs (90.24%) have food sufficiency for 6 months period only, which indicates that there is large food deficiency in the PAFs.

Table 4.87: Food Sufficiency Status of PAFs

9 Months	6 Months	Total
4	37	41
9.76	90.24	100.00

Source: Household Survey, EIA, 2011

4.3.4.7 Housing Structures

All the houses of the project-affected families are made up of stone, mud and wood. The roof of the house is constructed of corrugated sheet. It is also found that households use a common room for cooking and sleeping. In many houses, there is a presence of cowsheds near to the houses and most of these sheds are of hut types without walls.

4.3.4.8 Communication

The uses of cell phones have been increasing in the network access regions. However, these cell phones are limited only for the richer families. More than 60% of the PAFs have at least one cell phone within their families. Besides phones, the people very often use postal services as the mode of communication.

4.3.4.9 Gender Aspects

Gender discrimination is still widespread in PAFS as in VDCs. Women are considered as incapable and weak, hence, assumed they lack decision-making capacity. They are also bounded by social norms and taboos attached with them, in every aspect of their lives. In PAFs, women's involvement in decision making of household matters, money/property matters are extremely limited. Males dominate family planning matters. Gender discrimination in the family behaviour towards the male and female children is easily noticeably.

4.3.4.10 Perception about the Project

Almost all of the PAFs households show keenness for the development of project. They also expressed their willingness to cooperate with the project proponent for the development of the project. None of the PAFs household has disappointment with the project development.

However, they want a strong commitment in the job security, electrification and social infrastructure development from this project.

4.3.4.11 Desired Compensation Modality

Almost all PAFs preferred cash compensation for land and property in case of compulsory displacement. They preferred compensation through bilateral negotiation rather than through the Government Land Acquisition Act. In this whole project, only 2 houses belonging to Mr. Panja Bahadur Tamang and Dirgha Bahadur Tamang in Baluwa Phant (near Power house area) need to be evacuated during project construction. These two SPAFs of Baluwa Phant also desired for cash compensation for the acquired house structure.

4.3.5 Cultural Environment

Rasuwa district has a great historical as well as cultural importance. The rich culture and tradition of the district is a reflection of its environmental variation. Some historically and archeologically important locations in the district are Gosaikunda, Temple of Kalika Mata and Utter Gaya are main Holy place and because of the majority of Tamangs, there are many Gumpa in Rasuwa district. There is one temple in Ward No. 3 and two temples in Ward No. 5 of Dhunche VDC but no monasteries. In addition, there are three Gumba in Ward No. 3, 6 and 8 respectively. Similarly, in Ramche VDC, there are three gumpas located in Ward No. 2, 3 and 5 respectively. However, there were no temples in Ramche VDC. In Haku VDC, there are neither temples nor monasteries but there are two Gumba in Ward No. 2 and 5 respectively.

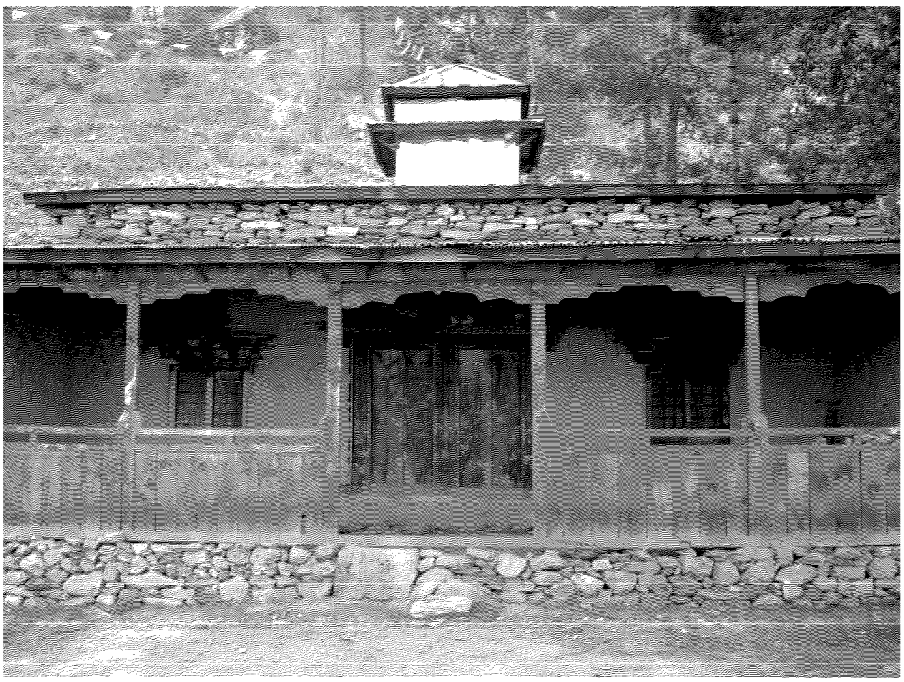


Figure 4-52: Gumba in Haku VDC

Lhochar, Dashain, Tihar, Ram Nawami, Maghe Sakranti, Saune Sakranti, Tij, Janai purnima, Krishnna Janmastami, Buddha Purnima are the common festivals of project VDCs. The Gosai Kunda Mela on Janai Purnima day is the main festival of the district. This festival is culturally of high importance for the inhabitants of the district.

The project affected VDCs is dominated by Tamang ethnic group. Tamang are one of the indigenous inhabitants of Nepal. They have their own distinct culture, language and religion. Their ancestral domain (land) is popularly known as Tamsaling. Tamsaling' means 'Tam' refers to the language spoken by Tamang people, 'sa' refers to the land and 'ling' refers to the territory or fragment. Therefore, 'Tamsaling' mean the land of Tamang tongue speaking people. Tamsaling extends from Buddi gandaki in the West to Dudhkoshi in the East and from the Himalayan range in the North to Chure or Siwalik hills in the South (*Research Paper, Dr.Mukta Singh Lama*).

They celebrate with equal fervour such diverse religious occasions as Lhosar, Maghe Sankranti, Baisakh Purnima and Shravan Purnima. They are fond of buckwheat delicacies. Their dance culture is equally rich and varied. There are many Tamang sub clans.

Tamangs have a system of six types of societal leaders: Tamba, Ganba, Bonbo, Labonbo, Lama and Choho--to keep the Tamang society continuously alive and dynamic. The six have their respective and important roles to play in the development of Tamang society. The Tamba looks after the cultural aspect and has a very important role to play in marriage ceremonies. The Lama carries out death rites (Ghewa) and undertakes activities related to the Buddhist religion. The EIA team also attended Ghewa ceremony once at Haku besi village. The Bonbo propitiates the local gods and goddesses and assists by providing treatment to the sick and needy in the village. The Labonbo (Laptaba) keeps alive the history of the clan and lineage through the worship of clan deities. As each thar, or subgroup, has its own Phola or clan deity, there are different Labonbos for every subgroup. The Choho looks into cases, dispenses justice, and maintains peace, security and wellbeing in society. The Ganba participates in all types of social, political and religious activities. He observes the various activities of society, including whether the Tamba, Bonbo, Lama, Labtaba, Choho, etc. have fulfilled their functions as prescribed by rituals and to the best of their ability or not, and evaluates the activities and gives his suggestions. Thus, the six societal leaders or actors continue to make the Tamang society aware of its duties and responsibilities. There are also in Tamang society traditional institutions like Nhangkhor active to undertake socio-cultural activities.

There are more than 70 subgroups (thar and sahathar) within the Tamang, and inter-marriage does not occur within the same subgroup (thar as well as sahathar). Although inter-marriage can occur between a boy for example, belonging to the Yonjan subgroup, and a girl belonging to the Moktan subgroup, if the mother of both the boy and girl belong to the same subgroup, however, marriage between them is not possible since they are socially recognized as the son and daughter of the same mother. There is the practice of marrying one's maternal uncle's and aunt's daughter. Unlike in Hindu society, Tamang women do not adopt the last name of their husbands following marriage. Their thar or subgroup does not change. The woman remains in the same subgroup her entire life. When she dies, the body cannot be disposed without the presence and permission of her relatives. There is the traditional practice among Tamang daughters of undertaking small economic activities (Pewa) like keeping goats, chicken, etc. This enables the daughter to learn to stand on her feet and makes her self-reliant.

On various festival and ceremonies, pujas (worshipping activities) are performed at Gumbas according to Buddhist rituals and injunctions. Along these rituals, Tamangs perform various forms of ancient worships also. They perform Phola venerating the contributions of their ancestors and the history of their earth. Ancestral history is narrated during Phola worship. Similarly the worship of Neda Sipda (deities of land and water) to revere earth as a source of sustenance, worship of Yhulla (Goddess of village) for the prosperity of the villages and the worship of Jyojyomo (most favoured family deity) are also ubiquitous in Tamang societies. Life cycle rituals such as naming ceremony, rice-feeding ceremony, tonsure ceremony, ceremony of giving Nepali Sari (Guniu), wedding ceremony and funeral rite are still prevailing in society. Different ritual experts have different roles in these rituals.

In project VDCs, certain areas have been designated as cremation sites in almost all the wards. In Haku, Dhunche and Ramche VDCs, people used their own land for cremation. The cremation sites are mainly at hills. In Haku VDC, The riverbanks at foothill of Hakubesi are used as cremation area by few Dalits of Haku VDC. This cremation site is located within the dewatered stretch of the proposed project. Apart from this, no cremation sites exist in the dewatered stretch as well as no land identified as cremation sites falls under project structures and facilities of the proposed project.

5 ENVIRONMENTAL IMPACT

This chapter discusses environmental impacts identified during the EIA Study. The impacts are identified and predicted by giving due consideration to all the activities related to construction and operation of the proposed project.

Implementation of any project in a remote mountain district of Nepal is likely to produce adverse impacts on the existing natural settings and also on the indigenous rural society. However, in order to support the overall national goals of economic development of the country, generation of hydroelectric has been given one of the priorities in the national development policy.

Taking into consideration of the principles of EIA, both beneficial and adverse impacts have been identified, predicted and evaluated for this Project. However, adverse and beneficial impacts that are not identified during the present EIA study if later discovered or found out during the construction and operation phases will be mitigated or enhanced by the proponent.

5.1 Adverse Impact

5.1.1 Physical Environmental Issues

5.1.1.1 Construction Phase

1. Change of Land use Including Agricultural, Forest, Shrub, Grazing, Settlements etc. due to Project Components and Project Facilities Such as Access Road, Permanent Camps and Construction Camps, Quarry Site etc.

The construction and establishment of various project structures and facilities is envisaged to change the land use of about 104.45 hectares of land. The permanent and temporary change in land use will be 47.58 hectares (45.55% of total land use) and 56.88 hectares (54.45% of total land use) respectively. Thus, the temporary change in land use will be little higher. Furthermore, the temporary change in land use is mainly in Bagar (30.31% of the total land area). The total change in land use of agricultural land including Khet, Bari and Pakho will be about 21.75 hectares [Permanent change (9.35 ha) and temporary change (12.40 ha)]. Similarly, the total change in forest land will be about 27.20 hectares [Permanent change (21.39 ha) and temporary change (5.81 ha)]. The detail of change in land use by different project structures and facilities are presented in **Table 5.1**.

The land occupied for all project structures (such as weir, adits, switchyard, etc.) will be permanently converted into structural sites. Likewise, some facilities such as entire access road as well as some camp sites to be utilized for operation phase will also result in the permanent change of land use. The change in land use of agricultural land and forest will permanently restrict access to these lands and decrease the valuable agricultural land and forest cover of the project area, which will have a long term impact to the communities using the resources & services for various purposes as well as forest ecosystem. .

The remaining project facilities such as, quarry sites, batching plant, construction yard, store, etc. will bring temporary change in land use which will be reverted back to the original land uses after the completion of the construction work. However, spoil disposal sites will be transformed into elevated land above the river flood plain. These changes are temporary in nature and will not have a long lasting impact on the overall land use of the area.

Table 5.1: Expected Change in Land Use

S.N.	Name of Project Structure and Facilities	Area (Ha)	Current Land Use	Change in Land Use	Name of VDC
1. Project Structures					
1.1	Pondage Area	2.44	Forest, River, Bagar and Cliff	Permanent	Haku and Dhunche
1.2	Weir	0.76	Forest, River, Bagar and Cliff	Permanent	Haku and Dhunche
1.3	Intake	0.03	Cliff	Permanent	Haku
1.4	Cutting for slope stabilization on right bank	0.47	Cliff	Permanent	Haku
1.5	Cutting for slope stabilization on left bank	2.02	Forest	Permanent	Dhunche
1.6	Adit portal to Desander Basin	0.03	Forest	Permanent	Haku
1.7	Adit 1	0.06	Forest	Permanent	Haku
1.8	Adit 2	0.09	Cultivated Land	Permanent	Haku
1.9	Adit 3	0.14	Forest	Permanent	Haku
1.10	Adit 4	0.09	Forest	Permanent	Haku
1.11	Adit Portal to Surge tank	0.09	Forest	Permanent	Haku
1.12	Air vent tunnel	0.03	Forest	Permanent	Haku
1.13	Tailrace Portal	0.06	Bagar	Permanent	Haku
1.14	Switchyard	1.01	Cultivated Land, Bushes, Khar Bari, Forest and Bagar	Permanent	Haku
Subtotal (1)		7.31			
2. Project Facilities					
2.1. Access Road					
2.1.1	Access Road to Headwork	26.94	Cultivated land, Forest, Bagar, Cliff and Existing Road	Permanent	Haku
2.1.2	Access Road to Surge Shaft	7.85	Cultivated Land, Forest and Existing Road	Permanent	Haku
2.1.3	Access Road to Tungbar Terrace	2.35	Existing Road and Bagar	Permanent	Haku
Sub Total (Access Road)		37.14			Haku
2.2. Quarry Site					Haku
2.2.1	Quarry Site -1 (Downstream of Weir)	1.27	Bagar	Temporary	Haku
2.2.	Quarry Site -2 (Near Hakubesi	0.77	Cliff	Temporary	Haku

S.N.	Name of Project Structure and Facilities	Area (Ha)	Current Land Use	Change in Land Use	Name of VDC
2	landslide)				
2.2.3	Quarry Site - 3 (Near Tungbar Terrace)	1.30	Forest and Existing Road	Temporary	Haku
2.2.4	Quarry Site - 4 (Near Switchyard)	6.27	Bushes and Existing Road	Temporary	Haku
Sub-total (Quarry Site)		9.62			
2.3.Spoil/Muck Disposal Area					
2.3.1	Spoil Disposal Area - 1 (Northeast from Hakubesi-Fulbari)	0.32	Bushes	Temporary	Haku
2.3.2	Spoil Disposal Area - 2 (Northeast from Hakubesi-Fulbari)	0.43	Bagar	Temporary	Haku
2.3.3	Spoil Disposal Area - 3 (Hakubesi-Fulbari)	0.52	Bagar	Temporary	Haku
2.3.4	Spoil Disposal Area - 4 (Northeast of Hakubesi-Fulbari)	1.33	Bagar	Temporary	Haku
2.3.5	Spoil Disposal Area - 5 (Northeast of Hakubesi)	1.13	Forest	Temporary	Haku
2.3.6	Spoil Disposal Area - 6 (Northeast of Hakubesi Landslide)	0.84	Forest	Temporary	Haku
2.3.7	Spoil Disposal Area - 7 (Southwest of Hakubesi Landslide)	2.65	Cultivated Land, Forest and Bagar	Temporary	Haku
2.3.8	Spoil Disposal Area - 8 (Southwest of Hakubesi Landslide)	2.74	Forest and Bagar	Temporary	Haku
2.3.9	Spoil Disposal Area - 9 (Southwest of Hakubesi Landslide)	2.52	Cliff	Temporary	Haku
2.3.10	Spoil Disposal Area - 10 (North east of Buchet Phant)	1.35	Bagar	Temporary	Haku
2.3.11	Spoil Disposal Area - 11 (Buchet Phant)	2.33	Cultivated Land	Temporary	Haku
2.3.12	Spoil Disposal Area - 12 (Southeast of Buchet Phant)	3.27	Bagar	Temporary	Haku
2.3.13	Spoil Disposal Area - 13 (Southeast of Buchet Phant)	0.89	Cliff	Temporary	Haku
2.3.14	Spoil Disposal Area - 14 (Tungbar Terrace)	3.00	Bushes, Khar Bari, Forest and Bagar	Temporary	Haku
2.3.15	Spoil Disposal Area - 15 (Dharanatar)	2.47	Bagar	Temporary	Haku
2.3.16	Spoil Disposal Area - 16 (Downstream of Dharanatar)	0.44	Bagar	Temporary	Haku
2.3.17	Spoil Disposal Area - 17 (Upstream of Gumchet)	0.44	Bagar	Temporary	Haku

S.N.	Name of Project Structure and Facilities	Area (Ha)	Current Land Use	Change in Land Use	Name of VDC
2.3.18	Spoil Disposal Area - 18 (Gumchet)	0.37	Bagar	Temporary	Haku
2.3.19	Spoil Disposal Area - 19 (Gumchet)	0.52	Bagar	Temporary	Haku
2.3.20	Spoil Disposal Area - 20 (Gumchet)	1.38	Bagar	Temporary	Haku
2.3.21	Spoil Disposal Area - 21 (Downstream from Gumchet)	0.93	Bagar	Temporary	Haku
2.3.22	Spoil Disposal Area - 22 (Downstream from Gumchet)	0.40	Bagar	Temporary	Haku
2.3.23	Spoil Disposal Area - 23 (Downstream from Gumchet)	1.63	Bagar	Temporary	Haku
2.3.24	Spoil Disposal Area - 24 (Upstream of Baluwa Phant)	1.03	Bagar	Temporary	Haku
2.3.25	Spoil Disposal Area - 25 (Baluwa Phant)	0.68	Bagar	Temporary	Haku
2.3.26	Spoil Disposal Area -26 (Switchyard)	0.43	Bushes, Khar Bari, Forest and Bagar	Temporary	Haku
2.3.27	Spoil Disposal Area - 27 (Near Switchyard)	0.24	Cultivated Land and Bagar	Temporary	Haku
2.3.28	Spoil Disposal Area - 28 (Mailun Dovan)	0.82	Bagar	Temporary	Haku
2.3.29	Spoil Disposal Area - 29 (Mailun Dovan)	1.25	Bagar	Temporary	Haku
2.3.30	Spoil Disposal Area - 30 (Near Mailun Headwork)	1.30	Bagar	Temporary	Haku
2.3.31	Spoil Disposal Area - 31 (Near Mailun Headwork)	1.28	Bagar	Temporary	Haku
	Sub-total (Spoil/Muck Disposal Sites)	38.92			
2.4.Camp and other Facilities					
2.4.1	Camp Facility -1 and Engineering Camp -1 (Northeast of Hakubesi-Fulbari)	0.50	Cultivated Land	Permanent	Haku
2.4.2	Construction Yard - 1 (Hakubesi-Fulbari)	2.01	Cultivated Land	Temporary	Haku
2.4.3	Camp Facilities - 2 (Hakubesi-Fulbari)	1.36	Cultivated Land	Temporary	Haku
2.4.4	Construction Yard - 2 & Camp Facility - 3 (Buchet Phant)	2.59	Cultivated Land	Temporary	Haku
2.4.5	Batching Plant Facility - 1 (Tungbar)	1.46	Cultivated Land	Temporary	Haku
2.4.6	Store Facility - 1 (Dharanatar)	0.82	Cultivated Land	Temporary	Haku
2.4.7	Camp Facility - 4 (Gumchet)	0.09	Cultivated Land	Temporary	Haku
2.4.	Camp Facility - 5 (Baluwa	0.93	Cultivated Land and	Permanent	Haku

S.N.	Name of Project Structure and Facilities	Area (Ha)	Current Land Use	Change in Land Use	Name of VDC
8	Phant)		Bushes		
2.4.9	Camp Facility - 6, Engineering Camp - 2 & Batching Plant Facility -2 (Mailun Dovan)	1.69	Cultivated Land	Permanent	Haku
Sub-total (Camp and Other Facilities)		11.46			
3	Total Change in Land Use	104.45			
4.1	Permanent Change in Land Use	47.58			
4.2	Permanent Change in Land Use (%)	45.55			
5.1	Temporary Change in Land Use	56.88			
5.2	Temporary Change in Land Use (%)	54.45			

Source: Feasibility Study Report, Upper Trishuli-IHPP and EIA Field Survey, 2011

2. Impact due to Blasting Activities

The tunnel excavation will require control blasting that can cause small tremors, dust pollution and instabilities inside the tunnel. The tunnel is vertically located at more than 150m below settlement area. Thus, the blasting activities will not have any impact on any structures above the tunnel alignment. On the contrary, the blasting activities carried out in tunnel adits and access road might develop crack on structures such as mud/ mortar houses and sheds of the Hakubesi (settlement located close to Adit 1 and access road) and damage such structures. Such incidents have been reported in other hydroelectric projects (e.g. Kaligandaki "A" and Middle Marsyangdi Hydroelectric Project). However, such impacts are not envisaged in other settlements of the project area.

The noise of the surface blasting activity is a high pitch noise of the order of 130 to 140 dBA at the source and become weaker as the distance increases from the source. Further, the noise and vibration related to blasting are lesser for the underground blasting than the surface blasting. Most of the blasting activity is confined to underground blasting. On the other hand, the surface blasting is confined to few areas in the initial construction phase (opening of adit portal areas and internal access road). Further, the blasting activity will be carried out only once or twice a day and mostly during the day time period, the impact of the noise and vibration to the local recipient is not considered significant except Hakubesi. Nevertheless, the noise will be heard at far of distances from the construction sites.

3. Sedimentation, Soil Erosion and Land Instability Associated with Construction and Establishment of Support Facilities and Particularly with the Management of Tunnel Spoil and Access Road

The construction of tunnel and access road will generate a huge quantity i.e. 6151644 m3 of spoil and muck. Though some quantity of spoil and muck will be used in the construction areas as backfill and other construction related works, the remaining needs to be disposed in appropriate location. The project area lacking wide flood plain for the disposal of

spoil/muck requires its disposal at many sites. The selected spoil & muck disposal site located near river could involve land instability and erosion of deposited spoil and muck in the lack of adequate drainages and toe protection measures inducing sedimentation at the river banks resulting contamination & sedimentation of water bodies. The long distance hauling and undulated & difficult hilly terrain of the project area will also affect in safe handling of spoil and muck. The improper handling of spoil will result its disposal on crop land, forest land and even in water bodies as these types of terrain are all around the project site that might result in destruction of productive land and forest vegetation, increasing of turbidity in the river affecting river water quality, and scars in the landscape.

One of the major concerns of construction in the mountainous/hill region is slope instability. Although steep slope and firm dominates the project area, majority of the project structures are located on stable geology consisting of rocky hills and mountains of gneiss. Some of the slopes also have colluviums deposits, which have risks of failure. The steep slopes of Quarry sites possess potentials of land instability and long term erosion.

The landslide of Hakubesi is the major slide of the area and some portion of access road is along this landslide. The slope cutting works on this section of access road can trigger additional landslide and mass wasting.

As many portion of road alignment is along steep hill slope, the clearing and slope cutting works of access road at steep slope will also have potentials of land stability and erosion. The slope overloading if side-casted at downhill slope can also result in slope failures and mass wasting. The other problem associated with the construction of access road is alteration of natural drainage that can obstruct the free flow of water from the upper area to the lower cultivated terrace namely Tungbar and Dharanatar that can affect agriculture yield.

4. Air Pollution, Noise and Vibration Issue Associated with the Construction Works, Construction Traffics and Spoils Management

The construction period will result in activities like transportation and handling of construction material, excavation, drilling, blasting, use of heavy equipment, and the use of crushing and batching plant, etc, which will generate significant amount of dust and vehicular emissions. The major pollutants generated to ambient air from these activities will be particularly carbon monoxide, sulphur oxide, hydrocarbons mainly methane, and oxides of nitrogen. These adverse changes in air quality will remain until the end of construction operation periods however mostly limited to the project site. The highest emission will be that of suspended particulates (PM10) which are heavier to have transboundary effects. They will be most severe at the sites of crushing plant, concrete mixing sites, along the access roads, in the spoil disposal area and in areas where major construction activities will occur, such as at the weir and the powerhouse site. The movement of heavy vehicle in project site is also likely to increase particulates (especially PM10) and emission of CO. The topographical condition of the site is characterized by gorges, which will hence restrict the dispersion of air pollutants to a certain extent.

Other two potential impacts on air quality are unpleasant odour, due to presence of hydrocarbons and hydrogen sulphides, caused by the improper management of sewerage

and solid waste, and indoor smoke pollution from cooking activities. Construction activities will attract large number of migrant labourers and people who supply goods and services to the labour force. If adequate measures are not taken to handle the sewerage and solid waste generated by this new population, there is a possibility of increase in foul odour of hydrocarbons, which will definitely cause health hazards especially in children and people with respiratory diseases (WHO, 2006). In addition, using firewood in traditional cooking stoves in labour camps will result in some extent of indoor air pollution. The major indoor air pollutant in combusting of firewood is carbon monoxide, which is a major carcinogenic gas of the world (Masters, 1998). These impacts will however be short-term in duration and limited to the project site, though magnitude of these impacts will depend on the various factors, in particular, ergonomics of the labour.

The main activities that will generate noise and vibration are blasting, use of batching plants and movement of heavy equipments on the access road such as drilling, vibrators, dozers, loaders, rollers, crane, generators and pumps. These can disturb the prevailing peaceful environment of the project area. The impact will however, be site specific and limited to the construction period. Noise level above 60dB (A) can cause health hazards. Occupational Safety and Health Administration (OSHA) of United States have set standards for industrial and constructional noise exposures. The basic OSHA criterion level (CL) is a 90dB (A) sound exposure level for an 8 hour per day (OSHA, 1983). The construction of the project is likely to exceed this threshold of noise level, affecting human, wildlife and livestock of the project area. Noise exceeding 90dB (A) are potential of harming human health by psychological and ontological (ear diseases) effects (Dhameja, 2005). Intense vibration can produce cracks in the houses existing nearest to project construction sites, trigger rock may fall in an unstable area.

5. Change in Surface and Subsurface Hydrology including Ground Water Level Changes along Tunnel Alignment

The underground excavation generally lowers and diminishes the ground water table and increases its flow. The springs lying close to the tunnel can be illustrate by reduced discharge or often may go dry. However, for the construction of tunnel for the proposed project, the effect to ground water will be low as the tunnel bed is located in bedrock banded gneisses. Furthermore, as per the construction design, the tunnelling structure will not interface with the water level in the area as the tunnel excavation occurs very deep i.e. more than 150 m from the surface. Apart from that, no springs will be affected due to non-existence of springs along the tunnel alignment. Thus, this impact is not envisaged.

6. Change in Water Quality of Surface and Sub Surface water due to Construction Related Activities including Tunnel Discharge, Camp Management and Spoil Management

Physical and biological characteristics of Trishuli water indicate that the river water is clean and free of organic pollution. There is no point source of pollutants where as diffuse source is very sparse. As some of the project structures and facilities such as weir, tailrace, construction camps, storage, batching plants, quarry sites, spoil disposal sites are located nearby the Trishuli River, the likely degradation of river water might arise from inappropriate disposal of muck & spoil, effluents from crushers & other sources and sewage from labor camp and engineering camps.

The spoil/muck will generate essentially from the construction of road, tunnel and other activities. The unsorted waste going into the river channel will greatly contribute to the turbidity of water continuously for long periods. The high turbidity is known to reduce the photosynthetic efficiency of primary producers in the river and as a result, the biological productivity will be highly reduced.

Activities at the project site will mainly produce solid wastes from two sources: construction and domestic. Construction activities will produce wastes such as synthetic materials and some forms of inorganic wastes, whereas, domestic activities will produce mainly food wastes and excretory wastes. Domestic waste will be generated by the people who are directly and indirectly involved in project construction. An urban resident in Nepal generates about 450 grams of solid waste per day. In rural Nepal, the amount of waste generated is expected to be significantly less. If we assume that one rural person generates approximately 100 grams of waste per day, and if the project will attract 1100 people to the project site, then during the construction period, the project will produce approximately 110 Kg of solid waste per day as an additional waste at the project site. If the organic waste is discharged into the river, the organic matters can readily augment BOD levels. Higher BOD levels can be lethal to fish population and other aerobic aquatic organisms (Best, 1999). BOD concentration of 10-20ppm has been recognized optimum for fish population (Chattopadhyay et al. 1988).

Apart from the domestic waste, huge amount of construction waste in the form of debris, sand, aggregates, broken brick pieces, excavated earth material, waste cement, sand-mix, unused concrete base, packing materials, left out part of reinforcement bars, iron rod , if disposed near water sources might cause water pollution.

Liquid waste will be generated by the use of lubricants, paints, cleaning, chemical and other aqueous oil based materials. Some liquid wastes might occur as a result of leaks from construction equipments, accidental spills during materials transfer and storage and also from improper and inadequate management, as lubrication and changing of oil are the common practices in constructing equipments, and these all may find their way to water sources as well. Similarly, solid, semi-liquid and liquid wastes will be generated from the operation of concrete batching plants. Solid waste will be in the form of sub standard concrete. Liquid and semi-liquid waste will consist of cement slurry; waste from equipment washed down, and surface runoff from the batching areas affecting the quality of water.

7. Change in River Morphology

The sediment distribution pattern is likely to have a few changes due to the diversion of flow at the weir site. The removal of boulders during construction and the barrier created by the weir will affect sediment distribution in the river to some extent. To fulfil the aggregate requirement during construction, some selected boulders needed to be removed but such activity will not significantly change the riverbed because of the moderate sediment load, and the presence of a large amount of boulders in the river. Thus, this impact is expected to be of low magnitude and limited to the project area during construction period only.

8. Impact on Langtang National Park

Most of the structures and facilities of proposed project is located on the right side of the Trishuli River, which is also the boundary river between Haku and Langtang National park. The weir structure is located in Haku and Dhunche VDCs whereas the tunnel alignment including overall project structures and facilities are located in Haku VDC. Some portion of weir is located in Buffer zone of Langtang National Park (LNP) of Dhunche VDC. Thus, there will not be any effect on project on physical infrastructure of LNP except acquisition of few land area (2.61 hectares) of buffer zone resulting change in land use. Thus, the envisaged physical impact is of low magnitude.

9. Impact due to Quarry Site and Stockpiling

The project construction will require about **183178** m^3 of construction aggregates i.e. boulders, stone and aggregates for concrete for civil structure, which needs to be sourced from the quarry sites located at Bagar (river bank or flood plain), cliff, forest, etc. Haphazard extraction of excessive amount of stones, boulders and aggregates from Bagar (river banks) and river bed will affect river morphology characterized by river bank erosion and change in sedimentation distribution pattern. The quarrying activities will change the land use and topographical features of the quarry sites located at forest, bushes and cliff. The steep slope cutting in the hill slope might result in land instability due to increased gradient. In addition, the excavation of material from these sites will result in generation of dust pollution in the vicinity.

For project construction works, different construction materials such as sand, aggregates, iron rods, steel frames, cement, etc. for the project construction period and are required in different quantity. The stockpiling of the construction materials will be carried out in construction yards and storage for the convenience and ease of construction work.

Although the project has designated separate areas for the stockpiling of construction materials, open and haphazard stockpiling of these construction materials will degrade the aesthetic beauty of the project sites.

10. Impact due to Spoil and Muck Disposal

Nearly **6151644** m^3 of spoil and muck is expected to generate from various surface and sub-surface excavation during the project construction. The haphazard disposal of the muck and spoil in the designated area or elswhere is of great concern as it is related to air pollution, land pollution, water quality degradation, and erosion & sedimentation. Additionally, as most of the muck disposal site is located in the flood plain area of the Trishuli River, improper disposal might also increase the sediment load in the river. Likewise, there is a possiblity of muck washout during high monsoon floods, which will have great implication on downstream sedimentation and aquatic life. The envisaged impacts are direct, short term and of high magnitude.

11. Impact due to Toxic and Hazardous Materials

The construction machinery and vehicles use large quantities of grease, mobils and other lubricants. Similarly, a number of toxic chemicals are used for enhancing the property of concrete admixtures and water proofing works. Disposal of these materials after use or expiry of the usable date into the water bodies has a long lasting impact on the water

quality of the receiving water bodies with implications on the aquatic life ecology on both local to regional scale.

Similarly, the seepage of the petroleum products from the store, construction yard, etc. of the construction site and the release of these products as wastewater of mechanical yard into the water bodies also has the potential of water quality degradation rendering the water unsuitable for consumption and aquatic life. Envisaged impacts of such disposal or seepage of the contaminated water is of high magnitude.

Furthermore, unused slurry and the washout water of the batching plants are the other sources of pollution to the receiving water bodies. Though the discharge volume and freqency of discharge of these materials is small and rare, it has potential to cause long term implication on the water body substratum where they are discharged and also has a mortality effect on the aquatic life.

12. Impact on Natural Spring due to Tunnel Excavation

The past experience from hydroelectric projects with tunnel component illustrated that the excavation of headrace tunnel structures was found to dewater the landmass above the level of tunnel within an area of up to 100 m of the tunnel. However, there are not any natural springs along the tunnel alignment. Thus, this impact is not foreseen.

13. Loss of Topsoil

The thin layer of topsoil is very precious and valuable natural resources. It takes decades for the formation of topsoil. The agricultural productivity of agricultural land (both Khet and Bari) of project construction site revealed that the soil of the project area is fertile and rich in organic matter. However, in construction works, there is a general tendency to excavate and throw away the topsoil that can result in permanent loss of top soil and in turn degrade the fertility of soil. In addition, soil is washed away ten times faster than it is replenished and when land is dry and bare, soil is easily eroded by winds.

5.1.1.2 Operation Phase

1. Impact on Topography

The establishment of project structures and facilities will change the topographical setting of the land area of project construction sites only in construction phase. As there will not be any construction of any project structure and facilities during operation phase, the impact on topography is not foreseen.

2. Sedimentation and Sediment Flushing from Desander will have adverse effects in the downstream and Damage to Turbine

The pre-monsoon and monsoon months i.e. from June through September are the months of high sediment load in the Trishuli River at the headwork site. Thus, during this period, sediment load is expected to increase in the river. As a result, high layers of sediment will be deposited below under sluice and flushing cannel thereby raising the river bed gradually. These deposited sediments in the weir will be released time to time during the process of maintenance and cleaning which will potentially cause erosion on river bank downstream of weir with implications on the aquatic ecology of the downstream. Besides, the suspended

particles in the water causes high possibility of wearing of turbine if large sized sediment particles at the minimum operation level.

3. Change in River Morphology Downstream of Diversion and its Effects on Downstream Water Use

The project will divert river flow through the tunnel. As a result, reduced water zone will be created within the stretch of weir and tailrace. The reduction of water in dewatered stretch will limit the water flow to few meter width and height. There will be boulders, pebbles and sand all over the bank of dewatered zone, along with widening of dewatered zone. The flood plain might get occupied with hygroscopic vegetation. Moreover, the upstream of weir will be deposited with sediments as well as release of sediment from the weir will erode river bed changing the course the river. As far as river flow is concerned, the hydrological analysis indicates that the river flow is likely to increase from May to October i.e. during pre-monsoon, monsoon and post-monsoon period. Thus, the diversion will not have significant reduction of flow during monsoon period. Similarly, the effect of diversion might be partially replenished by the inflow of tributaries opening to the river within the stretch between weir and tailrace. Further, the water within the dewatered stretch is not used for irrigation and other community use except for cremation site at Hakubesi, and even the downstream release from weir is sufficient for the purpose and thus, its effect on downstream water use is low

Table 5.2: Downstream Release from Weir

Months	River Discharge (m^3/s)	Environmental Release (10% of Monthly Flow)
January	43.5	4.35
February	38.4	3.84
March	38.4	3.84
April	48.6	4.86
May	89.2	8.92
June	236.8	23.68
July	500.2	50.02
August	568.9	56.89
September	375.8	37.58
October	161.3	16.13
November	79.6	7.96
December	54.2	5.42

Source: Feasibility Report, Nepal Water and Energy Development Company (P) Ltd

4. Change in Water Quality due to Reduce Flows Downstream

The flow rate of Trishuli River will be comparatively lower than the flow required for diluting the organic pollutants especially in the dry season i.e. from November to May. Thus, the dissolved oxygen level of water and self cleaning capacity of river will drop slightly while the water temperature will increase slightly. However, as the dewatered stretch is free from human interference, the change in river quality will be negligible. Similarly, in the monsoon season, the water quality of the river will be more or less similar to even in the dewatered section (between diversion weir and tailrace) to present.

5. Change in Surface and Subsurface Hydrology including Ground Water Level Changes along the Tunnel Alignment

The bedrock of tunnel alignment is bedrock banded gneisses which is strong enough to safeguard percolation as well as the tunnel is aligned more than 150 meter below the surface. Thus, any change in surface and subsurface hydrology including ground water level changes along the tunnel alignment is not envisaged.

6. Change in Micro Climate due to Water Diversion in Upstream and Downstream Areas

Micro-climatic change is expected to occur in the in the dewatered section of the river between diversion weir and tailrace of Haku, Dhunche and Ramche VDC as the flowing water acting as temperature buffering is highly reduced in the dewatered section. There can be slight fall and rise in temperature which is lesser than 1^{o} Celsius in winter and summer season respectively. However, in the monsoon season (June-September), the temperature is expected to remain more or less similar. However, there will not be any significant rise in temperature even in dry months.

7. The Hazard of GLOF in the Entire Project

A thorough review of the studies on glaciers and glacial lake in the upper catchment of the Trishuli River revealed that there is minimum Glacial Lake Outburst Flood (GLOF) threat in the project area. The types of glaciers found in the river basin are ice cap, valley glacier, mountain glacier, ice apron, Cirque, and Niche. In the Trishuli River catchment in Nepal, ICIMOD has identified about 117 glacier lakes with total area of 2.03km^2 and 74 Glacier Rivers with total area of 246.65 km^2. This study has further identified that the ice reserve is 27.47km^3. There are three major Glacier lakes identified and these are at a distance between 36 and 41km from the weir site. Among the three identified names Langtang, Longda and Khymjun, none are included under the high risk GLOF category.

8. Impact in the Dewatered Zone due to Sudden Release of Water

It is likely that the project operation will have to be closed for maintenance purpose. Similarly, excessive rainfall or over-filling of pondage area may make it necessary to suddenly release large quantities of water from the pondage area in order to protect the weir structure. Though dewatering of the river stretch between headwork and tailrace is not going to affect the local water utility except recreation and cremation at Hakubesi, the sudden release of water will create sudden catastrophe such as inundation and erosion of riverbank. As the project is run off the river type, the volume of water release so as to bring catastrophe will be minimum.

9. Noise Pollution in Powerhouse Area

The powerhouse structure is fully underground. However, increase in vehicular movement in and around the powerhouse area could increase the noise level thereby causing the noise pollution.

10. Possible Increase in Water Temperature D/S from the Tailrace due to Reduced Quantity of Flow

As already stated, there might be increased in temperature of water to less than 1^{o}C in dewatered zone in dry months. Thus, the water of dewatered zone flowing to downstream

of tailrace will not contribute significantly to increase the temperature of water D/S of tailrace.

11. Possibility of Slope Failure at Tunnel Portal and Penstock Alignment

The penstock alignment is fully underground and located in bedrock banded gneisses. Thus, the slope failure along the penstock alignment is not envisaged. However, the adits located on the hill slope might get unstable due to change in slope condition and surface excavation that might induce slope failure.

Table 5.3: Summary of Physical Environmental Adverse Impact

S.N.	Physical Environment Issues	Impacts	Nature (D/I)	Extent	Duration	Magnitude
Construction Phase						
1.1.1	Change of land use including agricultural, forest, shrub, grazing, settlements etc. due to project components and project facilities such as assess road, permanent camps and construction camps, trans, quarry site etc.	Permanent change of forest land use (21.39 hectares) by the establishment of various project structures and facilities.	D	L	LT	H
1.1.2		Permanent change of agricultural land use (9.35 hectares) by the establishment of various project structures and facilities.	D	SS	LT	H
1.1.3		Temporary change of agricultural land use (12.40 hectares) by the establishment of project facilities	D	SS	ST	M
1.1.4		Conversion of temporary acquired Bagar (Flood Plain) into elevated lands in the spoil & muck disposal sites	D	SS	L	L
1.2.1	Impact due to Blasting Activities	Small tremors, dust pollution and instabilities inside the tunnel	D	SS	ST	M
1.2.2		Damage of structures (mud/ mortar houses and sheds) located nearby access road and Adit1 at Hakubesi due to development of crack	I	SS	ST	M
1.2.3		Changes in Noise level within the construction site of Adit Portals and Access Road	D	L	ST	L
1.2.4		Disturbance due to vibration in the construction site of Adit Portals and Access Road	D	SS	ST	L
1.3.1	Sedimentation, Soil Erosion and Land Instability Associated with Construction and Establishment of Support Facilities and Particularly with the	Land instability and erosion of deposited spoil and muck	D	SS	LT	H
1.3.2		Sedimentation of water bodies by	D	SS	ST	M

S.N.	Physical Environment Issues	Impacts	Nature (D/I)	Extent	Duration	Magnitude
	Management of Tunnel Spoil and Access Road	disposal of spoil and muck				
1.3.3		Destruction of productive land and forest vegetation by disposal of spoil and muck	D	L	ST	M
1.3.4		Increase of turbidity in the river affecting water quality by disposal of spoil and muck	D	SS	ST	M
1.3.5		Additional Potentiality of Landslide along access road at Hakubesi landslide	D	L	LT	H
1.3.6		Land stability and erosion along other portion of access road	D	L	LT	M
1.3.7		Alteration of natural drainage due to construction of access road	D	L	LT	L
1.3.8		Land stability and erosion in the quarry sites	D	SS	LT	L
1.4.1	Air Pollution, Noise and Vibration Issue associated with the construction works, construction traffics and spoil management.	Degradation of air quality due to release of carbon monoxide, sulphur oxide, hydrocarbons, hydrogen sulphides, etc.	D	L	ST	M
1.4.2		Increase in suspended particulates(PM_{10})	D	L	ST	M
1.4.3		Change in noise level at batching plants, construction yards, access road	D	L	ST	L
1.4.4		Vibration due to movement of vehicle and blasting activities	D	L	ST	L
1.5.1	Change in surface and subsurface hydrology including ground water level changes along tunnel alignment	Lowering of ground water table and drying of springs	N/A	N/A	N/A	N/A
1.6.1	Changes in water Quality of Surface and Sub Surface water due to construction related activities including Tunnel Discharge, Camp Management and Spoil	Degradation of river water quality by inappropriate disposal of muck & spoil	D	L	ST	M
1.6.2		Degradation of water quality by	D	L	ST	H

S.N.	Physical Environment Issues	Impacts	Nature (D/I)	Extent	Duration	Magnitude
	Management	effluents released from crushers & other sources				
1.6.3		Degradation of water quality by sewage discharged from construction camp (labour camp and engineering camps)	D	L	ST	M
1.6.4		Degradation of water quality by solid waste generated from construction camp (labour camp and engineering camps)	D	L	ST	M
1.6.5		Degradation of water quality by construction waste	D	L	ST	M
1.6.6		Degradation of water quality by liquid waste such as lubricants, paints, cleaning, chemical and other aqueous oil based materials	ID	L	LT	H
1.6.7		Semi-liquid waste generated from batching areas degrading the quality of water	D	L	ST	M
1.7.1	Change in river morphology	Change in sediment distribution pattern in the river due to diversion of flow and removal of boulder	D	SS	ST	L
1.8.1	Impact on Langtang National park	Acquisition of forest land (2.61 ha) of Buffer zone of LNP resulting in change of land use	D	SS	LT	L
1.9.1	Impact due to quarry site and stockpiling	River bank erosion on the quarry site	D	SS	LT	L
1.9.2		Change in sedimentation distribution pattern of river in quarry site	D	SS	ST	L
1.9.3		Change in land use (9.62 ha) of quarry site	D	SS	ST	L
1.9.4		Change in topographical features of quarry site	D	SS	LT	L

S.N.	Physical Environment Issues	Impacts	Nature (D/I)	Extent	Duration	Magnitude
1.9.5		Land instability in the quarry sites	D	SS	LT	L
1.9.6		Generation of dust in quarry site	D	SS	ST	L
1.9.7		Degradation of aesthetic beauty of project site by haphazard stockpiling of construction material	ID	SS	ST	L
1.10.1	Impact due to spoil and muck disposal	Air pollution from haphazard disposal of muck and spoil	D	I	ST	M
1.10.2		Land pollution from haphazard disposal of muck and spoil	D	L	ST	M
1.10.3		Degradation of water quality by haphazard disposal of muck and spoil near river	D	L	ST	M
1.11.1	Impact due to toxic and hazardous materials	Degradation of water quality by Disposal of grease, mobils, lubricants, toxic chemicals into river	ID	L	LT	H
1.11..2		Degradation of water quality due to seepage of the petroleum products from the store, construction yard etc.	ID	L	LT	H
1.11.3		Degradation of water quality due to release of wastewater of mechanical yard into the water bodies	D	L	LT	H
1.12.1	Impact on natural spring due to tunnel excavation	Drying of spring	N/A	N/A	N/A	N/A
1.13.1	Loss of topsoil	Degradation of fertility of soil	D	SS	LT	H
Operation Phase						
2.1.1	Impact on Topography	Change in topography at project construction sites	N/A	N/A	N/A	N/A
2.2.1	Sedimentation and Sediment Flushing from Desander will have adverse effects in the downstream and damage to turbine	Erosion of river bank downstream of weir by the release of sediments	D	SS	LT	L
2.2.2		Damage of turbine	D	SS	LT	H
2.3.1	Change in river morphology downstream of	Reduction of water in dewatered zone	D	SS	LT	L

S.N.	Physical Environment Issues	Impacts	Nature (D/I)	Extent	Duration	Magnitude
	diversion and its effects on downstream water use	and widening of dewatered zone				
2.3.2		Eroding of river bed by sediment released from weir	D	SS	LT	L
2.4.1	Change in water quality due to reduce flows downstream	Reduction in dissolve oxygen level of water and self-cleaning capacity of river	D	SS	LT	L
2.5.1	Change in surface and subsurface hydrology including ground water changes along the tunnel alignment	Changes in ground water level	N/A	N/A	N/A	N/A
2.6.1	Change in Micro Climate due to Water Diversion in Upstream and Downstream Areas	Slight decrease in temperature of river water in dewatered stretch	D	SS	LT	L
2.7.1	The hazard of GLOF in the entire project	Impact due to GLOF located nearby the project development site	N/A	N/A	N/A	N/A
2.8.1	Impact in the Dewatered Zone due to Sudden Release of Water	Inundation and erosion of river bank	D	SS	LT	L
2.9.1	Noise Pollution in Powerhouse area	Increase in noise level due to vehicular movement in and around the powerhouse area	D	SS	LT	L
2.10.1	Possible Increase in Water Temperature D/S from the Tailrace due to Reduced Quantity of Flow	Decrease in water temperature downstream of tailrace	N/A	N/A	N/A	N/A
2.11.1	Possibility of slope failure at tunnel portal and penstock alignment	Slope failure of tunnel portal (adit)	ID	SS	LT	L

Note: D= Direct; ID = Indirect, SS= Site Specific; L = Local, R = Regional; ST= Short Term, MT = Medium Term, LT = Long Term; L = Low, M = Moderate, H = High; NA = Not Applicable or No impact

Biological Environmental Issues

5.1.1.3 Construction Phase

1. Impact to Existing Forest due to Site Clearance Works for Establishment of Project Structures and Facilities

The site clearance for establishment of project structures and facilities will result in loss of 27.20 hectares of forest land [21.39 hectares permanently (78.64% of total forest loss) and 5.81 hectares temporarily (21.36% of total forest loss)]. Thus, 21.39 hectares of forest land will be permanently changed into project structures and facilities where as the remaining 5.81 hectares will be reverted back to the forest land use after completion of construction period. Of this forest loss, the permanent loss of forest of buffer zone of LNP is only 2.61 hectares. Similarly the loss of community forest will be 23.01 ha (18.29 ha permanently and 4.72 ha temporarily)

Table 5.4: Permanent Acquisition of Forest Land

S. N	Project Structures and Facilities	Forest Type			Total
		Community	Government	Private	
1	Pondage Area	0.10	0.19	0.00	0.29
2	Weir	0.00	0.39	0.00	0.39
3	Cutting for slope stabilization on left bank	0.00	2.02	0.00	2.02
4	Adit portal to Desander Basin	0.03	0.00	0.00	0.03
5	Adit 1	0.06	0.00	0.00	0.06
6	Adit 3	0.14	0.00	0.00	0.14
7	Adit 4	0.09	0.00	0.00	0.09
8	Adit Portal to Surge tank	0.09	0.00	0.00	0.09
9	Air vent tunnel	0.03	0.00	0.00	0.03
10	Switchyard	0.00	0.00	0.20	0.20
11	Access Road to Headwork	11.19	0.00	0.30	11.49
12	Access Road to Surge Shaft	6.56	0.00	0.00	6.56
Total		18.29	2.61	0.50	21.39
Percentage (%)		85.49	12.19	2.32	100.00

Source: Feasibility Study Report, UT- and EIA Field Survey, 2011

Table 5.5: Temporary Acquisition of Forest Land

S.N	Project Facilities	Forest Type			Total
		Community	Government	Private	
1	Quarry Site - 3 (Tungbar Terrace)	0.95	0.00	0.00	0.95
2	Spoil Disposal Area - 5 (Northeast of Hakubesi)	1.13	0.00	0.00	1.13
3	Spoil Disposal Area - 6 (Northeast of Hakubesi Landslide)	0.84	0.00	0.00	0.84
4	Spoil Disposal Area - 7 (Southwest of Hakubesi Landslide)	0.00	0.00	1.00	1.00
5	Spoil Disposal Area - 8 (Southwest of Hakubesi Landslide)	1.28	0.00	0.00	1.28
6	Spoil Disposal Area - 14 (Tungbar Terrace)	0.53	0.00	0.00	0.53
7	Spoil Disposal Area -26 (Switchyard)	0.00	0.00	0.08	0.08
8	**Total**	**4.72**	**0.00**	**1.09**	**5.81**
Percentage (%)		**81.30**	**0.00**	**18.70**	**100.00**

Source: Feasibility Study Report, UT- and EIA Field Survey, 2011

2. Impact on Rare, Protected, Vulnerable, Endangered and Endemic Species of Flora and Fauna and their Habitat

Due to vegetation clearance of project structures and facilities, there will be loss of some protected plant species listed under GoN namely *Shorea robusta* and *Bombax ceiba*. Although the loss of *Shorea robusta* is large in number, this species is protected only due to economic exploitation in Nepalese context and is not the floral species of bio-diversity significance. Likewise, *Bombax ceiba* is protected by GoN for commercial reason only and furthermore, its loss is negligible in project context. Moreover, these two species are evenly and frequently distributed in the project area as well in similar habitat conditions at both uphill and downhill sides of project area. Thus, the envisaged impact is of low magnitude.

Table 5.6: Loss of Protected Plant Species

SN	Local Name	Botanical Name	Loss of Vegetation (Nos.)				
			Seedling	Sapling	Pole	Tree	Total
1	Sal	*Shorea robusta*	3499	1163	1167	299	6128
2	Simal	*Bombax ceiba*	7	7	16	0	30
Total			3506	1170	1183	299	6158

In the project area, 18 species (7 mammals, 10 avifauna and 1 herpetofauna) are identified as wildlife species of conservation significance. Of the wildlife species, it is reported that *Ursus Tibetans* (*listed* under CITES Appendix I and IUCN Red List V) frequently visit nearby the weir site (left bank or Trishuli River, Buffer zone area) for feeding and resting purpose. Though the core habitat of this species is located at upper belt and quite far from the weir construction site, the blasting and other construction activities will drive away these animals throughout construction period from the weir area. Thus, the core habitat is not disturbed but the construction activities will drive away this species from project construction area. Furthermore, the construction work force might get involved in illegal poaching and wildlife trade of these animals.

Similarly, the other wildlife species of conservational importance such as *Naemorhedus goral, Macaca mulatta, Semnopithecus hector* will lose their feeding and resting ground in the community forest located at Haku VDC by the clearance of trees for establishment of various project structures and facilities. As these mammals are occasional visitors and their core habitat is located far from the construction area, the envisaged impact is low. However, the construction activities might disturb the wildlife.

The direct impact to the birds is envisaged to be minimal as they have very large home range and additionally, no nesting ground of conservational significant avifauna species is identified within the project construction site. *Haplobatrachus tigerinus* is commonly found in the project area as well as its economical use is not practiced in project area, any impact to its habitat loss by project construction is not envisaged.

3. Disturbance to the Aquatic Habitat including Obstruction for Fish Migration due to Construction of Weir

The major construction works carried out in the Trishuli River is the erection of foundation of weir, for which the diversion of water is necessary. This activity will be carried out in dry season for a short period of about 3 months. Few stretch of river (about 300 m) downstream of weir will be dewatered from this activity in which some species of fish might get trapped. The diversion works will also increase the turbidity of water affecting fish species and fishery habitats. Sedimentation by silt and clay materials may occur along the few 100s of meter of river stretch downstream of weir that might disturb the spawning and rearing ground of ground of Snow Trout. The increased fishing activities in this area for the growing demand of construction and construction workers may occur that adversely affect the fish population. However, the change in river hydrology is not foreseen.

4. Impact on Aquatic Ecosystem due to Project Activities

The construction related works such as removal of stream boulder for construction materials, extraction of construction materials like sand, stones, pebbles, etc. from river, will disturb the aquatic ecosystem. Likewise, the river water may get polluted by fortuitous discharge of spoil, cement slurry, lubricants, fuel and other chemicals that will affect fish and other aquatic life. Similarly, the waste water of the construction camp might get discharged into the river changing water quality. The changes in water quality brought by these activities will affect the aquatic ecosystem. These activities will severely affect the aquatic ecosystem including fish population.

5. Increased Pressure to the Surrounding Forest for its Products such as Firewood, Timber, Non timber Forest Product (NTFP)

All the project structures and facilities (except some portion of weir and pondage area) are located on the right side of the river, which was purposely designed so as to avoid possible adverse impacts of the project upon the protected areas (LNP). Nevertheless, some impacts due to eased access are likely to occur from the collection of firewood, NTFPs, valuable floral species etc. by the construction workers from the buffer zone areas (left bank). However, most of the areas of buffer zone are less accessible due to the presence of rocky environmental settings where the accessible forest area is only found in the valley bottom. Furthermore, there is minimal chance of such impacts on the National park area as it is little far and buffer zone itself is acting as a strong barrier to conduct such activities. Though the

area is already under the surveillance of the LNP to control collection of forest products, the rangers and game scouts of LNP will come under pressure to control the increased numbers of people in the site.

As far as the forest of right bank (Haku VDC) is concerned, the construction workforce and their dependent might exploit the local community forest by harvesting forest product for fuel wood, timber and NTFPs. As the surveillance, mechanism for community forest is not so effective in Haku VDC, the degradation of existing forest as well as increased pressure on the existing forest resources of project area persist.

6. Increased Access to Forest, Illegal Hunting and Poaching

The establishments of permanent structures such as weir, access road, tunnel adits, etc are located on community forest, private forest and forest of buffer zone of LNP signifying access to forest. Furthermore, there will be frequent movement of project vehicles, public vehicles due to availability of the access road for the proposed project. Thus, it is likely that the both local forest resources and LNP including wildlife of the area could be exploited commercially with increased access. Due to the presence of outside workforce and their dependents and other employee within the project area, illegal hunting and poaching of wild animal practice may get accelerated. The work force may start hunting of wildlife in the project area. As the surveillance mechanism for community forest is not so effective in Haku VDC, the impact is of concern in the existing forest of Haku VDC. On the other hand, although the forest of buffer zone is already under the strict surveillance of LNP, the extraction of forest and illegal hunting could not be overruled that can increase the additional pressure to rangers and game scouts of LNP.

7. Access Road Construction from Powerhouse to Intake Site and its Subsequent Loss or Degradation of Forest and Wildlife Habitat

As the access road stretch from powerhouse site to Gogane village will be constructed by the local community of Haku VDC, the project needs to construct 12.54 km long road to access headworks and surge shaft. The construction of these stretches of access road will result in permanent loss of 18.05 hectares of forest (17.75 ha community forest) as a part of site clearance. Thus, the majority of permanent loss of forest of the proposed project is due to the construction of access road as the forest loss (18.05 hectares) for the access road is about 84.36% of total permanent loss of forest (21.39 hectares). Of the permanent loss of forest in access road, the loss of community and private forest will be 17.75 ha (98.34%) and 0.30 ha (1.66%) respectively.

Table 5.7: Land Use of Access Road to Surge Shaft and Gogane Village to Headworks

Area	Agricultural Land (Khet and Bari)	Forest	River	Bagar	Cliff	Existing Road	Total
Hectare	6.0	18.05	0.00	3.98	8.76	0.35	37.14
%	16.16	48.60	0.00	10.71	23.59	0.95	100.00

Source: Feasibility Study Report, UT- and EIA Field Survey, 2011

Though road construction in hilly terrain is considered as one of the major cause of environmental degradation, the proposed road from Gogane to headworks as well as surge shaft passes from heavily degraded forest patches with sparse distribution of tree. Many stretch of this road is represented by rocky barren terrain almost devoid of tree vegetation,

Thus, the loss in terms of wood volume and tree density is not so large, and so as the degradation of forest is not envisaged.

As far as wildlife is concerned, the baseline wildlife survey revealed that the forest of access road is not the core habitat of wildlife species. The forest stretch within Hakubesi and Mailun is unfavourable ground for wildlife species due to presence of settlements, agricultural land and usual intervention of human. Similarly, the forest of road stretch in rocky terrain i.e. nearby Buchet Phant is used by wild animals occasionally as a route for their movement and resting area. The forest stretch of the road near Adit 3 and 4 is also used as feeding and resting purposes. Thus, there is no effect on core habitat of wildlife by the construction of road, thus, the degradation of wildlife habitat is not envisaged.

On the other hand, the project affected area is not connected with the vehicular road facility. Thus, the use of the local forest resources is limited only to the local community consumption. With the road construction, there is a potentiality of the forest resource exploitation for commercial benefit by the local community apart from the regular use. Additionally, the opening of new vehicular road increases the mobility of people and construction vehicles that in turn, increase the noise level. The noisy environment will drive away the terrestrial wildlife from the vicinity of construction sites as the terrestrial wildlife is very noise sensitive.

8. Disposal of Spoil and Muck in the River may Affect the Aquatic Ecosystem Including Disturbance to Spawning Ground of Fishes

Excavation activities during the construction phage will produce large quantity of spoil and muck (**6151644 m^3**). Improper and haphazard disposal of spoil and muck might increase the sediment load in the river. Additionally, there is also a possiblity of washout of disposed spoil and muck in the river during high monsoon floods as most of the spoil and muck disposal sites of the project are located in the flood plain area along the right bank of the Trishuli River. High water flow accompanied by increase turbidity of the river water during the monsoon season will have great implication on aquatic ecosystem including fish and their spawning ground located nearby these spoil disposal sites. The gill of fishes may get blocked resulting their death.

9. Impact on Langtang National Park and its Buffer Zone

Except weir, remaining project structures and facilities of proposed project are located on the right bank of the Trishuli River in Haku VDC, which is also the boundary river between Haku VDC and Langtang National park. Although there will be not be significant construction work on the left bank of the river (except construction of left portion of weir), the interruption on the National Park area and its buffer zone cannot be ignored. There may be some disturbance on animal and bird movement at weir construction site, temporarily during construction work due to human and heavy equipment's movement, noise and vibration. Furthermore, workforce may involve in medicinal plant and firewood collection, illegal hunting and poaching of wild animals in spite of current surveillance of LNP, which will have negative impact on the species diversity and increase pressure on park surveillance activities.

10. Impact on Biodiversity

a. Impact on Plant Biodiversity

Due to gorgeous nature of the river and difficult terrain condition, the project installation sites have to be selected on forest land (both temporarily and permanently). For the project of such scale, apparently, the loss of biodiversity occurring in these sites due to the project activities seems to be large but these sites are purposely established on degraded areas, river banks, barren land, and fallow land etc. where minimum impact on plant biodiversity is anticipated. In the project context, the direct impacts of project activities on the plant biodiversity are due to the acquisition of forestland [**Government Forest (2.61 ha), Community Forest (23.01 ha) and Private Forest (1.58 ha)]** and tree felling & other vegetation clearance for establishment of project structures and facilities. The project will require clearing of 12001 tree species (Seedling-4858, Sapling- 346, Pole- 3880 and Tree-917) of about 30 plant species.

Table 5.8: Loss of Vegetations in Various Project Structures and Facilities

SN	Project Structures/Facilities	Type of Forest	Forest Area (Ha.)	Loss of Vegetation (Nos.)					Major Vegetation Species
				Seedling	Saplings	Pole	Tree	Total	
1	Pondage Area	Government	0.19	1	0	8	18	27	*Toona ciliata , Schima wallichii*
		Community	0.10	4	0	7	0	11	*Wendlandia* sp., *Englehardtia spicata*
2	Weir/CSS	Government	2.42	148	0	259	407	814	*Schima wallichii,, Englehardtia spicata, Alnus nepalensis*
3	Adit Portal to Desander Basin	Community	0.03	6	5	4	0	15	*Macaranga Pustulata, Alnus nepalensis*
4	Adit 1	Community	0.06	3	2	10	3	18	*Boehmeria regulosa, Syzizium* sp., *Pinus roxburghii,*
5	Adit 3	Community	0.14	5	7	7	5	24	*Pinus roxburghii, Schima wallichii*
6	Adit 4	Community	0.09	9	7	29	2	47	*Shorea robusta, Pinus roxburghii*
7	Adit Portal to Surge Tank	Community	0.09	91	30	26	6	153	*Shorea robusta, Wendlandia* sp.
8	Air Vent Tunnel	Community	0.03	9	4	3	1	17	*Shorea robusta*
9	Switchyard	Private	0.20	104	68	60	12	244	*Shorea robusta*
10	Access Road to Headworks	Community	11.19	469	476	1401	176	2522	*Shorea robusta, Pinus roxburghii, Alnus nepalensis, Schima Wallichii, Wendlandia sp.*
		Private	0.30	5	10	14	0	29	*Pinus roxburghii, Wendlandia* sp.
11	Access Road to Surge Shaft	Community	6.56	3687	1419	1355	255	6716	*Pinus roxnurghii, Shorea robusta, Boehmeria regulosa*
12	Quarry Site - 3 (Tungbar Terrace)	Community	0.95	0	44	121	0	165	*Shorea robusta, Schima wallichii*
13	Spoil and Muck Disposal Area - 5 (Northeast of Hakubesi-Fulbari)	Community	1.13	90	80	120	30	320	*Callicarpa arbolea, Wendlandia sp., Mallotus phillippinensis*

SN	Project Structures/Facilities	Type of Forest	Forest Area (Ha.)	Loss of Vegetation (Nos.)					Major Vegetation Species
				Seedling	Saplings	Pole	Tree	Total	
14	Spoil and Muck Disposal Area - 6 (Northeast of Hakubesi Landslide)	Community	0.84	64	64	128	0	256	*Phyllanthus emblica, Ficus cunia, Mallotus philippinensis*
15	Spoil and Muck Disposal Area - 7 (Southeast of Hakubesi Landslide)	Private	1.00	48	48	72	0	168	*Alnus nepalensis, Ficus cunia, Boehmeria regulosa*
16	Spoil and Muck Disposal Area - 8 (Southeast of Hakubesi Landslide)	Community	1.28	30	10	110	0	150	*Boehmeria regulosa, Englehardtia spicata, Desmodium ojinensis*
17	Spoil and Muck Disposal Area - 14 (Tungbar Terrace)	Community	0.53	42	49	119	0	210	*Englehardtia spicata, Toona ciliata*
18	Spoil and Muck Disposal Area -26 (Switchyard)	Private	0.08	43	23	27	2	95	*Shorea robusta, Mallotus phillippinensis*
Total	**27.20**	**4858**	**2346**	**3880**	**917**	**12001**			

Table 5.9: Loss of Wood Volume and Biomass in terms of Plant Species

S. N	Local Name	Botanical Name	Avg. DBH/Range*(for >= 10 cm DBH)	Loss of Vegetation**				Standing Wood Volume		Biomass for STANDING Tree (MT) [Wet]	Biomass Usages
				Loss of Regeneration		Loss of Tree (Number)		Timber (Cubic Meter)	Fuel Wood (Chatta)		
				Seedlings per ha.	Saplings per ha.	Pole Class	Tree Class				
1	-	*Ficus* sp.	10.51	0	0	1	0	0.030	0.002	0.027	Firewood
2	Aanp	*Mangifera indica*	20.70	0	0	8	0	1.959	0.138	1.721	Timber
3	Amala	*Phyllanthus emblica*	14.33	3	7	31	0	1.874	0.132	1.647	Firewood
4	Amba	*Psidium guajava*	11.15	0	0	7	0	0.171	0.012	0.150	Firewood
5	Chilaune	*Schima wallichi*	34.04	4	2	167	87	245.413	17.316	220.014	Firewood, Timber
6	Chiuri	*Aesandra*	31.53	0	0	4	4	4.592	0.324	4.035	Timber

S. N	Local Name	Botanical Name	Avg. DBH/Range*(for >= 10 cm DBH)	Loss of Vegetation**				Standing Wood Volume		Biomass for STANDING Tree (MT) [Wet]	Biomass Usages
				Loss of Regeneration		Loss of Tree (Number)		Timber (Cubic Meter)	Fuel Wood (Chatta)		
				Seedlings per ha.	Saplings per ha.	Pole Class	Tree Class				
		butyracea									
7	Daar	*Boehmeria rugulosa*	18.48	0	0	602	1	52.215	3.684	45.918	Making Wood Container
8	Gogan	*Saurauia nepaulensis*	19.11	0	0	1	0	0.100	0.007	0.088	Firewood, Timber
9	Guelo	*Calicarpa arbolea*	13.95	1	1	126	0	5.351	0.378	4.703	Firewood
10	Guras	*Rhododendron arboreum*	12.74	0	1	1	0	0.016	0.001	0.014	Medicine, Firewood and Preparation of Wine
11	Jamun	*Syzizium* sp.	18.75	1	4	120	2	8.194	0.578	7.202	Firewood, Timber
12	Kabhro	*Ficus lacor*	14.33	0	0	4	0	0.226	0.016	0.198	Fodder
13	Kangiyo	*Wendlandia* sp.	18.46	15	8	170	12	20.247	1.429	17.871	Timber, Firewood
14	Kaphal	*Myrica esculanta*	27.39	23	6	23	6	12.187	0.860	10.916	Timber, Firewood
15	Khanayo	*Ficus cunia*	16.74	2	2	61	0	4.848	0.342	4.261	Fodder, firewwod
16	Khote Sallo	*Pinus roxburghii*	20.23	4	4	403	15	97.426	6.874	85.679	Timber
17	Koiralo	*Bauhinia variegata*	21.97	2	0	58	15	14.111	0.996	12.483	Firewood
18	Maleto	*Macaranga pustulata*	22.98	0	0	17	37	109.833	7.750	98.775	Timber, Firewood
19	Mauwa	*Englehardtia spicata*	26.96	5	3	268	199	557.461	39.334	498.119	Timber, Firewood
2	Painyu	*Prunus cerasoides*	10.51	0	0	4	0	0.061	0.004	0.053	Firewood, Religion

S. N	Local Name	Botanical Name	Avg. DBH/Range*(for >= 10 cm DBH)	Loss of Vegetation**				Standing Wood Volume		Biomass for STANDING Tree (MT) [Wet]	Biomass Usages
				Loss of Regeneration		Loss of Tree (Number)		Timber (Cubic Meter)	Fuel Wood (Chatta)		
				Seedlings per ha.	Saplings per ha.	Pole Class	Tree Class				
21	Pipal	*Ficus religiosa*	12.74	0	0	4	0	0.229	0.016	0.202	Religion, Firewood
22	Rohini	*Mallotus philippinensis*	11.92	4	4	44	0	1.299	0.092	1.142	Firewood
23	Saaj	*Terminalia alata*	17.25	3	3	157	0	15.260	1.077	13.411	Timber
24	Saandan	*Desmodium ojinensis*	15.22	0	0	174	0	20.870	1.473	18.342	Fodder, Firewood
25	Sal	*Shorea robusta*	23.43	129	43	1167	299	481.219	33.955	423.414	Timber
26	Simal	*Bombax ceiba*	15.39	0	0	16	0	0.928	0.066	0.816	Timber
27	Siris	*Albizzia* sp.	23.99	0	0	22	0	4.202	0.296	3.693	Fodder
28	Syalphusro	*Grewia optiva*	16.56	0	0	14	0	1.228	0.087	1.079	Firewood
29	Tooni	*Toona ciliata*	28.98	1	1	74	8	31.714	2.238	28.325	Timber, Firewood
30	Uttis	*Alnus nepalensis*	28.28	1	1	132	232	315.113	22.234	279.33575	Timber
Total						3880	917	2008.377	141.7111	1783.633	

*Note: **Seedling_0-4 cm DBH; Sapling_4-10 cm DBH; Pole Class_10-30 cm DBH; Tree Class_>30 cm DBH*

The current market value of loss of tree species as per the valuation of Government of Nepal accounts to NRs.**2,07,01,365.70**/-

Table 5.10: Valuation of Forest Product Loss (in terms of Plant Species)

S.N	Local Name	Botanical Name	Value of Timber Loss (NRs)		Value of fuel Wood Loss (NRs)	Value of Fodder Loss (NRs.)	Total (NRs)
			Pole Class	Tree Class			
1	-	*Ficus* sp.	250.00	0.00	24.62	0.471	275.10
2	Aanp	*Mangifera indica*	3600.00	0.00	1589.29	30.41	5219.69
3	Amala	*Phyllanthus emblica*	7750.00	0.00	1520.97	29.100	9300.07

S.N	Local Name	Botanical Name	Value of Timber Loss (NRs)		Value of fuel Wood Loss (NRs)	Value of Fodder Loss (NRs.)	Total (NRs)
			Pole Class	Tree Class			
4	Amba	*Psidium guajava*	1750.00	0.00	138.497	2.65	1891.15
5	Chilaune	*Schima wallichi*	75150.00	2751078.26	199138.25	2901.67	3028268.18
6	Chiuri	*Aesandra butyracea*	1800.00	34401.37	3725.91	71.29	39998.56
7	Daar	*Boehmeria rugulosa*	270900.00	17342.25478	42368.98	804.47	331415.70
8	Gogan	*Saurauia nepaulensis*	450.00	0.00	81.40	1.56	532.96
9	Guelo	*Calicarpa arbolea*	31500.00	0.00	4342.27	83.08	35925.35
10	Guras	*Rhododendron arboreum*	450.00	0.00	12.92	0.25	463.17
11	Jamun	*Syzizium* sp.	54000.00	14773.56	6649.20	127.22	75549.98
12	Kabhro	*Ficus lacor*	1800.00	0.00	183.16	3.50	1986.66
13	Kangiyo	*Wendlandia* sp.	42500.00	38563.91	16428.92	298.03	97790.86
14	Kaphal	*Myrica esculanta*	10350.00	121260.60	9889.17	146.12	141645.89
15	Khanayo	*Ficus cunia*	27450.00	0.00	3933.73	75.26	31458.99
16	Khote Sallo	*Pinus roxburghii*	181350.00	129625.98	129625.98	1500.89	442102.85
17	Koiralo	*Bauhinia variegata*	14500.00	34403.88	11450.06	201.95	60555.90
18	Maleto	*Macaranga pustulata*	7650.00	1327013.80	89122.76	1233.64	1425020.21
19	Mauwa	*Englehardtia spicata*	120600.00	6270682.82	452346.09	6936.46	6850565.38
20	Painyu	*Prunus cerasoides*	1800.00	0.00	49.25	0.94	1850.19
21	Pipal	*Ficus religiosa*	1800.00	0.00	186.06	3.56	1989.62
22	Rohini	*Mallotus philippinensis*	11000.00	0.00	1054.05	20.17	12074.22
23	Saaj	*Terminalia alata*	70650.00	0.00	12382.49	236.91	83269.40
24	Saandan	*Desmodium ojinensis*	78300.00	0.00	16934.88	324.01	95558.89
25	Sal	*Shorea robusta*	525150.00	3095682.38	390480.13	7367.21	4018679.73
26	Simal	*Bombax ceiba*	7200.00	0.00	753.34	14.41	7967.75
27	Siris	*Albizzia* sp.	9900.00	0.00	3409.34	65.23	13374.57
28	Syalphusro	*Grewia optiva*	3500.00	0.00	996.68	19.07	4515.74
29	Tooni	*Toona ciliata*	33300.00	277538.21	25734.15	397.44	336969.80
30	Uttis	*Alnus nepalensis*	59400.00	3225664.747	255695.24	4389.17	3545149.15
Total			**1655800.00**	**17338031.78**	**1680247.78**	**27286.13**	**20701365.70**

Note: Pole - Ku Kath = NRs. 250/pole, Sukath NRs 450/pole; Timber - KuKath = NRs 125/cft, SuKath = NRs 350/cft; Fuel Wood - Lump Sum NRs.11500/Chatta; Fodder- Lump sum NRs 0.5/kg

All the tree species that will require clearing for the construction of the proposed project is the common species of the project area and their loss will only in number and will not affect the biodiversity of the project area. Moreover, these species are commonly available in other region of Nepal. However, the loss of plant species in already degraded forest is of local significance in the conservational perspective of these species.

Moreover, apart from the forest located within the buffer zone of LNP, most of the forest area affected by the proposed project possesses minimum forest cover and density. Moreover, the forest land of 27.20 ha required for the project is just 0.06% of total forest cover (42616 ha) of the district. Similarly, the temporary and permanent acquisition of 23.01 ha of community forest of Haku VDC results in loss of only 0.74% area of total community forest (3086.71 ha) of Haku VDC.

The other details regarding forest loss of the proposed project is presented in **Annex 5.1 (Forest Resource Data Presentation)**.

b. Impact on Animal Biodiversity

The baseline wildlife study revealed that the project area is less favourable for wild animals due to thinly scattered tree vegetation & steep rocky terrain and presence of agricultural fields & settlements. The project area is not the core habitat or migratory route of mammals or any other animal life. The recorded Snow trout is the most common fish species found in many rivers of Nepal. Similarly, the reported species of herpetofauna and birds are very common species, which are commonly available on other regions of Nepal as well. However, the forest clearance works and construction activity in the river might disturb the wildlife and fish of the project area.

5.1.1.4 Operation Phase

1. Barrier Effect of Weir on Fish Migration and Effect of Dewatered Zone on Fish Habitats and Aquatic Life

The placement of weir in the Trishuli River will obstruct the route of the long and mid-distance migratory fish. These species will abandon the original pool and colonize deep pool regions downstream or upstream. Thus, the construction of the proposed weir is likely to abrupt the free flowing behaviour of the mid distant Snow Trout and obstruct their migration that in turn can reduce their significant population, especially downstream. Fish such as snow trout may even pulled into the intake and get killed.

Moreover, the volume of water is considerably reduced in the downstream of weir during dry season. As a result, the downstream of weir site i.e. dewatered zone may change to pools alternating with dry stretches for about 7 months from November to May. Snow Trout needs running water with high-oxygenated water, but after diverting the water into tunnel, amount of water will be reduced where this species will experience less favourable habitat.
In addition, rooted plants will grow in the riverbed due to the decrease in water volume. Fish food organisms will be highly affected by reduced flow rates and new species will invade areas with a slow current, which leads to stunted growth, diseases and parasite infestation and increased mortality. Thus, the river ecosystem will change and both feeding grounds and breeding grounds will be affected, leading to fish abundance loss. There will be

some localized impacts in the flow regime of the river during dry season. The essential ecological effect that can be traced in comparatively lower range of time will be effects on food chain, i.e. decline of other aquatic lives especially downstream.

2. Issue Related with Impacts on Vegetation of Surrounding Area and Dependent Wildlife due to Project Accessibility

Due to road access, many economic activities might get established in project area in the form of hotel, lodge, restaurant, cottage industry, etc. This will result in influx of large number of people in project area from inside project area as well as outside project area. The easy access might encourage the people for illegal collection of the forest products, in particular the timber, firewood and non-timber forest products from the local forest of Haku VDC. The unregulated collection of the forest products might hinder natural regeneration and growth of plants. These activities will result in the degradation as well as fragmentation of the forest. This will have implication on the forest dependent wildlife as well as some wild animals lose their feeding and resting ground due to fragmentation of forest. However, this impact is comparatively low in buffer zone of LNP as the road access will be restricted to weir site only as well as the area is already under the surveillance of LNP.

3. Impact on Forest and Biodiversity during Operation of the Project

During operation period, the number of project staffs will be limited and also their activity within the forest area is less. Thus, the impact on forest and biodiversity during operation period is envisaged very low. However, some regular events of reconstruction, renovation, maintenance and transportation of equipments and related activities may disturb the existing forest as well as wildlife of forest of both Haku VDC and Buffer zone, though significant impact is not foreseen.

4. Loss of Vegetation, Forests and Forest Products

The increase access and increase in flow of people might result in illegal collection and harvesting of forest products for timber, firewood and NTFPs from the forest of Haku VDC. In addition, the encroachment of forest land by the people cannot be ignored. However, this impact is comparatively low in buffer zone of LNP due to restriction in access as well as project work being mainly confined at Haku VDC.

5. Increased Access to Forest

Due to road access in project area (Haku VDC), there will be frequent movement of public vehicles inducing mobility of people. As many forest areas are located within the access road of the project, it would be easier for people to access the forest and exploit the timber, firewood and non-timber forest products available in the local forest. However, this impact is comparatively low in buffer zone of LNP as the road access will be restricted to weir site only.

6. Illegal Hunting and Poaching

The access road facility after the construction of project will attract many people in the project area for various purposes such as business, sightseeing of hydroelectric plant, etc. resulting in the increase of flow of people, both from local area, adjoining area as well as outside district. Furthermore, the access road of the project will be used by local villagers for their main access. As the permanent structures such as headworks, powerhouse, etc. are

located on forest land as well as major portion of access road is nearby forest, illegal hunting and poaching of wild animal might be practiced by the visitor as well local people. As the project construction area in Haku VDC is not under any sort of surveillance to control these activities, the foreseen impact is of concern. However, the envisaged impact is low in buffer zone area of Dhuche VDC as the area is already under the surveillance of LNP as well as the road is restricted to left portion of weir site i.e. in Haku VDC.

7. Impact on Wild Animals

As already stated the project area is less favourable for wild animals due to thinly scattered tree vegetation & steep rocky terrain. Moreover, the forest area has been already intervened by human activity due to the location of settlements and agricultural field nearby forest. Likewise, the project area is not the core habitat or migratory route of mammals or any other animal life. Furthermore, during operation phase, the number of project staffs as well as their activity will be less. However, the movement of vehicle around the forested area increase noise level of the surrounding and might disturb the wildlife of forest of Haku VDC, though the envisaged impact is not envisaged in Buffer zone area of LNP.

8. Impact on Langtang National Park and its Buffer Zone

The project site is within the borderline of the buffer zone of LNP and some part of buffer zone area (2.61 Ha) is utilized for establishment of weir site and pondage area. However, due to steep topographical condition of both banks and distantly situated settlements, the further chance of encroachment of forest of buffer zone as well as LNP in operation phase is not envisaged in spite of creation of dry dewatered zone. However, the collection of forest products and illegal hunting of wild animals of LNP and its Buffer Zone cannot be ignored in spite of strict surveillance of LNP authorities in the area.

The sudden release of water from headworks during load dispatch or maintenance purpose, especially during dry season, could affect the movement of wild animals of national park, buffer zone as well as surrounding forest. This sudden release will be more severe during night hour as it can result in an accidental washout or drowning of wild animals.

The cold water fish species like Churches Asala and Buchche Asala are ecologically adapted to a fast flowing condition of the Trishuli River bordering buffer zone of LNP. In dry months of operation stage, the river stretch will feature reduction in discharge of water and decrease river depth in which will affect river ecology including habitat of fish of LNP area.

Table 5.11: Summary of Biological Environmental Adverse Impact

S.N.	Biological Environment Issues	Impacts	Nature (D/I)	Extent	Duration	Magnitude
Construction Phase						
1.1.1	Impact to Existing Forest due to site clearance works for establishment of project structures and facilities	Permanent loss of 18.29 hectares of community forest	D	L	LT	M
1.1.2		Permanent loss of 2.61 hectares of government forest (forest of buffer zone of LNP).	D	SS	LT	L
1.1.3		Permanent loss of 0.50 hectares of private forest	D	L	LT	L
1.1.4		Temporary loss of 4.72 hectares of community forest	D	L	ST	L
1.1.5		Temporary loss of 1.09 hectares of private forest	D	SS	ST	L
1.2.1	Impact on rare, protected, vulnerable, endangered and endemic species of flora and fauna and their habitat	Loss of Shorea robusta and Bombax ceiba i.e. protected plant species listed under GoN.	D	SS	LT	L
1.2.2		Loss of feeding and resting ground of Ursus tibetans at weir area of buffer zone of LNP	ID	SS	ST	M
1.2.3		Illegal poaching and wildlife trade of Ursus tibetans	ID	SS	ST	H
1.2.3		Loss of feeding and resting ground of Naemorhedus goral, Macaca mulatta, Semnopithecus hector in community forest of Haku VDC	ID	L	ST	L
1.2.4		Illegal poaching and wildlife trade of Naemorhedus goral	ID	L	ST	H
1.2.5		Disturbance to protected wildlife by construction activities	ID	L	ST	M
1.3.1	Disturbance to the aquatic habitat including obstruction for fish migration due to construction of weir	Trapping of fish in the dewatered stretch created by diversion of weir.	D	SS	ST	L
1.3.2		Increase in turbidity of river water affecting fish species and fishery habitats	D	SS	ST	L
1.3.3		Disturbance to spawning and rearing ground of ground of Snow Trout	D	SS	ST	L
1.3.4		increased fishing activities in dewatered area	ID	SS	ST	M
1.4.1	Impact on aquatic ecosystem due to project activities	Disturbance to aquatic ecosystem due to removal of boulders and extraction of construction materials from river	D	SS	ST	M

S.N.	Biological Environment Issues	Impacts	Nature (D/I)	Extent	Duration	Magnitude
1.4.2		Fortuitous discharge of spoil, cement slurry, lubricants, fuel, chemicals, etc polluting river water and affecting fish and other aquatic life	ID	L	ST	M
1.4.3		Waste water discharged from construction camp polluting river water quality and in turn, affecting aquatic ecosystem	ID	L	ST	L
1.5.1	Increased pressure to the surrounding forest for its products such as firewood, timber, non-timber forest product (NTFP	Illegal collection of firewood, NTFPs, valuable floral species, etc. by construction workers from the buffer zone areas of LNP	ID	L	ST	L
1.5.2		Illegal harvesting of forest product for fuel wood, timber and NTFPs by construction workers in local community forest of Haku VDC.	ID	L	ST	M
1.6.1	Increased access to forest, illegal hunting and poaching	Illegal hunting and poaching of wild animal in buffer zone area of LNP	ID	L	ST	L
1.6.2		Illegal hunting and poaching of wild animal in community forest of Haku VDC	ID	L	ST	M
1.7.1	Access road construction from powerhouse to intake site and its subsequent loss or degradation of forest and wildlife habitat	Permanent loss of 17.75 hectares of community forest as a part of site clearance for the construction of access road.	D	L	LT	M
1.7.2		Permanent loss of 0.30 hectares of private forest	D	SS	LT	L
1.7.3		Degradation of forest and wildlife habitat	N/A	N/A	N/A	N/A
1.7.4		Loss of feeding and resting ground of wildlife species	ID	L	ST	L
1.7.5		Exploitation of forest resource and wildlife by local community for commercial benefit	ID	L	ST	M
1.7.6		Driving away of terrestrial wildlife due to increment of noise level.	ID	L	ST	M

S.N.	Biological Environment Issues	Impacts	Nature (D/I)	Extent	Duration	Magnitude
1.8.1	Disposal of spoil and muck in the river may affect the aquatic ecosystem, including disturbance to spawning ground of fishes	Increase in turbidity of river water affecting spawning ground of fish	ID	L	ST	M
1.8.2		Death of fish due to blocking of gills by turbid water	ID	L	ST	M
1.9.1	Impact on Langtang National Park and its buffer zone	Disturbance on animal and bird movement at weir construction site due to human and heavy equipment´s movement, noise and vibration	ID	L	ST	M
	Impact on biodiversity (plant diversity and animal diversity)	Loss of 12001 tree species (Seedling-4858, Sapling-2346, Pole-3880 and Tree-917) of community, government and private forest.	D	L	LT	M
1.10.2		Disturbance to wildlife due to clearance of forest	ID	L	ST	L
1.10.3		Disturbance to fish habitat due to construction activity of weir	ID	L	ST	L
Operation Phase						
2.1.1	Barrier effect of weir on fish migration and effect of dewatered zone on fish habitat and aquatic life	Obstruction of the route of mid distant Snow Trout by the placement of weir in Trishuli river	D	R	LT	H
2.1.2		Change in aquatic habitat in dewatered zone due to diversion of water from weir resulting decrease of fish population	D	L	LT	H
2.1.3		Decline of other aquatic lives	D	L	LT	H
2.2.1	Issues related with the impacts of vegetation of surrounding area and dependent wildlife due to project accessibility	Illegal collection of the forest products, in particular the timber, firewood and NTFPs from the local forest of Haku VDC	ID	L	LT	M
2.2.2		Degradation and fragmentation of the forest due to unregulated collection of the forest products of local forest of Haku VDC	ID	L	LT	H
2.2.3		Disturbance to feeding and resting ground of wildlife due to fragmentation of forest	ID	L	LT	M
2.2.4		Illegal collection of the forest products in buffer zone of LNP	ID	L	LT	L
2.2.5		Disturbance to wildlife habitat in LNP	ID	L	LT	L

S.N.	Biological Environment Issues	Impacts	Nature (D/I)	Extent	Duration	Magnitude
2.3.1	Impact on forest and biodiversity	Disturbance to forest and wildlife of Haku and buffer zone of LNP by regular events of reconstruction, renovation, maintenance and transportation	ID	L	LT	L
2.4.1	Loss of vegetation, forest and forest products	Illegal collection and harvesting of forest products for timber, firewood and NTFPs from the forest of Haku VDC	ID	L	LT	M
2.4.2		Encroachment of forest land of Haku VDC	ID	L	LT	M
2.4.3		Illegal collection and harvesting of forest products from Buffer zone of LNP	ID	L	LT	L
2.4.4		Encroachment of forest land in buffer zone of LNP	ID	L	LT	L
2.5.1	Increase access to forests	Exploitation of forest products within access road of Haku VDC	ID	L	LT	M
2.5.2		Exploitation of forest products of buffer zone of LNP	ID	L	LT	L
2.6.1	Illegal hunting and poaching	Illegal hunting and poaching of wild animal by the visitor in Haku VDC	ID	L	LT	M
2.6.2		Illegal hunting and poaching of wild animal by the visitor in Buffer zone area of LNP	ID	L	LT	L
2.7.1	Impact on wild animals	Driving away of terrestrial wildlife due to increment of noise level at Haku VDC	ID	L	LT	M
2.7.2		Driving away of terrestrial wildlife due to increment of noise level at Buffer zone, LNP	N/A	N/A	N/A	N/A
2.8.1	Impact on Langtang National Park and its Buffer zone	Collection of forest products and illegal hunting of wild animals of LNP	ID	L	LT	L
2.8.2		Accidental washout or drowning of wild animals by sudden release of water from weir	D	L	LT	M
2.8.3		Reduction in discharge of water and decrease river depth in dry month affecting river ecology including habitat of fish of LNP area	D	L	LT	H

Note: D= Direct; ID = Indirect, SS= Site Specific; L = Local, R = Regional; ST= Short Term, MT = Medium Term, LT = Long Term; L = Low, M = Moderate, H = High; NA = Not Applicable or No impact

5.1.2 Socioeconomic and Cultural Environmental Issues

5.1.2.1 Construction Phase

1. Loss of Agricultural Land and Agricultural Production due to Permanent and Temporary Establishment of Project Structures and Facilities

The establishment of project structures and facilities will result in total loss of 21.75 hectares of private agricultural land belonging to 41 households (***Annex 4.5***). Of this total acquired land, the permanent and temporary loss of agricultural land will be 9.35 ha and 12.40 ha affecting 14 and 27 household respectively. Of the permanently acquired land, irrigated land constitutes 2.49 ha where as Bari and Khar bari constitute 6.70 ha and 0.16 ha respectively. Likewise, the different categories of land to be temporarily acquired by the proposed project are Khet (7.22 ha), Bari (4.30 ha) and Khar Bari (0.89 ha). The temporarily acquired land will be returned back to landowner after completion of the project; however the land owners will lose their agricultural land forever by the permanent acquisition. The detail of permanent and temporary acquisition of agricultural land by different project structures and facilities are provided in **Table 5.12** and **Table 5.13**.

Table 5.12: Permanent Acquisition of Agricultural Land

S. N	Project Structures and Facilities	Agricultural Land (Ha)				Remarks
		Irrigated Land (Khet)	Non-irrigated Land (Bari)	Pakho or Khar Bari	Total	
1	Adit 2 (Buchet Phant)	**0.09**	0.00	0.00	0.09	Land has remained fallow from some years
2	Switchyard	0.00	0.20	0.16	0.35	
3	Access Road to Headwork	0.00	4.80	0.00	4.80	
4	Access Road to Surge Shaft	0.00	1.20	0.00	1.20	
5	Camp Facility -1 and Engineering Camp -1 (Northeast of Hakubesi-Fulbari)	0.00	0.50	0.00	0.50	
6	Camp Facility - 5 (Baluwa Phant)	0.72	0.00	0.00	0.72	
7	Camp Facility - 6, Engineering Camp -2 & Batching Plant Facility -2 (Mailun Dovan)	1.69	0.00	0.00	1.69	Land has remained fallow from some years
Total		2.49	6.70	0.16	9.35	
Percentage (%)		26.67	71.67	1.66	100.00	

Source: Feasibility Study Report, UT-1 HPP and EIA Field Survey, 2011

Table 5.13: Temporary Acquisition of Agricultural Land

S. N	Project Structures and Facilities	Agricultural Land (Ha)				Remarks
		Irrigated Land (Khet)	Non-irrigated Land (Bari)	Pakho or Khar Bari	Total	
1	Spoil Disposal Area - 7 (Southeast of Hakubesi Landslide)	0.00	0.75	0.00	0.75	
2	Spoil Disposal Area - 11 (Buchet Phant)	2.33	0.00	0.00	2.33	Land has remained fallow from some years
3	Spoil Disposal Area - 14 (Tungbar Terrace)	0.00	0.00	0.82	0.82	
4	Spoil Disposal Area -26 (Switchyard)	0.00	0.08	0.07	0.15	
5	Spoil Disposal Area - 27 (Near Switchyard)	0.02	0.00	0.00	0.02	
6	Construction Yard - 1 (Fulbari)	0.00	2.01	0.00	2.01	
7	Camp Facilities - 2 (Fulbari)	0.00	1.36	0.00	1.36	
8	Construction Yard - 2 & Camp Facility - 3 (Buchet)	2.59	0.00	0.00	2.59	Land has remained fallow from some years
9	Batching Plant Facility - 1 (Tungbar)	1.46	0.00	0.00	1.46	
10	Store Facility - 1 (Dharanetar)	0.82	0.00	0.00	0.82	
11	Camp Facility - 4 (Gumchet)	0.00	0.09	0.00	0.09	
Total		7.22	4.30	0.89	12.40	
Percentage (%)		58.20	34.64	7.15	100.00	

Source: Feasibility Study Report, UT-1 HPP and EIA Field Survey, 2011

As agriculture is the predominant occupation of the PAFs, the decrease in agricultural production due to loss of agricultural land will decrease the main source of income of PAFs. Furthermore, as the project area lacks agricultural land and none of PAFs are able to fulfil their food requirement for whole year from their own agricultural production, it will generate additional pressure on their livelihood and people can face hardship. The loss of agricultural production by permanent and temporary land acquisition from Khet is presented in **Table 5.14** and **5.15**. Similarly, the loss of agricultural production by permanent and temporary land acquisition from Bari is given in **Table 5.16** and **5.17.**

Table 5.14: Permanent Loss of Agricultural Production from Irrigated Land (Khet)

S.N	Name of Crops	Production (MT/Ha)	Production (MT/0.72 Ha)
1	Paddy	5.40	3.87
2	Wheat	3.09	2.22
3	Potato	10.31	7.38
4	Mustard	1.55	1.11

Source: Household Survey, EIA, 2011 [Note: The agricultural production of cultivated land (0.72 ha) is only considered whereas of fallow land (1.78ha) is not considered]

Table 5.15: Temporary Loss of Agricultural Production from Irrigated Land (Khet)

S.N	Name of Crops	Production (MT/Ha)	Production (MT/2.30 Ha)
1	Paddy	5.40	12.45
2	Wheat	3.09	7.13
3	Potato	10.31	23.76
4	Mustard	1.55	3.56

Source: Household Survey, EIA, 2011

[Note: The agricultural production of cultivated land (2.30 ha) is only considered whereas of fallow land (4.91ha) is not considered]

Table 5.16: Permanent Loss of Agricultural Production from Non-irrigated Land (Bari)

S.N	Name of Crops	Production (MT/Ha)	Production (MT/6.70 Ha)
1	Maize	8.25	55.28
2	Millet	2.95	19.74
3	Bean (Masyang, Bhatmas)	1.03	6.91

Source: Household Survey, EIA, 2011

(Note: The agricultural production of vegetables is not considered as these are grown in very negligible quantity)

Table 5.17: Temporary Loss of Agricultural Production from non-irrigated Land (Bari)

S.N	Name of Crops	Production (MT/Ha)	Production (MT/4.30 Ha)
1	Maize	8.25	35.43
2	Millet	2.95	12.66
3	Bean (Masyang, Bhatmas)	1.03	4.43

Source: Household Survey, EIA, 2011

(Note: The agricultural production of vegetables is not considered as these are grown in very negligible quantity)

2. Loss of Other Category of Land excluding Agricultural Land and Forest affecting local community

About 55.50 hectares of various categories of government land [bushes, river, bagar, cliff and existing road)] will be acquired by the project for the establishment of various project structures and facilities. Of these government lands, 16.61 hectares will be acquired permanently whereas the remaining 38.88 ha land will be acquired temporary. The temporarily acquired land will be reverted back to original form after the completion of construction period. Most of these lands are also located in steep topography. During field survey, it was revealed that most of these lands are not used for any purpose by the local community as most of the lands are either located in steep terrain or far-off from human access. However, some of these lands located near the cultivated terrace of project facilities such as spoil disposal sites, labour camps, etc. are used occasionally as cattle grazing, fuel wood collection, etc. Thus, the restriction on community use is incredibly low.

Table 5.18: Permanent Loss of Other Category of Land

S. N	Name of Project Structure and Facilities	Bushes	River	Bagar (Flood plain)	Cliff	Existing Road	Total
1	Pondage Area	0.00	0.78	0.57	0.80	0.00	2.15
2	Weir	0.00	0.16	0.12	0.08	0.00	0.36
3	Intake	0.00	0.00	0.00	0.03	0.00	0.03
4	Cutting for slope stabilization on right bank	0.00	0.00	0.00	0.47	0.00	0.47
5	Tailrace Portal	0.00	0.00	0.06	0.00	0.00	0.06
6	Switchyard	0.14	0.00	0.27	0.00	0.04	0.46

S. N	Name of Project Structure and Facilities	Bushes	River	Bagar (Flood plain)	Cliff	Existing Road	Total
7	Access Road to Headwork	0.00	0.00	1.80	8.76	0.09	10.65
8	Access Road to Surge Shaft	0.00	0.00	0.00	0.00	0.09	0.09
9	Access road to Tungbar Terrace	0.00	0.00	2.18	0.00	0.18	2.35
Total		0.14	0.94	5.00	10.14	0.40	16.61

EIA Field Survey, 2011

Table 5.19: Temporary Loss of Other Category of Land

SN	Name of Project Facilities	Bushes	River	Bagar (Flood plain)	Cliff	Existing Road	Total
1	Quarry Site	5.92	0.00	1.27	0.77	0.71	8.67
2	Spoil/Muck Disposal Sites	1.18	0.00	25.39	3.41	0.02	30.00
3	Camp Facility - 5 (Baluwa Phant)	0.22	0.00	0.00	0.00	0.00	0.22
Total		7.31	0.00	26.66	4.18	0.72	38.88

EIA Field Survey, 2011

3. Issue Related to Change in Social Structure, Cultural and Traditional Practices of the Rural People due to the Exposition to the Outside Work Force

The project construction work will require large numbers of workforce. Consequently, the project might have to recruit some exterior work force. People of different parts of Nepal may be recruited in the project works from different parts of Nepal that possess dissimilar culture and rituals. At present, the ethnically isolated groups of people of project area have set relatively stable relationships. These are based on a combination of kinship, residential proximity, and economic cooperation and mutuality. The influx of large numbers of outside people into these communities is certain to cause major changes in social relationships & structure as well as cultural and traditional norms. The difference in culture and rituals may clash between the outside and local work force resulting conflict between them. This could be also disruptive in the network of social relationships practiced by local people. These changes will be envisaged particularly near settlements such as Hakubesi, Gogane and Mailun.

4. Implication of Boom Effect on the Local Economy and Inflation

At present, majority of the population of project affected VDCs follow agriculture and animal husbandry for their subsistence. Thus, the local economy is basically dependent on agriculture and farm activities. During project construction period, people will shift to the occupations other than agriculture and animal husbandry such as project's work force, labour, business (i.e. hotel, lodge, teas shops and supply of goods) etc. As the project area already lack agricultural works because of migration of people as foreign employee in the countries of Middle East, the shifting of occupation further deduce their availability. Thus, these new economic opportunities will have a boom effect on local economy. Similarly, the higher demand of commodity goods and agricultural products in the project area may increase the price of these goods in the project area resulting inflation.

5. Resettlement or Relocation Issues

The project needs to acquire 2 residential houses at Baluwa Phant for the establishment of permanent camp near powerhouse area. Thus, two households need to be relocated due to acquisition of the residential houses. These families will lose land as well as 2 cowsheds in addition. The loss of houses will take out shelter of these affected families. Thus, these two project affected families are termed as SPAF (Seriously Project Affected Family). As the acquisition of houses will directly affect the residence of these affected families, the envisaged impact is of high magnitude. The remaining 39 households need to be rehabilitated as they only lose land.

Table 5.20: Detail of House and other Structures of SPAF

SN	Structure Type	Dimension (m)		Area (m^2)	No. of Storey	Wall Type	Roof Type
		Length	Breadth				
1	Residential House	10.57	8.71	92.06	1	Stone and Mud	Corrugated Sheet
2	Residential House	7.41	3.91	28.97	1	Stone and Mud	Corrugated Sheet
3	Cow Shed	3.0	2.5	7.5	1	Wooden Flank	Thatched
4	Cow Shed	3.0	2.5	7.5	1	Wooden Flank	Thatched

Source: Household Survey, EIA, 2011

6. Issue Related to Compensation of the Affected People with Especially Preference to Disadvantage Group, Indigenous, Tribal and Gender

All the project affected people (including SPAF) belong to Tamang indigenous group. In addition to this group, other group such as tribal and disadvantaged group will not be affected by the land or structure acquisition.

PAFs expected appropriate compensation of the acquired land and assets and they wanted their compensation as per the current market price and not as per the current governmental value. Thus, the payment of appropriate compensation is a matter of concern for the project.

The male members of PAFs acquire ownership certificate of land and assets to be acquired by the proposed project. Thus, the misused of the compensation amount by male member of the family cannot be neglected. If the compensation amounts get misused, the family members may suffer from lifelong poverty and impoverishment. In PAFs, women's involvement in decision making regarding money/property matters are extremely limited. Thus, the female members or women may be deprived of utilizing compensation although they have equal right as man. Thus, gender discrimination cannot be ignored as well.

7. Issue Related to Existing Infrastructure Facilities such as Health and Safety, Education, Communication, Water Supply, etc. due to the Large Number of Outside Workforce

During construction period, influx of large number of work force as well as other people looking for business opportunity will migrate in Haku VDC. The influx of human population in large numbers in the VDC will exert pressure on the capacity of existing infrastructure facilities i.e. school, health post, water supply, security, etc. as it has to cater the service requirements of these outside peoples as well.

The available educational institutions of Haku VDC are facilitated with only primary and secondary level with miserable condition of school infrastructures. Thus, it will be very difficult for these schools to meet the additional burden of students. Lack of facilities makes both learning and teaching difficult. Moreover, children and youth suffer from overcrowding in schools directly. The crowded condition makes it difficult for children to concentrate on their studies.

Similarly, the available treatment facility of Haku VDC is exceptionally poor due to lack of proper health personnel, treatment technology and medicine. Thus, the health service will be pressurized with additional people in the VDC.

Likewise, the availability of water is hardly consistent and the sanitation condition is extremely poor. Thus, the available water supply sources get disrupted as well as the environmental degradation can occur with additional contamination related to poor sanitation practice. Besides, there will be extra pressure on electricity.

8. Large Workforce might Pose Threat to Law and Order Situation of the Project Area

Haku VDC is situated in small geographical area with scattered settlements. The high number of outside workforce in a small area like Haku VDC is envisaged to burden the local communities in a number of ways. The communities residing nearby the project construction sites particularly Hakubesi, Gogane and Mailun VDC will have mental fear associated with construction workers regarding safety of their property, family members and own lives compelling them to live on continual psychological stress and result in conflict with project

Additionally, the increase in movement of people in the project area might increase incidents of theft and burglary. These sorts of anxiety may bring uneasiness to the local people resulting conflicts and quarrels. Further, the involvement of workforce in illegal collection and extraction of vegetation and wildlife from the surrounding community forest of Haku VDC and buffer zone of LNP cannot be overruled. Moreover, the project work will result in good income for both outside and local workforce and its misuse may lead to anti-social activities such as alcohol consumption, gambling, quarrel, etc. Apart from this, the conflict between project worker and local people may arise due to personal ego. Local people always have a pride of their locality whereas project personnel do not feel it important to share anything with the local people. This might result in occurrence of conflict between local people and project personnel.

All of these consequences might deteriorate the local law and order condition immensely. Moreover, the one police post with the current available human resources in Haku VDC might find it difficult or suffer overburden in maintaining the security situation in the VDC.

9. Occupational Health and Safety Hazard Related Issue

Occupational health and safety is a highly sensitive matter that the project proponent has to look at with serious concerns. The construction activities such as blasting, using heavy equipment, and working in dangerous areas such as in the river, tunnel and on steep slopes,

may cause accidents and injuries. The most common injuries that might occur are due to falls from scaffoldings or other structures, injuries due to falling objects such as rocks or other construction equipment, collapse of tunnel or other excavations, traffic accidents and drowning. The victims will most probably be construction workers although injuries to local people are also possible.

The construction related accidents are common in Nepal, primarily because of unsafe construction practices, improper training to construction workers, unavailability of safety equipments, unstable landform. Similarly, the collapsing of tunnels has occurred in tunnelling related hydroelectric projects where as small landslides are common occurrences in access road construction in the hilly areas of Nepal increasing susceptibility of accidents. Flash floods and drowning are also common in the swift and turbulent rivers of Nepal, especially during the highly unpredictable monsoon season. As some of the activities occur nearby Trishuli River, drowning of project personnel cannot be neglected as well.

The labour camp with poor hygiene condition will result in several health risks. The overcrowded and unventilated condition of camp will result in respiratory infection of construction workforce. The camp mismanaged with unsafe water sources, unhygienic sanitation conditions bear the risk of endemic diseases, such as dysentery, diarrhoea and cholera. Water logging and badly managed borrows pits bear the risks of spreading vector-borne diseases like malaria, typhoid. The inadequate management solid waste of the camp can result in garbage heaps and can be favourable breeding place of rodents and insects, which can further harbour and transmit infectious diseases to the workers. Thus, migrant workers will be at increased risk for contracting a variety of viral, bacterial, fungal, and parasitic infections.

10. Loss of Grazing and Forest Land Squeezing the Supply of Forestry Resources Such as Fodder, Fuel wood etc.

The construction and establishment of different structures and facilities in the construction phase of the proposed project will result in loss 23.02 ha of community forest subsequently bringing loss of forest resources such as timber, fodder, fuel wood etc. This will result in loss of grazing ground for their livestock and limit the forest area for forest resources for local community. However, the loss of forest is only 4.33% of total community forest (531.50 ha) of Haku VDC. Likewise, there are adequate areas available as community forest for grazing and supply of forest resources in the VDC. Moreover, of the total acquisition of community forest, 4.72 ha community forest will be temporarily acquired which will be reverted back to original state after project construction. Thus, the envisaged impact related to this issue is of low magnitude

11. Possibility of Uncontrolled Settlement Expansion

The establishment of settlements, shops and food stalls adjacent to the construction site is a common feature in Nepal. The existing trend is to settle along the construction site for economic opportunities provided by the project. In the project context, the likely development of such settlement will be near Hakubesi, Gogane and Mailun. The adverse consequences of these uncontrolled settlements are reducing of aesthetic or natural scenery of project area, shortage of water supply, degradation of sanitation condition, additional pressure on solid waste management & construction traffic, isolation or

abandonment of older settlement, etc. Furthermore, this will temporarily alter the local demography in the project area.

12. Risk of Diminished Local Traditional Occupation, Skills such as Handicraft, Indigenous Medical Practices

The construction of project will bring employment as well as business & trade opportunities to local people. Thus, the local people possessing traditional occupational and skills such as handicrafts, indigenous medical practice, etc. might get diverted to the new occupation generated by the project, resulting consequences of diminishing of such occupation. However, no people are reported to follow such occupation as livelihood in the project construction area. They follow such occupation only to utilize their knowledge and skill in leisure time or need. Thus, the foreseen impact is of low magnitude.

13. Loss of Traditional Practices and Rituals

The influx of people from outside project area might introduce host of unfamiliar socio-cultural and religious practices in the local area that may interface with the indigenous rituals and traditional practices of the predominant Tamang Group of the project area. Different practices and rituals may contradict the existing practices of the local people. Thus, the interfacing of local people with outside culture can change their behaviour that can create threat of losing indigenousness of the group.

Similarly, the high cash flow from the project is likely to divert people to other occupations such that they may not provide time to perform their customary rituals, which in turn, can affect traditional social linkages resulting into degradation of the traditional social structure. These consequences might also affect traditional practices and ritual.

14. Impact of Reduced Water Flow Downstream of Weir

The river diversion work carried out at weir site will create dewatered zone for few stretch of river (about 300 m) at downstream of weir for the limited diversion period of 3 months during dry month. There is not any consumptive or non-consumptive use of river water in this stretch as well as the human intervention is not observed due to steep slope of river bank, the impact of reduced flow downstream of weir is not envisaged.

Furthermore, in the entire stretch of river between weir to tailrace, there is only one cremation site of Dalit at right bank of river, and that too is located more than 500 meters downstream of this dewatered stretch of river diversion such that no impact is foreseen.

15. Prostitution and Issue Related with STD

The project area is located in remote setting and presently, less exposed to the outside world and communities and free from dreadful diseases such as HIV/AIDS. With the start of project work, there will be temporary influx of people from outside for project work and more than 50% of the expected peak population of technical, non-technical and labours will be from outside project area. Many more people will travel to the project area as in the interest of establishing small business and trade. In addition, these migrants might be the probable carriers of various diseases not known so far in the region resulting in health risk of the local population. Similarly, male workers staying away from the family may go for sex partners, as is the case in many development projects constructed in different parts of the

country creating the consequence of prostitution though illegal in the context of Nepal. Likewise, there is a possibility of transmission of STD, primarily among young, single women in labour camps, who face social isolation and have limited recreational facilities. Additionally, some migrant workers as well as other people might act as carriers and transmitters of various diseases such as HIV, AIDS, etc. Additionally, the project major construction site i.e. Haku VDC already lacks adequate medical facility. Thus, the arising health related consequence from this issue can be more severe.

16. Impact on Tourism

The project construction site is manly located in Haku VDC. Though Dhunche VDC is the favourable tourist centre due to location of LNP and district head quarter, the weir site located in Dhunche VDC is quite far from the district head quarter, LNP as well as tourist trail or other tourism spots of the VDC. Similarly, Ramche VDC is not affected by the proposed project except by the formation of dewatered stretch. Moreover, both of these VDCs are connected with district road. Thus, any impact on tourism is not foreseen. In case of Haku VDC, the VDC is situated in a remote location and relatively less exposed to the outside world and communities, and moreover, it is not the place of tourism significance. Furthermore, no infrastructures of tourism significance will be affected by the project. Thus, the impact on tourism is not envisaged.

17. Impact of Gender and Vulnerable Group

In Nepal, the women are still largely considered as second group citizens and the project affected VDCs are not isolated from this fact as well. As majority of women in the project area are illiterate, they will be the most disadvantaged group during implementation of project. They might be given small work and are less preferred by contractors who award the work. Though women are employed in work, their daily wages may be less than that of their male counterparts, and in some cases, their wages are taken over by their spouse. Once men are engaged in project work, they will have cash income such that they might start to consume more alcohol and initiate conflicts in their own families. Likewise, if men are employed in the project, women would remain at home to shoulder the additional domestic chores and agricultural works. Apart from these circumstances, if property holdings are acquired by the project and cash is paid for land and houses, women will have to take most of the burden and they feel insecure until their family is well resettled somewhere.

Girl trafficking, drug addiction, and prostitution are not common in the project area, but during the project construction, the said cases may arise. The exploitation of women to satisfy the sexual needs of project employee and work force cannot be neglected as well. The other mode of gender discrimination in the project area can be in the form of girl trafficking. Trafficking of young girls and women has plagued this Himalayan Kingdom of Nepal for many decades. In Nepal, trafficking has become a highly profitable business. Thus, there is high possibility of some workforce getting involved in such activities in project area. The innocent girls in the project area may get trapped in the web of conspiracy of such people through false assurance such as marriage, good jobs, etc.

In addition to women, children are also the deprived and vulnerable group. As majority of the household of the project area are farmers and most of them have food deficiency from

their own production, the parents can employ their children in the project area for some money that can create risk of child labour. Additionally, pressures at home from the demands of project mean that girls are sometimes pulled out of school to help their mothers at home. Moreover, the children especially boys get distracted with the changes in their surroundings and they may themselves get involved in small business and other manual work around the construction site or labour camps where they might be exploited with less pay. All these consequence may jeopardize the education of children.

Additionally, the issues related to labour exploitation of Dalit group cannot be neglected. The Dalit group comprises a very low population of 2.59 % in project affected VDCs. In either direct or indirect way, these groups have been left behind in social, economic, educational, political and religious spheres and deprived from human dignity and social justice due to caste based discrimination and untouchability. Thus, these diminutive groups might get ignored or given less priority to work in an influence of other dominating group of the project area.

18. Impact on Existing Water Use Right

All of the 3 project affected VDCs may claim for the water right within the project stretch in their own perspective. Local VDCs may demand for compensations and enhancement programmes as a replacement of water use by the project. Some of these claims can be irrelevant and cannot be addressed by the project and can generate conflict and argument between local people and project during construction. As no such claims and demand related to water use are encountered during different phases of EIA study, the envisaged impact is considered of low magnitude.

19. Impact on Foot Trail and Movement of the People

The access road of the project has been so designed to avoid foot trails of the Haku VDC. Thus, no foot trail will be disturbed or affected by the construction of proposed project. Thus, the impact on foot trail and movement of people is not envisaged

20. Impact of Safety to People due to Sudden Release of Water along the Dewatered Stretch of the River

The river diversion work carried out at weir site will create dewatered zone for few stretch of river (about 300 m) at downstream of weir. Further, the diversion work is limited to about 3 months period only. Moreover, the sudden release in this stretch is rarely carried out. In addition, the banks of this dewatered stretch are very steep and thus, the stretch is devoid of local human movement or intervention. Thus, the mentioned impact is not foreseen.

5.1.2.2 Operation Phase

1. Impact of Withdrawal of Economic Activities, Employment Opportunity

After the accomplishment of the construction work of the hydroelectric project, the end of construction activities will drastically bring down economic activities in local area. The demand of commodity goods and other amenities will be decreased due to leaving of large number of work force from the project area. Consequently, many shops, markets, restaurants, tea shops, hotels will be closed due to decrease in demand. Additionally, the going away of people that has come for business and trade from the local area further

deteriorates the local economy. Moreover, large number of local people will lose their job. All these consequences may result into dissatisfaction and frustration among the local people. As the project construction site is an isolated rural site and development of the area into township is rather low, the potentiality of this impact is high.

2. Impact on Life Style

With the closure of the construction activities, large number of workforce loses their job. As a result, the income source of local people decreases considerably.

Furthermore, as the project area is situated in rural setting and the settlements are highly scattered, the development of township or any other commercial venture in the project construction site i.e. Haku VDC will be low. Moreover, the road access will be limited to headworks ceasing possibility of link road. All these consequence will reduce economic activities in the project area.
Thus, local people who have developed habit of spending on various items due to good cash flow during construction period will be deprived of such activity affecting their life style. It will have some effect on their livelihood.

3. Impact on Existing Water Use in Downstream of Weir

The reduced flow of river might affect the cremation ritual of Dalit of Hakubesi of Haku VDC which is performed on right bank of Trishuli river at foothill of Hakubesi village Except cremation site, the river stretch between headworks to tailrace is not used for any uses such as drinking, irrigation or any other uses. In addition, the recreation activity related to fishing is very less in dewatered stretch due to steep terrain of the riverbank. Thus, except to have an effect on cremation site, the envisaged impact of reduced water flow in the downstream of weir is not observed.

4. Impact on Religious, Cultural and Historic Sites

Apart from ritual site of Dalit at riverbank, there are no sites of religious, cultural and historical importance nearby the permanent structures and facilities of the proposed project. Thus, the mentioned impact is not foreseen.

5. Impact on Gender and Vulnerable Group

The project related activities will be limited during operation period. The number of project staffs will be also few in numbers. Thus, the impact of gender and vulnerable group is not foreseen.

6. Impact of Safety of People due to Sudden Release of Water along the Dewatered Stretch of the River

The river stretch of the project near foothill of Hakubesi is used as Dalits of the village as cremation site i.e. for ritual purpose. Thus, the sudden release of water from headworks during load dispatch or maintenance purpose might be the matter of safety of these people especially during dry season. In spite of steep topography of river banks and non-recreational significance of river, some people nearby the villages might be attracted to dewatered stretch for fishing as well as other recreation purpose. The sudden release of water could be the safety concern of these people as well and will be more severe during day time.

7. Impact of Induced Development Activities

There will be flow of more people to observe the hydroelectric plant in project operation. However, these people stay in the project for short time period and thus, any impact eroding community structure and tradition is not envisaged. The access road constructed by the project to link headworks and powerhouse site will be developed as main road for accessing villages namely Mailun, Gogane and Hakubesi. The operation of vehicles in the road can cause air and noise pollution and can be nuisance to sensitive spots like schools areas and residential. Further, the local people especially children can meet road accidents

8. Cumulative Impact of Upper Trishuli-I Hydroelectric Project

Due to unavailablity of comprehensive information of other potential projects upstream and downstream of the proposed project, the total length of the river that would face reduced flow couldn't be exactly mentioned at this stage. However, the further socioeconomic issues or impacts related to the project operation regarding change in water quality are envisaged of low magnitude as there are no polluting sources nearby the river stretch of project area. Furthermore, the conflict of water use right is not envisaged.

Table 5.21: Summary of Socioeconomic and Cultural Adverse Environmental Impact

S.N.	Physical Environment Issues	Impacts	Nature (D/ID)	Extent	Duration	Magnitude
Construction Phase						
1.1.1	Loss of agricultural land and agricultural production due to permanent and temporary establishment of project structures and facilities	Permanent loss of 9.35 ha of agricultural land affecting 14 households	D	SS	LT	H
1.1.2		Permanent loss of agricultural production	D	SS	LT	H
1.1.3		Temporary loss of 12.40 ha of agricultural land affecting 27 households	D	SS	ST	M
1.1.4		Temporary loss of agricultural production	D	SS	ST	M
1.1.5		Hardship faced by the people due to loss of land	D	SS	LT	M
1.2.1	Loss of other category of land excluding agricultural land and forest affecting local community	Permanent Loss of 16.61 ha of community land used for cattle grazing, fuel wood collection, etc	D	SS	LT	L
1.2.2		Temporary Loss of 38.88 ha of community land used for cattle grazing, fuel wood collection, etc	D	SS	ST	L
1.3.1	Issue related to change in social structure, cultural and traditional practices of the rural people due to the exposition to the outside work force	Conflict due to clash of culture and rituals between outside and local work force near settlements such as Hakubesi-Fulbari, Gogane and Mailun	ID	L	ST	M
1.4.1	Implication of Boom effect on the local economy and inflation	Reduce of agricultural work force due to shifting of occupation for project works	ID	L	ST	M
1.4.2		Inflation resulting from rise of price of commodity goods	ID	L	ST	M
1.5.1	Resettlement or relocation issues	Permanent acquisition of 2 residential structures resulting in the loss of shelter of 2 families	D	SS	LT	H
1.5.2		Permanent loss of 2 cow sheds of 2 families affecting livestock rearing and earning	D	SS	LT	L
1.6.1	Issue related to compensation of the affected people with especially preference to	Providing of compensation of acquired land and assets in the market price demanded by	D	SS	ST	M

S.N.	Physical Environment Issues	Impacts	Nature (D/ID)	Extent	Duration	Magnitude
	disadvantage group, indigenous, tribal and gender	PAFs				
1.6.2		Misuse of compensation by male members of PAFs resulting lifelong poverty and impoverishment	ID	SS	LT	H
1.6.3		Women or female member deprived of utilizing compensation	ID	SS	LT	H
1.6.4		Compensation issues related to disadvantaged and tribal group	N/A	N/A	N/A	N/A
1.7.1	Issue related to existing infrastructure facilities such as health and safety, education, communication, water supply etc due to the large number of outside workforce	Pressure on educational Institution	ID	L	ST	H
1.7.2		Pressure on health institution	ID	L	ST	H
1.7.3		Pressure on water supply	ID	L	ST	H
1.7.4		Pressure on management of sanitation condition and consequence of environmental degradation	ID	L	ST	H
1.8.1	Large workforce might pose threat to law and order situation of the project area	Physiological fear of security resulting conflict with project	ID	L	ST	M
1.8.2		Occurrence of theft and burglary	ID	L	ST	M
1.8.3		Illegal collection and extraction of vegetation of wildlife from surrounding community forest of Haku VDC and buffer zone of Dhunche VDC	ID	L	ST	M
1.8.4		Incidence of anti-social activities like alcohol consumption, gambling, quarrel, etc	ID	L	ST	M
1.8.5		Personal ego resulting conflict between project personnel and local people	ID	L	ST	M
1.8.6		Deterioration of local law and order condition	ID	L	ST	H
1.9.1	Occupational and safety hazard related issue	Occurrence of accident and injuries to project personnel	ID	SS	ST	H

S.N.	Physical Environment Issues	Impacts	Nature (D/ID)	Extent	Duration	Magnitude
1.9.2		Drowning of project personnel in Trishuli river nearby construction site	ID	SS	ST	H
1.9.3		Occurrence of various disease to labours due to poor hygiene condition in the labour camp	ID	SS	ST	H
1.10.1	Loss of grazing and forest land squeezing the supply of forestry resources such as fodder, fuel wood etc	Local community losing forest resources such as timber, fodder, fuel wood etc	D	L	ST	L
1.10.2		Local community losing grazing ground for their livestock	D	L	ST	L
1.11.1	Possibility of uncontrolled settlement expansion	Reducing of aesthetic or natural scenery of project area	ID	L	ST	M
1.11.2		Shortage of water supply	ID	L	ST	M
1.11.3		Degradation of sanitation condition	ID	L	ST	M
1.11.4		Additional pressure on solid waste management & construction traffic,	ID	L	ST	M
1.11.5		Isolation or abandonment of older settlement	ID	L	ST	H
1.11.6		Alteration of local demography	ID	L	ST	L
1.12.1	Risk of diminished local traditional occupation, skills such as handicraft, indigenous medical practices	Diminishing of local traditional occupation to newer occupation generated by project	ID	L	ST	L
1.13.1	Loss of traditional practices and rituals	Losing of indigenousness of the Tamang ethnic group due to interfacing with culture of outside workforce	ID	L	ST	M
1.13.2		Lack of time due to project works affecting traditional practices and rituals	ID	L	ST	M
1.14.1	Impact of reduced water flow downstream	Impact on water use of community	N/A	N/A	N/A	N/A
1.15.1	Prostitution and issue related with STD	Occurrence of prostitution	ID	L	ST	L
1.15.2		Transfer and spreading of diseases such as	ID	L	ST	M

S.N.	Physical Environment Issues	Impacts	Nature (D/ID)	Extent	Duration	Magnitude
		STDs, HIV/AIDS				
1.16.1	Impact on Tourism	Impact on tourism infrastructures and tourist flow	N/A	N/A	N/A	N/A
1.17.1	Impact on gender and vulnerable group	Gender discrimination in Project employment and payment of daily wages	ID	L	ST	M
1.17.2		Additional burden of workload to women	ID	I	ST	M
1.17.3		Exploitation of women to satisfy sexual need of work force	ID	L	ST	M
1.17.4		Trafficking of young girls and women	ID	L	ST	M
1.17.5		Incidence of child labor i.e employment of underage children in project works	ID	L	ST	M
1.17.6		Discrimination of disadvantaged group (Dalit) in project works	ID	L	ST	M
1.18.1	Impact on existing water use rights	Conflict arises regarding water use right of 3 VDCs	ID	L	ST	L
1.19.1	Impact on foot trail and movement of the people	Disturbance to foot trail and movement of people	N/A	N/A	N/A	N/A
1.20.1	Impact of safety to people due to sudden release of water along the dewatered stretch of the river	Drowning of people in dewatered stretch	N/A	N/A	N/A	N/A
Operation Phase						
2.1.1	Impact of withdrawal of economic activities, employment opportunity	Recession due to withdrawal of economic activities and employment opportunities	D	L	LT	H
2.2.1	Impact on lifestyle	Change in spending habit and livelihood of local people	ID	L	LT	L
2.3.1	Impact on existing water use in down stream	Reduced flow of water at downstream affecting cremation site of Dalit of Haku VDC	D	L	LT	H
2.4.1	Impact on religious, cultural and historical sites	Reduced flow of water at downstream affecting cremation site of Dalit	D	L	LT	H
2.5.1	Impact on gender and vulnerable group	Discrimination of women, children and disadvantaged group	N/A	N/A	N/A	N/A

S.N.	Physical Environment Issues	Impacts	Nature (D/ID)	Extent	Duration	Magnitude
2.6.1	Impact of safety of people due to sudden release of water along dewatered stretch	Sudden release of water resulting drowning of people in dewatered stretch	D	L	LT	M
2.7.1	Impact of Induced Development Activities	Air and noise pollution due to plying of vehicle in access road	D	L	LT	M
2.7.2		Occurrence of road accidents	ID	L	LT	M
2.8.1	Cumulative impact of Upper Trishuli-I HEP	Change in water quality downstream of tailrace	ID	I	LT	I
2.8.2		Conflict due to water use right	N/A	N/A	N/A	N/A

Note: D= Direct; ID = Indirect, SS= Site Specific; L = Local, R = Regional; ST= Short Term, MT = Medium Term, LT = Long Term; L = Low, M = Moderate, H = High; NA = Not Applicable or No impact

5.2 Beneficial Impact

5.2.1 Construction Phase

1. Employment Generation to Local People and Economic upliftment

The project constriction will require large numbers workforces (200 skilled, 300semi-skilled and 600 unskilled) during peak construction period. The project policy also emphasizes local people for the project works. Thus, the policy will directly benefit people of project affected VDCs. The household survey and VDC employment record also revealed that many local people have migrated out of the village for foreign employment. Similarly, local people show high desire for employment in projects during various consultation meeting carried out in EIA Study. Thus, the local people could generate substantial income from unskilled, semi-skilled and administrative work in the project resulting in economic upliftment. The benefit can be of long duration if the earned wage income is saved and utilized for other commercial and enterprise activities

2. Local Entrepreneur and Economic Opportunity Could Expand with the Advent of in Migration

During the construction period, the construction workers will reside in the project area for considerable period of time of about 5 years. In this period, the demands for different types of food, beverage and other daily needed commodity goods will increase in the project area. In addition, the demand for local products such as milk, meat, vegetables, fruits etc. will also rise simultaneously creating the business opportunities of the local people. The supply or selling of local products and other commodity goods to the project personnel and the construction workers will increase income of the local people. Moreover, many tea stalls, grocery shops, restaurants, hotel might get opened in the project area especially nearby three settlements of Haku VDC namely Hakubesi, Gogane and Mailun that, in turn, can generate substantial amount of income to local people. Likewise, the entrepreneur women of the project area will have a good chance for starting their business and earn money for their household expenditure. All these benefits will bring considerable amount of cash into the local economy. Thus, the local entrepreneur and economic opportunity will get expanded with the advent of in migration of construction work force.

3. Skill Enhancement

The employment in the project will help local people to obtain technical skills and know-how related to construction works. Thus, the specific skill and knowledge will help them to obtain employment opportunities in other construction projects especially hydroelectric as many hydroelectric projects are going to be constructed in the region.

5.2.2 Operation Phase

1. Hydro Electricity Generation and Availability of Electricity in Project Area

The direct benefit from operation of the proposed Upper Trishuli-I Hydroelectric Project (216 MW) is a continuous supply of 1440 GWh of clean and renewable energy per year. The generated electricity will feed into the national grid which will help to fill the energy gap

between supply and demand and consequently minimize the current crisis of load shedding (more than 10 hours per day) of the whole nation. Moreover, energy being the basic requirement of all the sectors of national development, the garnered electricity of such a huge quantity will directly assist in development endeavours of nation inducing economic development of the country.

The two Project Affected VDCs namely Dhunche and Ramche are facilitated with the electricity supplied from national grid. However, Haku VDC is not connected with national grid till date and Peltric set & Solar panel are the only source of light. With the development of the project, the proponent has a plan of rural electrification in the Haku VDC. The Project in itself will not implement rural electrification programme. But it will provide basis for future rural electrification programme in the area. Thus, the rural electrification programme is mainly dependent on the plans and programmes of Nepal Electricity Authority. The availability of electricity through rural electrification programme in Haku VDC will help to enhance the living standard of local people in the form of entertainment (television), communication (internet, TV, radio,), education (enhanced access at night), cooking & heating (electric heater, stoves, cooker), cooling (refrigerator), etc. The availability of electricity will also encourage local people to commence the business, trade and cottage industries that depend upon electricity. In addition, dependency on firewood for cooking and heating will readily decrease after electrification to advent two advantages: first will be decreased deforestation, which certainly has economic benefits and second will be reduced indoor air pollution, which will have health benefits especially to women and children..

2. Increment in Revenue and Local Development Activities

As per hydroelectric development policy, 2001 (amended 2003), 50 % of the total revenue obtained from the sale of hydroelectric generation will be allocated to the DDCs, the affected Development Region and the affected VDCs. Out of which, 12 % will be allocated to the affected DDCs for the local development and 38 % will be allocated to the related Development Region. Apart from this, the policy also suggests that 1 % of the royalty obtained by Government from a hydroelectric project shall be provided to the Village Development Committees (VDCs) that are directly affected by the hydroelectric infrastructure with the sole purpose of expanding electrification in the VDCs.

Thus, the increase in revenue obtained through royalty of sale of electricity will be utilized in improving the existing services related to education, health, water supply, sanitation, roads, sports, etc. of project affected VDCs.

3. Employment Generation to Local People and Economic Upliftment

During operation stage, the project will require various working personnel (about 100 numbers) for the smooth operation and regular maintenance works related to hydroelectric plant and facilities. These working personnel will be recruited both temporarily and permanently. Some of local people will be also recruited for administrative and technical works as per their qualifications and skills. Some of the available jobs will be the permanent income source for some local people. These opportunities will enhance the livelihood of local people.

Furthermore, the electricity user will be increased due to availability of electricity in project area such that some technical manpower will be required for wiring and to maintain & repair regular problems associated with electrical connections and meters. This might be the good source of income for some local people that are trained in repair and maintenance of electrical equipments and the generated income will enhance the livelihood as well.

4. Increased Tourism and Trade Opportunity

The project area has two direct linkages with tourism activities: the first one is Langtang National Park, which lies within Dhunche and Ramche VDCs and has substantial flow of tourists. The second one is popular tourist route for the Himalayan Trekking. Thus, these areas possess immense potentiality for tourism. There is already a district road available to access Dhunche and Ramche. However, the major project construction site i.e. Haku VDC is neither connected by the road or is the potential site for tourism. However, some tourists may come to the project site to observe the hydroelectric plant. Few small hotels and lodges may get developed; nevertheless, the staying of tourist is expected to be negligible. Thus, the trade opportunities generated by tourism will be also low. Thus, the envisaged impact of increased tourism and trade opportunity in operation phase is expected to be low.

Table 5.22: Summary of Socioeconomic and Cultural Beneficial Environmental Impact

S.N.	Beneficial Environment Issues	Impacts	Nature (D/I)	Extent	Duration	Magnitude
Construction Phase						
1.1.1	Employment generation to local people and economic upliftment	Economic upliftment of local people by generation of income through employment in the project	D	L	ST	H
1.2.1	Local entrepreneur and economic opportunity could expand with the advent of in migration	Increase in supply of commodity and locally produced goods	ID	L	ST	M
1.2.2		Establishment of tea stalls, grocery shops, restaurants, hotels, etc. creating business opportunities for local people	ID	L	ST	M
1.2.3		Business opportunity for entrepreneur women	ID	L	ST	M
1.3.1	Skill enhancement	Increase in employment opportunities in other similar projects	ID	L	LT	M
Operation Phase						
2.1.1	Hydro electricity generation and availability of electricity in project area	Generation of 1440 GWh of clean and renewable energy fulfilling energy demand and minimizing energy crisis	D	R	LT	H
2.1.2		Economic development of country due to generation of economic activities with enhanced availability of	ID	R	LT	H

S.N.	Beneficial Environment Issues	Impacts	Nature (D/I)	Extent	Duration	Magnitude
		electricity				
2.1.3		Opportunities related to rural electrification programme in Haku VDC	D	L	LT	H
2.1.4		Improvement of living standard of local people due to availability of electricity	D	L	LT	H
2.1.5		Decrease in deforestation due to reduced use of firewood	D	L	LT	M
2.1.6		Improvement of health of women and children by the use of electricity instead of fire wood.	ID	L	LT	M
2.2.1	Increment in revenue and local development activities	Increment in revenue of local area by the operation of proposed hydroelectric plant	D	R	LT	H
.2.2.2		Utilization of royalty in improvement of existing services	ID	L	LT	H
2.3.1	Employment generation to local people and economic upliftment	Economic upliftment of local people by generation of income through employment in the project	D	L	LT	M
2.3.2		Generation of other employment opportunities associated with project	ID	L	LT	L
2.4.1	Increased tourism and Trade opportunity	Generation of opportunities related to local tourism and trade	ID	L	LT	L

Note: D= Direct; ID = Indirect, SS= Site Specific; L = Local, R = Regional; ST= Short Term, MT = Medium Term, LT = Long Term; L = Low, M = Moderate, H = High; NA = Not Applicable or No impact

6 ANALYSIS OF ALTERNATIVES

The proposed Hydroelectric Project intends to construct and install a hydroelectric system having 216 MW capacity that can generate 1557 GWh of energy annually. The purpose of alternative analysis in EIA study is to assess the environmental impacts of different alternatives that have been considered during the feasibility and EIA study. The various alternatives to achieve the above Project objectives with minimum environmental degradation are discussed in the following sub-sections.

6.1 No Action Alternative

There is a large gap between the demand and supply of electricity in Nepal. As a result, the country's economy is suffering from severe energy shortages. Furthermore, the current state of unfulfilled demand for electricity is expected to continue for quite some time. Although the operation of some hydroelectric projects have added significant landmark power generation to the national grid, the supply for electricity is not sufficient yet.

The non-implementation of this alternative will thus, have a serious negative impact on Nepal's economy and development process. In the end, this could lead to aggravation among the people, and social and political instability due to insufficient work in the economic boost of the country. Besides, not implementing UT-I HEP will also result in losing all the other beneficial impacts of the project, including employment, local development, and encouragement for other private companies to invest in hydroelectric.

6.2 Project Alternative

There are very few alternatives to hydroelectric development to meet the growing demand for energy in the country. Majority of the people still depend on forest resources. With respect to the continuation of harvesting country's limited forest resources, the growth in energy demand cannot be met by this resource alone.

The use of solar power and biogas can be alternate sources but they will still not be able to fulfil all of the country's energy demands. Because all fossil fuels must be imported, thermal power is an unreliable and expensive option. Thermal power also has its own hindrance as per environmental pollution. Therefore, hydroelectric development is a very attractive alternative for the country.

Hydroelectric is a clean form of energy and it utilizes a renewable resource that Nepal is generously endowed with. Hydroelectric is a very suitable option for meeting present and future demand of electricity. Although Nepal has many potential small and large hydroelectric schemes, at present very few schemes have been studied to the feasibility level or beyond. As a result, there are only a few projects that can be implemented immediately.

Many of the projects that have been studied to the pre-feasibility or feasibility stage are large projects. The process of implementing these projects, including preparing detail design, securing financing and construction, is very time consuming. Therefore, the large projects to the scale like Upper Trishuli-I are more suitable to meet Nepal's present energy needs. Furthermore, development of these projects also have the advantage of being less environmentally demanding, using maximum local human resource, spreading development activities to many parts of the country and reducing dependency on one or a few large projects.

It can thus be concluded that there are very few alternate projects that can match the advantages provided by a run-of-the river project like the UT-I. The fact that the implementation of UT-I HEP will result in a very few adverse environmental impacts further strengthens the case for its implementation.

6.3 Alternative Design Options (Power Generation Options)

The detail investigation has shown four potential options from power generation point of view. The following generation options have been used based on the detail investigations. After the cost estimation and detail risk analysis of all four options, the Option IV is considered to be the best option viewing the cost and risk factors as well as environmental factors. In the environmental contest, this option requires lesser vegetation clearance and ground disruption hence, it making the best option. Thus, from the given options, option for generation of 216 MW power has been selected as technically and environmentally best and financially must attractive option

Table 6.1: Power Generation Options for different Installed Capacities

SN	Options	Option-1	Option-2	Option-3	Option-4
1	Design Discharge (m^3/s)	60	74	120	150
2	Installed Capacity (Mw)	**175**	**216**	**353**	**437**
3	Dry season Energy (GWh)	323	342	328	328
4	Wet season Energy (GWh)	997	1,215	1,715	2,038
5	Annual Energy GWh)	1,320	1,557	2,043	2,366
6	Plant Factor	86 %	82 %	67 %	62 %
A	**Civil Works ($)**	**166,294,945**	**178,712,315**	**212,532,221**	**247,888,663**
	Infrastructures ($)	2,500,000	2,500,000	3,500,000	4,000,000
B1	Headworks ($)	50,342,590	61,069,960	69,663,764	85,499,317
B2	Headrace Tunnel ($)	73,500,000	75,500,000	89,190,000	98,790,000
B3	Penstock ($)	9,930,000	11,620,000	15,110,000	18,910,000
B4	Power House Complex ($)	26,842,677	26,242,488	29,842,877	32,842,677
	Tailrace ($)	3,179,678	3,500,678	5,225,780	7,846,669
C	Electromechanical and Hydro mechanical Works ($)	61,250,000	81,550,000	122,500,000	152,950,000
E	Transmission Line ($)	60,000,000	60,000,000	60,000,000	60,000,000
	Total Base Cost ($)	287,544,945	320,262,315	395,032,221	460,838,663
F	Engineering and Administration (8% of	**23,003,596**	**25,620,985**	**31,602,578**	**36,867,093**

SN	Options	Option-1	Option-2	Option-3	Option-4
	Base Cost) ($)				
G	Environmental Mitigation (2% of Base Cost) ($)	**5,750,899**	**6,405,246**	**7,900,644**	**9,216,773**
H	Total Direct Cost ($)	**316,299,440**	**352,288,546**	**434,535,443**	**506,922,529**
I	VAT and Tax ($)	23,437,093	25,355,851	30,366,689	35,419,776
J	Total Project Cost ($)	**339,736,533**	**377,644,397**	**464,902,132**	**542,342,305**
K	Per MW cost ($)	1941	1748	1328	1241
	IRR	**13.10 %**	**16.10 %**	**15.90 %**	**15.30 %**

6.4 Alternative Location

The feasibility study has indicated that the present project site for UT-I is technically, economically, and environmentally suitable. The project site cannot be placed the weir upstream from its present location because of the terrain. The possibility of placing the weir downstream project downstream is also limited because of narrow gorge and unavailability of flat land. In addition, moving the project site downstream will not yield any beneficial effects but will further add problem related to space and suitable valley, Furthermore, the electricity generation will be lesser than that of present location.

The feasibility study has recommended an underground desander. From an environmental perspective, an underground desander has the following merits over the proposed surface type basins. The underground basin will not disturb the steep slopes, and as a result, damage to the desander due to landslide or river cutting will not be a problem. The problems faced for the acquisition of properties will be less. The construction of the surface type basin will result in loss of vegetation.

The powerhouse will be an underground structure with an installed capacity of 216 MW, constructed at the right bank of the river. There is sufficient space that allows the housing of the three units, erection or repair bay, control room, workshop and stores, battery room, auxiliary equipment room, and rest room. This underground option prevents the acquisition of private agricultural land.

The access road from Gogane village to Headworks is mainly aligned along cliff and barren land avoiding acquisition of large quantity of cultivated land and forest. The road is aligned along the forest land with less vegetation species. Furthermore, in the present topographical and geological setting, there is a very diminutive possibility for other alignment from environmental and economic considerations.

Majority of spoil disposal sites are selected along river flood plain so as to utilize the unproductive land and preserve the cultivated land and forest. The selected quarry sites mainly comprises of cliff and Bagar for the same reason. The appropriate site for the quarry in the sides of riverbank is easily accessible deposits of quartzite. Quarrying and spoil disposal in the proposed location will not affect the surrounding community.

The campsites and other facilities are proposed in agricultural land as most of these facilities are utilized for temporary purpose. These placing of these sites in other land such as forest

will result in permanent loss of huge quantity of forest land. In addition, the selected sites are favourable to maintain occupational safety with respect to natural calamities such as erosion, landslide, etc. Furthermore, the sites are located in southeast aspect to get contact with sunlight. The southeast aspect warms the camp and maintains fruitful and healthy human condition in the camp.

The placing of structures and facilities at left bank of Trishuli River is avoided, except at weir site to prevent any consequence with Langtang National park and its buffer zone from the implication of project.

6.5 Alternative Energy to be used

The energy to be used for construction of the Project will be fossil fuel for vehicles and machinery operation, electricity, fuel wood/LPG/kerosene/solar power for heating and cooking. The effort of the Proponent will be to strictly restrict use of forest wood for heating and cooking, minimize use of fossil fuel, and maximize alternative energy like solar power in construction and labour camps for lighting purposes.

6.6 No Forest Alternative

The location of hydroelectric components layout has been finalized after couple of conceptual layout planning also based on minimization of impacts on forest area. The layout of all project structures and facilities has been planned and designed to minimize the loss of forest resources. Although many of the project structures and facilities are located within the forest land, the forest land selected comprises of less forest cover and is mostly situated on barren rocky cliffs. In these contest, the proposed alternative is the best alternative requiring less forest land considering the topographical setting and geological appropriateness and will not induce any significant impact on the green cover of the area as well as any stratification of the forest.

6.7 Construction Material Alternative

The construction materials such as sand, aggregate, etc. will be source from the area within project vicinity. The timber required for the project will be fulfilled as much as possible from the trees felled by acquisition of forest to avoid tree loss in other area. For this purpose, the approval shall be get from the concerned authority. The other construction materials that are unavailable locally such as cement, steel, chemicals, admixtures, explosives, etc. shall be sourced from the third country unless these materials available within the country meet the required quality, specifications, rate and supply volumes. The selected site for quarry and aggregates has low environmental and social impacts.

6.8 Environmental Management System

The effective implementation of environmental management system can play a key role in minimizing environmental impact and create a roadmap for sustainable development. As the appropriate management of environmental impact is the key concern of the project, several alternatives are analysed in terms of waste management, spoil and muck disposal,

batching plant, quarry site, location of camp & engineering sites, etc. As far as possible, these sites are purposely established on degraded areas, river banks, barren land, and fallow land etc. to cause minimum impact on environment. Furthermore, environmental management plan is prepared for the proper management of environmental impacts foreseen in both construction and operation phase of the project. The implementation of this plan will strengthen effective environmental protection and enforce environmental regulation in the project site. The plan can further enable the proponent to increase its operating efficiency.

7 ENVIRONMENTAL MITIGATION MEASURES

The impacts identified and predicted in Chapter 5 of this report are without mitigation scenario. This section of the report proposes environmental mitigation measures required to avoid or minimize adverse impacts and maximize beneficial impacts. The proponent of UT-I HEP will be primarily responsible for all mitigation measures. Furthermore, the adverse and beneficial impacts that are not identified or pretermitted during the study if later discovered during the construction and operation phases will be mitigated or enhanced by the proponent and the proponent will compensate the affected parties for losses of lives or properties due to the implementation of the project as per prevailing law.

7.1 Adverse Impact

7.1.1 Physical Environment

This section of the report has prescribed the practical and cost effective mitigation measures to minimize and compensate the effects of physical adverse impact identified in the preceding chapter to acceptable level.

Table 7.1: Mitigation Measures for Physical Environmental Impact

SN	Physical Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
Construction Phase					
1.1.1	Change of land use including agricultural, forest, shrub, grazing, settlements etc due to project components and project facilities such as assess road, permanent camps and construction camps, trans, quarry site etc	Permanent change of forest land use (21.39 hectares) by the establishment of various project structures and facilities.	Residual impact of the project; Utilization of not more than required forest land; the nearby forest will not be disturbed.	No cost	The impact cannot be avoided
1.1.2		Permanent change of agricultural land use (9.35 hectares) by the establishment of various project structures and facilities.	Residual impact of the project; Utilization of not more than required agricultural land; the nearby agricultural land will not be disturbed.	No cost	The impact cannot be avoided
1.1.3		Temporary change of agricultural land use (12.40 hectares) by the establishment of project facilities	Residual impact of the project; Utilization of not more than required agricultural land	No cost	The impact cannot be avoided
			The temporary acquired agricultural land will be re-established into original form matching the original landscape after completion of the project.	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.1.4		Conversion of temporary acquired Bagar (Flood Plain) into elevated lands in the spoil & muck disposal sites	Residual impact of the project; Utilization of not more than required agricultural land	No cost	The impact cannot be avoided
1.1.5			The temporary acquired Bagar (flood plain) will be re-established into original form after completion of the project.	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.2.1	Impact due to Blasting Activities	Small tremors, dust pollution and instabilities inside the tunnel	Careful selection of overburden depth and selection of proper alignment (with respect to rock type and geological structures) for tunnel excavation.	No cost	Included in Contract Bid Document to abide the provision
1.2.2			Control blasting and careful use of explosive materials for excavating tunnel to avoid unnecessary breakage of rock mass than	No cost	Included in Contract Bid Document to abide the provision

SN	Physical Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
			required.		
1.2.3		Damage of structures (mud/ mortar houses and sheds) located nearby access road and Adit1 at Hakubesi due to development of crack	Survey of structures (house and shed) located within 250m on either side of Adit 1 and access road at Hakubesi before construction to verify the condition of these structures.	NRs.200000 /-(Lump sum)	Survey Report of Structure will be prepared nearby acc and documented by the .project proponent.
1.2.4			Compensation will be provided to structures if reported to be damaged by blasting activities during construction period.	NRs.500000 0/-(Lump sum) provisioned in project civil cost	The survey report of structure will be the basis for compensation
1.2.5		Changes in Noise level within the construction site of Adit Portals and Access Road	Regular maintenance of construction vehicles, machineries and equipments will be carried out to control mechanical noise	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.2.6			The ventilators at adit portals will be fitted with noise control device	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.2.7			Restriction on the use of pressure horn near school and residential site by placing traffic signs and signal	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.2.8			Procurement of low noise generating compressors, and diesel generating sets	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.2.9			Blasting activities will not be carried out at night hour.	No cost	Included in Contract Bid Document to abide the provision
1.2.10			Local communities will be pre-informed about blasting	No cost	Included in Contract Bid Document to abide the provision

SN	Physical Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
1.2.11		Disturbance due to vibration in the construction site of Adit Portals and Access Road	The equipments or machineries generating vibration will be placed in strong foundation. Further, the equipment used in the construction should meet minimum safe guards for natural areas and cause minimum ground vibrations.	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.2.12			Controlled blasting will be practiced at all times near such structures to have a minimum vibration impact.	No cost	Included in Contract Bid Document to abide the provision
1.3.1	Sedimentation, Soil Erosion and Land Instability Associated with Construction and Establishment of Support Facilities and Particularly with the Management of Tunnel Spoil and Access Road	Land instability and erosion of deposited spoil and muck	The generated spoil and muck will be disposed behind the gabion structures of required size and capacity for the protection of spoil/muck disposal toe to prevent from instability and erosion	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.3.2			Establishment of appropriate drainage system in and around spoil and muck disposal areas.	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.3.3			The surface of spoil and muck disposal area will be properly compacted by making layers of preferably 15 cm to prevent from settling and furthermore, the area will be planted with vegetation such as *Alnus nepalensis*	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.3.4			The generated muck and spoil will be disposed at authorized site only.	No cost	Included in Contract Bid Document to abide the provision
1.3.5			Preparation of muck and spoil management plan	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.3.6		Sedimentation of water bodies by disposal of spoil	The mitigation measure mentioned in 1.3.1, 1.3.2, 1.3.4 and 1.3.5 will be implemented and additional cost is not required.		

SN	Physical Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
1.3.7		and muck	The generated spoil and muck will not be disposed in the river or river sources.	No cost	Included in Contract Bid Document to abide the provision.
1.3.8		Destruction of productive land and forest vegetation by disposal of spoil and muck	The generated spoil and will not be disposed on fragile slopes, farmland, forest areas, natural drainage path, etc.	No cost	Included in Contract Bid Document to abide the provision
1.3.9			The mitigation measure mentioned in 1.3.1 and 1.3.4 will be implemented and additional cost is not required.		
1.3.10		Increase of turbidity in the river affecting water quality by disposal of spoil and muck	The mitigation measure mentioned in 1.3.1 and 1.3.4 will be implemented and additional cost is not required.		
1.3.11		Additional Potentiality of Landslide along access road at Hakubesi landslide	The 'Landslide Stabilization Plan' will be prepared and implemented for the construction of road at landslide susceptible area that include: Pegging and flagging of landslide area boundary. Maintenance of slope less than the angle of repose to the extent possible, mostly above 35 degree. The steep slope cutting above 35 degree will be protected through necessary civil structures such as breast wall, gabion structure or concreting as per the requirement of the site and further, bio-engineering will be applied for long-term stabilization wherever necessary. Drainage will be provided both vertically and horizontally No surface would be left exposed and Bio-engineering works will be carried out.	Included in project civil cost	Included in Contract Bid Document to abide the provision

SN	Physical Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
1.3.12			Control blasting will be practiced near the landslide susceptible area.	No cost	Included in Contract Bid Document to abide the provision
1.3.13		Land stability and erosion along other portion of access road	The construction of access road will be carried out in balancing depth principle where the volume of cut and fill of the spoil will be equal to the extent possible.	No cost	Included in Contract Bid document to abide the provision
1.3.14			Maintenance of slope less than the angle of repose to the extent possible, mostly above 35 degree and cut batter slopes above 1.5 heights will be protected by bio-engineering works.	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.3.15			Control blasting will be practiced at access road construction site	No cost	Included in Contract Bid Document to abide the provision
1.3.16		Alteration of natural drainage due to construction of access road	The side drains along with drainage bypass will be constructed at appropriate location in access road to safely divert the water from the hill slope.	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.3.17			The generated spoil will be disposed at authorized site only.	No cost	Included in Contract Bid Document to abide the provision
1.3.18		Land stability and erosion in the quarry sites	Benching of slope will be managed at every 7m to avoid land stability	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.3.19			Quarrying will be avoided at steep slopes (greater than 70 degree)	No cost	Included in Contract Bid Document to abide the provision
1.3.20			After the completion of extraction, the site will be rehabilitated to suit the local landscape preferably by re-vegetating	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.3.21			Use of explosives will be minimized to the	No cost	Included in Contract

SN	Physical Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
			extent possible		Bid Document to abide the provision
1.3.22			Adequate drainage will be constructed to avoid erosion due to disturbance of natural drainage	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.3.23			Quarry Management Plan will be prepared	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.4.1	Air Pollution, Noise and Vibration Issue associated with the construction works, construction traffics and spoil management	Degradation of air quality due to release of carbon monoxide, sulphur oxide, hydrocarbons, hydrogen sulphides, etc by the construction activities and equipments	All vehicles belonging to the Project i.e., proponent, contractors, consultants will comply with the national emission standards of the Ministry of Environment, Nepal (with Green Sticker)	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.4.2			Regular (monthly) maintenance of all vehicles will be made mandatory	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.4.3			The burning of biomass will be prohibited in the construction camps	No cost	Included in Contract Bid Document to abide the provision
1.4.4		Increase in suspended particulates (PM_{10})	Open storage and spillage of loose soil in and around construction site will be prohibited	No cost	Included in Contract Bid Document to abide the provision
1.4.5			Regular maintenance of project access road mainly in dry season by sprinkling water particularly nearby the settlement areas namely Hakubesi-Fulbari, Gogane and Mailun.	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.4.6			Truck loads will be covered during transportation to prevent blowing of loose construction materials	No cost	Included in Contract Bid Document to abide the provision
1.4.7		Change in noise level at batching plants,	Mitigation measures as proposed in 1.2.5, 1.2.7 and 1.2.8 and additional cost is not required		

SN	Physical Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
1.4.8		construction yards, access road	The construction activities will be limited to working hours and will not be carried night hour	No cost	Included in Contract Bid Document to abide the provision
1.4.9		Vibration due to movement of vehicle and blasting activities	Mitigation measures for impact due to blasting activities is already addressed in 1.2.3 and 1.2.4 and additional cost is not required.		
1.4.10			The project vehicle plying on the road will be restricted to limit speed nearby the settlement area by providing proper instruction and placing traffic signs and signal	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.4.11			Cracks caused, if any, by vibration due to movement of vehicle will be compensated	Mitigation measures as proposed in 1.2.3 and 1.2.4 and no additional cost is required.	
1.5.1	Change in surface and subsurface hydrology including ground water level changes along tunnel alignment	Lowering of ground water table and drying of springs	No mitigation measure is required	No cost	This impact is not envisaged.
1.6.1	Changes in water Quality of Surface and Sub Surface water due to construction related activities including Tunnel Discharge, Camp Management and Spoil Management	Degradation of river water quality by inappropriate disposal of muck & spoil	The mitigation measure mentioned in 1.3.1 and 1.3.4 will be implemented and additional cost is not required.		
1.6.2		Degradation of water quality by effluents released from crushers & other sources	The effluents released from crusher and other sources will be settled into sedimentation tank before releasing into water sources	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.6.3		Degradation of water quality by sewage discharged from construction camp (labor camp and engineering camps)	Separate washing, bathing, urination and toilet facilities will be provided at the labor camps and engineering camps -Fulbari	Included in project civil cost	Included in Contract Bid Document to abide the provision

SN	Physical Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
1.6.4			The liquid waste discharged from the construction camp will be properly treated (as per the standard of Ministry of Environment) before releasing into water sources.	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.6.5			Prohibition of urination and defecation in open areas and water bodies by construction workers	No cost	Included in Contract Bid Document to abide the provision
1.6.6		Degradation of water quality by solid waste generated from construction camp (labor camp and engineering camps)	Establishment of proper solid waste management system in the construction camp for collection, segregation and disposal of solid waste.	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.6.7			Prohibition of haphazard disposal of solid waste in construction camp	No cost	Included in Contract Bid Document to abide the provision
1.6.8		Degradation of water quality by construction waste	Establishment of proper solid waste management system for collection, segregation and disposal of solid waste in construction site.	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.6.9			Prohibition of haphazard disposal of construction waste in construction site	No cost	Included in Contract Bid Document to abide the provision
1.6.10		Degradation of water quality by liquid waste such as lubricants, paints, cleaning, chemical and other aqueous oil based materials	The liquid waste generated from construction sites such as lubricants, paints, cleaning, chemical and other aqueous oil based materials will be collected separately and stored in suitable storage tank for final management with the advice of the authorized officer.	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.6.11			The lubricants and other petroleum products will be stored on the platform with concrete or cemented floor with adequate draining system	Included in project civil cost	Included in Contract Bid Document to abide the provision

SN	Physical Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
			connecting oil and grease trapping unit for collection of discharges of the floor		
1.6.12			Prohibition of haphazard disposal of liquid waste such as lubricants, paints, cleaning, chemical and other aqueous oil based materials in construction site	No cost	Included in Contract Bid Document to abide the provision
1.6.13		Semi-liquid waste generated from batching areas degrading the quality of water	The semi-liquid waste generated from batching plant will be settled into sedimentation tanks before releasing into water sources.	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.6.14			Prohibition of haphazard disposal of Semi-liquid waste generated from batching areas	No cost	Included in Contract Bid Document to abide the provision
1.7.1	Change in river morphology	Change in sediment distribution pattern in the river due to diversion of flow and removal of boulder	Residual impact of the project	No cost	The impact cannot be avoided
1.8.1	Impact on Langtang National park	Acquisition of forest land (2.61 ha) of Buffer zone of LNP resulting in change of land use	Residual impact of the project; Utilization of not more than required forest land; the nearby forest land will not be disturbed.	No cost	The impact cannot be avoided
1.9.1	Impact due to quarry site and stockpiling	River bank erosion on the quarry site	Extraction of material (boulder, sand, etc) from river bed will be carried out in balanced way and only in required quantity by preparing quarry area management plan	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.9.2		Change in sedimentation distribution pattern of river in quarry site	Mitigation measures as proposed in 1.9.1 and additional cost is not required		
1.9.3		Change in land use of quarry site	Residual impact of the project; Utilization of not more than required land;	No cost	The impact cannot be avoided
1.9.4			The temporary acquired land for Quarry site	Included in	Included in Contract

SN	Physical Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
			(9.62 ha) will be re-established into original form matching the original landscape after completion of the project	project civil cost	Bid Document to abide the provision
1.9.5		Change in topographical features of quarry site	Residual impact of the project;	No cost	The impact cannot be avoided
1.9.6			Utilization of not more than required land and additional cost is not required	No cost	Included in Contract Bid Document to abide the provision
1.9.7		Land instability in the quarry sites	Mitigation measures for land stability in the quarry sites are already addressed in 1.3.18, 1.3.19, 1.3.20, 1.3.2 and 1.3.23.		
1.9.8		Generation of dust in quarry site	Water will be sprinkled at quarry site and the provision is included in Quarry site management plan	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.9.9		Degradation of aesthetic beauty of project site by haphazard stockpiling of construction material	Construction materials will be stored in the designated site.	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.9.10			Stockpiling will be prohibited in unauthorized site.	No cost	Included in Contract Bid Document to abide the provision
1.10.1	Impact due to spoil and muck disposal	Air pollution from haphazard disposal of muck and spoil	Water will be sprinkled at quarry site and the provision is included in muck and spoil management plan	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.10.2			The mitigation measures mentioned in 1.3.1, 1.3.3, 1.3.4, 1.3.5 will be implemented and additional cost is not required.		
1.10.3		Land pollution from haphazard disposal of muck and spoil	The mitigation measures mentioned in 1.3.1, 1.3.3, 1.3.4, 1.3.5 will be implemented and additional cost is not required.		
1.10.4		Degradation of water quality by haphazard disposal of muck and spoil near river	The mitigation measures mentioned in 1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5 will be implemented and additional cost is not required		

SN	Physical Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
1.11.1	Impact due to toxic and hazardous materials	Degradation of water quality by Disposal of grease, mobils, lubricants, toxic chemicals into river	The mitigation measures mentioned in 1.6.10, 1.6.11 and 1.6.12 will be implemented and additional cost is not required		
1.11..2		Degradation of water quality due to seepage of the petroleum products from the store, construction yard etc	The mitigation measures mentioned in 1.6.10, 1.6.11 and 1.6.12 will be implemented and additional cost is not required		
1.11.3		Degradation of water quality due to release of wastewater of mechanical yard into the water bodies	The mitigation measures mentioned in 1.6.13 and 1.6.14 will be implemented and additional cost is not required		
1.12.1	Impact on natural spring due to tunnel Excavation	Drying of spring	No mitigation measure is required	No cost	This impact is not envisaged.
1.13.1	Loss of topsoil	Degradation of fertility of soil	The top soil preservation plan will be prepared to collect top soil (10 to 30cm) of agricultural land (both khet and bari) to reuse afterward.	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.13.2			Prohibition on haphazard disposal of topsoil	No cost	Included in Contract Bid Document to abide the provision
1.14.1	Impact associated with access road construction	Land instability and erosion	The mitigation measures mentioned in 1.3.13 , 1.3.14 and 1.3.15 will be implemented and additional cost is not required		
1.14.2		Alteration of natural drainage	The mitigation measures mentioned in 1.3.16 and 1.6.17 will be implemented and additional cost is not required		
Operation Phase					
2.1.1	Impact on Topography	Change in topography at project construction sites	No mitigation measure is required	No cost	This impact is not envisaged.
2.2.1	Sedimentation and Sediment Flushing	Erosion of river bank downstream of weir by the	The erosion of river bank will be minimized by implementing river bank protection measures	Included in project civil	Included in Contract Bid Document to

SN	Physical Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
	from Desander will	release of sediments	in susceptible site downstream of weir.	cost	abide the provision
2.2.2	have adverse effects in the downstream and damage to turbine	Damage to turbine	The turbine will be designed to withstand the wear and tear by suspended particles	Included in project civil cost	
2.2.3			The hydropower plant will be closed for some period when the sediment load entering Desander basin exceeds more than 10000 ppm	No cost	Included in Project Operation Plan
2.3.1	Change in river morphology downstream of diversion and its effects on downstream water use	Reduction of water in dewatered zone and widening of dewatered zone	Residual impact of the project	No cost	The impact cannot be avoided
2.3.2		Eroding of river bed by sediment released from weir	The mitigation measures mentioned in 2.2.1 will be implemented and additional cost is not required		
2.4.1	Change in water quality due to reduce flow downstream	Reduction in dissolve oxygen level of water and self cleaning capacity of river	In driest month, the environmental release is 3.84 m^3/s is sufficient to maintain the dissolved oxygen level and self cleaning capacity as the dewatered stretch is devoid of any pollutant sources.	No Cost	
2.5.1	Change in surface and subsurface hydrology including ground water changes along the tunnel alignment	Changes in ground water level	No mitigation measure is required	No cost	This impact is not envisaged.
2.6.1	Change in Micro Climate due to Water Diversion in Upstream and Downstream Areas	Slight decrease in temperature of river water in dewatered zone	The rise in temperature	No cost	
2.7.1	The hazard of GLOF in	Impact due to GLOF located	No mitigation measure is required	No cost	This impact is not

SN	Physical Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
	the entire project	nearby the project development site			envisaged.
2.8.1	Impact in the Dewatered Zone due to Sudden Release of Water	Inundation and erosion of river bank	The mitigation measures mentioned in 2.2.1 will be implemented and additional cost is not required		
2.9.1	Noise Pollution in Powerhouse area	Increase in noise level due to vehicular movement in and around the powerhouse area	Residual impact of the project	No cost	The impact cannot be avoided
2.10.1	Possible Increase in Water Temperature D/S from the Tailrace due to Reduced Quantity of Flow	Decrease in water temperature downstream of tailrace	No mitigation measure is required	No cost	This impact is not envisaged.
2.11.1	Possibility of slope failure at tunnel portal and penstock alignment	Slope failure of tunnel portal (adit)	The structural rigidness of tunnel portals (adits) will be checked annually (twice a year) and repair works such as slope stabilization works, bioengineering, etc will be implemented as per the requirement.	Included in project civil cost	

Majority of the mitigation cost related to physical environmental impact are incorporated in the project cost or Contract Bid Document. The total physical environmental mitigation cost for both construction and operation phase of the proposed project is estimated as **NRs.5200000/-**

7.1.2 Biological Environment

This section of the report has prescribed the practical and cost effective mitigation measures to minimize and compensate the effects of biological adverse impact identified in the preceding chapter to acceptable level.

Table 7.2: Mitigation Measures for Biological Environmental Impact

SN	Biological Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
Construction Phase					
1.1.1	Impact to Existing Forest due to site clearance works for establishment of project structures and facilities	Permanent loss of 18.29 hectares of community forest	The area equivalent to occupied forest area (27.20 hectares) for project physical infrastructures will be afforested and protected for 5 years and handed over to concerned stakeholders as per the Forest Guideline for the Allocation of the Forest land to other Development Projects. The afforestation area will be as per the area designated by the respective district forest office and LNP	NRs.15,000,000 /-	The cost includes land cost, preparation of nursery & seedling and other cost associated with management of forest area and plant species in the new forest land.
1.1.2		Permanent loss of 2.61 hectares of government forest (forest of buffer zone of LNP).			
1.1.3		Permanent loss of 0.50 hectares of private forest			
1.1.4		Temporary loss of 4.72 hectares of community forest			
1.1.5		Temporary loss of 1.09 hectares of private forest			
1.2.1	Impact on rare, protected, vulnerable, endangered and endemic species of flora and fauna and their habitat	Loss of *Shorea robusta* and *Bombax ceiba* i.e. protected plant species listed under GoN.	The compensatory afforestation programme will focus on planting maximum number of protected species	Cost is included in compensatory afforestation programme (1.10.2)	
1.2.2			The felling down or clearance of protected species is avoided as much as possible	No cost	Included in Contract Bid Document to abide the provision
1.2.3		Loss of feeding and resting	This impact is unavoidable for the		

SN	Biological Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
		ground of *Ursus tibetans* at weir area of buffer zone of LNP	construction period; however, the proper afforestation programme will bring back these animals after completion of construction phase.		
1.2.4		Illegal poaching and wildlife trade of *Ursus tibetans*	Proper fencing will be constructed at a minimal height of 3 meters around the weir site to prevent unauthorized access of workers to the forest.	NRs.700,000/- (Lump sum)	
1.2.5			Awareness programme will be provided to construction workers for protection of black bears.	NRs.200,000/- (Lump sum)	
1.2.6			Black bear gives birth to cubes in hollow trees or cave during November to March. These months will be avoided while clearing trees. If such habitat are observed, these habitat would be protected by informing LNP authorities	No Cost	Included in Contract Bid Document to abide the provision
1.2.7			Outside workforce and staff found in illegal poaching of black bear will be terminated from project jobs and punished as per legal provision of LNP.	No Cost	Included in Contract Bid Document to abide the provision
1.2.8			Hoarding board will be kept in buffer zone of LNP at weir site to provide information that the hunting and trade of these animals is punishable offence. The conservation significance of black bear will be also displayed in the hoarding board.	NRs.25,000/-	@NRs.25,000/- at single location
1.2.9			Restoration of habitat in weir area of buffer zone after construction of the	Included in project civil	Included in Contract Bid Document to abide the

SN	Biological Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
			project	cost	provision
1.2.10		Loss of feeding and resting ground of *Naemorhedus goral, Macaca mulatta, Semnopithecus hector* in community forest of Haku VDC	This impact is unavoidable for the construction period; however, the proper afforestation programme will bring back these animals after completion of construction phase		
1.2.11		Illegal poaching and wildlife trade of *Naemorhedus goral*	Outside workforce and staff involved in illegal poaching of these animals will be terminated from project jobs and punished as per legal provision of GoN.	No Cost	Included in Contract Bid Document to abide the provision
1.2.12			Awareness programme will be provided to construction workers for protection of this protected mammal	NRs.25,000/-	
1.2.13			Hoarding board will be kept in buffer zone of LNP at weir site to provide information that the hunting and trade of this animal is punishable offence. The conservation significance of will be also displayed in the hoarding board	NRs.50,000/-	@NRs.25000/- at 2 locations in the project stretch between Hakubesi and Mailun
1.2.14		Disturbance to protected wildlife by construction activities	Blasting and noise generating activities will be limited to day time zone and will not be carried out in night zone.	No Cost	Included in Contract Bid Document to abide the provision
1.3.1	Disturbance to the aquatic habitat including obstruction for fish migration due to construction of weir	Trapping of fish in the dewatered stretch created by diversion of weir.	The fish trapped in the dewatered stretch will not be disturbed or killed	No Cost	Included in Contract Bid Document to abide the provision
1.3.2		Increase in turbidity of river water affecting fish species and fishery habitats	The riverbed will not be disturbed unless required for establishment of weir and other structures. The impact is residual.	Specified in the contractor bid document	Included in Contract Bid Document to abide the provision
1.3.3		Disturbance to spawning	The spawning and rearing ground will	Included in	Included in Contract Bid

SN	Biological Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
		and rearing ground of ground of Snow Trout	not be disturbed by implementing proper construction plan in weir construction site.	project civil cost	Document to abide the provision
1.3.4		Increased fishing activities in dewatered area	The construction workers will be prohibited to catch fish in dewatered stretch and if found culpable, will be terminated from the job	No Cost	Included in Contract Bid Document to abide the provision
1.4.1	Impact on aquatic ecosystem due to project activities	Disturbance to aquatic ecosystem due to removal of boulders and extraction of construction materials from river	Extraction of material (boulder, sand, etc) from river bed will be carried out in balanced way and only in required quantity by preparing quarry area management plan	Included in project civil cost	Included in Contract Bid Document to abide the provision
1.4.2		Fortuitous discharge of spoil, cement slurry, lubricants, fuel, chemicals, etc polluting river water and affecting fish and other aquatic life	Mitigation measures as proposed in 1.6.10, 1.6.11, 1.6.12 (Table 7.1: Mitigation Measures for Physical Environmental Impact) and no additional cost is required.		
1.4.3		Waste water discharged from construction camp polluting river water quality and in turn, affecting aquatic ecosystem	Mitigation measures as proposed in 1.6.2, 1.6.3, 1.6.4, 1.6.8 (Table 7.1.Mitigation Measures for Physical Environmental Impact) and no additional cost is required.		
1.5.1	Increased pressure to the surrounding forest for its products such as firewood, timber, non timber forest product (NTFP)	Illegal collection of firewood, NTFPs, valuable floral species, etc. by construction workers from the buffer zone areas of LNP	All the project personnel will be informed through awareness programme that the illegal collection of floral species from buffer zone areas of LNP is a punishable offense	Specified in the contractor bid document	Included in Contract Bid Document to abide the provision
1.5.2			Any project personnel found involved in such offense will be terminated from the	No cost	Included in Contract Bid Document to abide the

SN	Biological Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
			project job.		provision
1.5.3			LNP will be supported in recruiting additional staffs to increase monitoring and surveillance activities in buffer zone of LNP at weir site as well as LNP area nearby project construction site.	NRs.1500000/-	@NRs.300000/- per year for 5 years
1.5.4			Hoarding board will be kept in buffer zone of LNP at weir site mentioning such act is illegal.	NRs.25000/-	@NRs.25,000/- on single location at weir site
1.5.5		Illegal harvesting of forest product for fuel wood, timber and NTFPs by construction workers in local community forest of Haku VDC.	The construction workers will be prohibited to collect firewood, timber and other forest products from the local community forest of Haku VDC and such act will be termed illegal.	No cost	Included in Contract Bid Document to abide the provision
1.5.6			Any project personnel found involved in such offense will be terminated from the project job	No cost	Included in Contract Bid Document to abide the provision
1.5.7			The construction workers will be subjected to awareness programmes on the issues of deforestation and afforestation to let them know the consequences of environmental conservation.	Specified in the contractor bid document	Included in Contract Bid Document to abide the provision
1.5.8			The constructed workers will be provided with cooking fuels such as kerosene and LPG and will be encouraged to stay in their camp.	Specified in the contractor bid document	Included in Contract Bid Document to abide the provision
1.5.9			Firewood will be strictly prohibited in the construction camps for cooking or any other purpose	No cost	Included in Contract Bid Document to abide the provision

SN	Biological Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
1.5.10			Hoarding board will be kept in forest area of Haku VDC mentioning such act is prohibited and illegal.	NRs.125000/-	@NRs.25,000/- at 5 locations in the project stretch between Hakubesi and Mailun
1.5.11			Local forest user group will be supported in surveillance activities for conservation of forest and wildlife.	NRs.2500000/-	@NRs.500000/- per year for 5 years
1.6.1	Increased access to forest, illegal hunting and poaching	Illegal hunting and poaching of wild animal in buffer zone area of LNP	All the project personnel will be informed through awareness programme that the illegal hunting and poaching of wild animal in buffer zone areas of LNP is a punishable offense	Specified in the contractor bid document	Included in Contract Bid Document to abide the provision
1.6.2			Outside workforce and staff found in illegal poaching of wild animals will be terminated from project jobs and punished as per legal provision of LNP.	No Cost	Included in Contract Bid Document to abide the provision
1.6.3			Hoarding board will be kept in buffer zone of LNP at weir site mentioning such act is illegal.	NRs.25000/-	@NRs.25,000/- on single location at weir site
1.6.4			The wildlife meat will be prohibited in the camp.	No Cost	Included in Contract Bid Document to abide the provision
1.6.5		Illegal hunting and poaching of wild animal in community forest of Haku VDC	All the project personnel will be informed through awareness programme that the illegal hunting and poaching of wild animal in community forest of Haku VDC is a punishable offense	Specified in the contractor bid document	Included in Contract Bid Document to abide the provision
1.6.6			Outside workforce and staff found in illegal poaching of wild animals will be	No Cost	Included in Contract Bid Document to abide the

SN	Biological Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
			terminated from project jobs and punished as per legal provision of Nepal		provision
1.6.7			Hoarding board will be kept in forest area of Haku VDC mentioning such act is prohibited and illegal	NRs.125000/-	@NRs.25,000/- at 5 locations in the project stretch between Hakubesi and Mailun
1.6.8			The wildlife meat will be prohibited in the camp.	No Cost	Included in Contract Bid Document to abide the provision
1.6.9			Mitigation measures as proposed 1.5.11 and no additional cost is required.		
1.7.1	Access road construction from powerhouse to intake site and its subsequent loss or degradation of forest and wildlife habitat	Permanent loss of 17.75 hectares of community forest as a part of site clearance for the construction of access road.	Mitigation measures as proposed 1.1.1 and no additional cost is required.		
1.7.2		Permanent loss of 0.30 hectares of private forest	Mitigation measures as proposed 1.1.3 and no additional cost is required		
1.7.3		Degradation of forest and wildlife habitat	Mitigation measures as proposed in 1.2.14, 1.5.5, 1.5.6, 1.5.7, 1.5.8, 1.5.9, 1.5.10, 1.6.5, 1.6.6, 1.6.7 and no additional cost is required		
1.7.4		Loss of feeding and resting ground of wildlife species	This impact is unavoidable for the construction period; however, the proper afforestation programme will bring back these animals after completion of construction phase.		
1.7.5		Exploitation of forest resource and wildlife by local community for commercial benefit	Awareness programmes will be launched to local community with the help of wildlife and forest expert for conservation of forest and wildlife to let them know about the negative	NRs.500000/-	@NRs.50000 per programme twice a year for 5 years

SN	Biological Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
			consequences arises of such activities.		
1.7.6			The community user group of Haku VDC will be provided with technical assistance in the form of saplings, tools, equipments, skilled manpower to control deforestation & further degradation and increase forest cover & density in order to conserve community forest.	NRs.2000000/- (Lump sum)	
1.7.7			The security personnel of the VDC will be informed to take legal action against people involved in illegal exploitation of forest resource and wildlife	No Cost	Included in Contract Bid Document to abide the provision
1.7.8		Driving away of terrestrial wildlife due to increment of noise level.	Mitigation measures as proposed in 1.2.14		
1.8.1	Disposal of spoil and muck in the river may affect the aquatic ecosystem, including disturbance to spawning ground of fishes	Increase in turbidity of river water affecting spawning ground of fish	Mitigation measures as proposed in 1.3.1,1.3.2, 1.3.3,1.3.4,1.3.5,1.3.7,1.3.8 (Table 7.1: Mitigation Measures for Physical Environmental Impact) and no additional cost is required		
1.8.2		Death of fish due to blocking of gills by turbid water			
1.9.1	Impact on Langtang National Park and its buffer zone	Disturbance on animal and bird movement at weir construction site due to human and heavy equipment´s movement,	Mitigation measures as proposed 1.2.14, 1.5.1,1.5.2,1.5.3,1.5.4,1.6.1,1.6.2,1.6.3,1.6.4 and no additional cost is required		

SN	Biological Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
		noise and vibration			
1.10.1	Impact on biodiversity (plant diversity and animal diversity)	Loss of 12001 tree species (Seedling-1858, Sapling-2346, Pole-3880 and Tree-917) of community, government and private forest	The trees will be felled not more than required for establishing project structures and facilities.	No cost	Included in Contract Bid Document to abide the provision
1.10.2			The project will carried out compensatory plantation of 4797 felled trees at a ratio of 25 seedlings for each lost tree equivalent to 119925 numbers as per the Forest Guideline, 2006 in an area as directed by the District Forest office of Rasuwa district and LNP authorities	NRs.10200000/ -	The cost includes preparation of nursery, plantation cost, nurturing cost for 5 years and other associated costs.
1.10.3			The project will clear the forest and stockpile the materials as per the guideline of Forest Produces Collection, Sale and Distribution Guidelines, (1998) in the presence of officials of District Forest Office & LNP and will be handed over to the respective owners. This will prevent haphazard clearance of trees and preserve resource value of forest products.	NRs.3000000/- (Lump sum)	
1.10.4			The district forest officer as well as the concerned owner will be requested to provide the felled trees to the project at market price which will hep to fulfil the requirement of timber for construction of house or furniture for the project works, which will help to reduce additional loss of tree required for	No cost	

SN	Biological Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
			project works..		
1.10.5		Disturbance to wildlife due to clearance of forest	or their related belongings , etc found safer	No cost	Included in Contract Bid Document to abide the provision
1.10.6		Disturbance to fish habitat due to construction activity of weir	Mitigation measures as proposed in 1.3.2,1.3.3,1.3.4 and no additional cost is required		
Operation Phase					
2.1.1	Barrier effect of weir on fish migration and effect of dewatered zone on fish habitat and aquatic life	Obstruction of the route of mid distant Snow Trout by the placement of weir in Trishuli river	Out of the four species in the Trishuli River, two species- *Noemacheilus botia* (Gadela) and *Pseudecheneis sulcatus* (Kabre) are resident fish species, inhabiting river bottoms and are slow swimming species. The fish pass, therefore, would be useless for these species. However, *Schizothorax richardsonii* (Buchche Asala) and *Schizothoraichthys progastus* (Chuchche Asala) are mid-distant migratory and fast swimming fish species in the river, for which a fish ladder is provided in weir structure.	Included in project civil cost	
2.1.2		Change in aquatic habitat in dewatered zone due to diversion of water from weir resulting decrease of fish population	Release of stated environmental flow (10% of monthly flow) at all times during project operation will be carried out	No Cost	The project operators will be instructed to release environmental flow at all times of project operation based on Table 5.2.
2.1.3		Decline of other aquatic lives	The study related to fish (Tenant, 1976)		

SN	Biological Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
			he minimum environmental release of 3.84m^3/sec even in dry season will be sufficient for survival of aquatic species.		
2.2.1	Issues related with the impacts of vegetation of surrounding area and dependent wildlife due to project accessibility	Illegal collection of the forest products, in particular the timber, firewood and NTFPs from the local forest of Haku VDC	The roaming of unauthorized people in local forest will be prohibited by coordinating and supporting local forest user group committee in surveillance activities for protection of forest and wildlife	NRs.3000000/-	@NRs.1000000/- per year for 30 years
2.2.2			Annual awareness programme will be conducted for local people for conservation of local forest and wildlife	NRs.3000000/	@NRs.1000000/ for 30 years
2.2.3			Hoarding board will be kept in forest area of Haku VDC mentioning such act is prohibited	NRs.125000/-	@NRs.25,000/- at 5 locations in the project stretch between Hakubesi and Mailun
2.2.4			The security personnel of the Haku VDC will be informed to take legal action against people involved in illegal exploitation of forest resource in coordination with local forest user group committee	No cost	
2.2.5		Degradation and fragmentation of the forest due to unregulated collection of the forest products of local forest of	Mitigation measures as proposed in 2.2.1, 2.2.2, 2.2.3, 2.2.4 and additional cost is not required		

SN	Biological Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
		Haku VDC			
2.2.6		Disturbance to feeding and resting ground of wildlife due to fragmentation of forest	Mitigation measures as proposed in 2.2.1, 2.2.2, 2.2.3, 2.2.4 and additional cost is not required		
2.2.7		Illegal collection of the forest products in buffer zone of LNP	LNP will be supported in recruiting additional staff to increase monitoring and surveillance activities in buffer zone of LNP at weir site as well as LNP area nearby project construction site.	NRs.4500000/-	@NRS.150000/- per year for 30 years
2.2.8			Except project staffs, other people will be prohibited to enter the weir premises located at buffer zone of LNP.	No Cost	Specified in Project Operation Plan.
2.2.9			Hoarding board will be kept in buffer zone of LNP at weir site prohibiting entry of unauthorized people.	NRs.25000/-	@NRs.25,000/- on single location at weir site
2.2.10			The security personnel of the VDC as well as LNP authorities will be informed to take legal action against people involved in illegal exploitation of forest resource and wildlife.	No Cost	
2.2.11		Disturbance to wildlife habitat in LNP	Mitigation measures as mentioned in 2.2.7, 2.2.8,2.2.9, 2.2.10 and no additional cost is required		
2.3.1	Impact on forest and biodiversity	Disturbance to forest and wildlife of Haku and buffer zone of LNP by regular events of reconstruction, renovation, maintenance and transportation	The reconstruction, renovation, maintenance work will not be carried out in night hour.	No Cost	Specified in Project Operation Plan.
2.3.2			The vehicular movement will be limited to day hour as far as possible.	No Cost	Specified in Project Operation Plan.
2.4.1	Loss of vegetation,	Illegal collection and	Mitigation measures as proposed in 2.2.1, 2.2.2, 2.2.3, 2.2.4 and no additional cost is		

SN	Biological Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
	forest and forest products	harvesting of forest products for timber, firewood and NTFPs from the forest of Haku VDC	required		
2.4.2		Encroachment of forest land of Haku VDC	Mitigation measures as proposed in 2.2.1, 2.2.2, 2.2.3, 2.2.4 and no additional cost is required		
2.4.3		Illegal collection and harvesting of forest products from Buffer zone of LNP	Mitigation measures as proposed in 2.2.7, 2.2.8.2.2.9 , 2.2.10 and no additional cost is required		
2.4.4		Encroachment of forest land in buffer zone of LNP	Mitigation measures as proposed in 2.2.7, 2.2.8.2.2.9, 2.2.10 and no additional cost is required		
2.5.1	Increase access to forests	Exploitation of forest products within access road of Haku VDC	Mitigation measures as proposed in 2.2.1, 2.2.2, 2.2.3, 2.2.4 and no additional cost is required		
2.5.2		Exploitation of forest products of buffer zone of LNP	Mitigation measures as proposed in 2.2.7, 2.2.8.2.2.9, 2.2.10 and no additional cost is required		
2.6.1	Illegal hunting and poaching	Illegal hunting and poaching of wild animal by the visitor in Haku VDC	Mitigation measures as proposed in 2.2.1, 2.2.2, 2.2.3, 2.2.4 and no additional cost is required		
2.6.2		Illegal hunting and poaching of wild animal by the visitor in Buffer zone area of LNP	Mitigation measures as proposed in 2.2.7, 2.2.8.2.2.9, 2.2.10 and no additional cost is required		
2.7.1	Impact on wild animals	Driving away of terrestrial wildlife due to increment of noise level at Haku VDC	The vehicular movement of both project as well as local people will be limited to day hour as far as possible and this mitigation measure will be enlisted in the awareness programme proposed in	No additional cost is required	

SN	Biological Environmental Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
			2.2.2		
2.7.2		Driving away of terrestrial wildlife due to increment of noise level at Buffer zone, LNP	No mitigation measure is required	No cost	This impact is not envisaged.
2.8.1	Impact on Langtang National Park and its Buffer zone	Collection of forest products and illegal hunting of wild animals of LNP	Mitigation measures as proposed in 2.2.7, 2.2.8.2.2.9, 2.2.10 and no additional cost is required		
2.8.2		Accidental washout or drowning of wild animals by sudden release of water from weir	Siren network will be installed at different locations in the dewatered zone	Included in project cost	
2.8.3			The sudden release of water from dam will be limited to day hour as far as possible	No cost	The project operators will be instructed to release water for such provision in day hour as far as possible
2.8.4		Reduction in discharge of water and decrease river depth in dry month affecting river ecology including habitat of fish of LNP area	Mitigation measures as proposed in 2.1.2 and 2.1.3		

The total biological environmental mitigation cost for both construction and operation phase of the proposed project is estimated as **NRs.46650000/**-

7.1.3 Socioeconomic and Cultural Environmental

This section of the report has prescribed the practical and cost effective mitigation measures to minimize and compensate the effects of socioeconomic and cultural Environmental adverse impact identified in the preceding chapter to acceptable level.

Table 7.3: Mitigation Measures for Socioeconomic and Cultural Environmental Impact

SN	Socioeconomic and Cultural Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
Construction Phase					
1.1.1	Loss of agricultural land and agricultural production due to permanent and temporary establishment of project structures and facilities	Permanent loss of 9.35 ha of agricultural land affecting 14 households	The loss of permanently acquired agricultural land will be compensated at the current market price. Furthermore, land will not be acquired forcefully and will be acquired with bilateral negotiation with land owners and with their consent.	NRs.190079264/-	The cost of land is calculated as per the various category of land namely Khet, Bari and Pakho Bari. This cost also includes rehabilitaion benefit to the affected land owners.
1.1.2		Permanent loss of agricultural production	The loss of standing crops of one year will be provide to PAFs	NRs.1501826/-	Loss of crops is calculated as per Table 5.14 and 5.16 and the price of crops are referred from the rate of VDC.
1.1.3		Temporary loss of 12.40 ha of agricultural land affecting 27 households	The loss of temporarily acquired agricultural land will be compensated through land rental. Furthermore, land will not be acquired forcefully and will be acquired with bilateral negotiation with land owners and with their consent	NRs.46990056/-	The lease value of land is calculated as per the various category of land namely Khet, Bari and Pakho Bari. This cost also includes rehabilitaion benefit to the affected land owners.

SN	Socioeconomic and Cultural Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
1.1.4		Temporary loss of agricultural production	The loss of standing crops of one year will be provided to PAFs	NRs.1833774/-	Loss of crops is calculated as per Table 5.15 and 5.17 and the price of crops are referred from the rate of VDC
1.1.5		Hardship faced by the people due to loss of land	PAFs will be prioritized for employment and other support programme of the project	No cost	Included in Contract Bid Document and project policy to abide the provision
1.1.6			Mitigation measure as proposed in 1.3.4 and no additional cost is required		
1.2.1	Loss of other category of land excluding agricultural land and forest affecting local community	Permanent Loss of 16.61 ha of community land used for cattle grazing, fuel wood collection, etc	The lost community land will be compensated to the concerned stakeholder as per the lease price of the Forest Regulation for the period of land occupancy (30 years)	NRs.6725960.37/-	@ NRs.800/ha/yr with annual increment of 20% for 20 years and thereafter the rate of 20th year
1.2.2		Temporary loss of 38.88 ha of community land used for cattle grazing, fuel wood collection, etc	The lost community land will be compensated to the concerned stakeholder as per the lease price of the Forest Regulation for the period of land occupancy (5 years)	NRs.277756.23/-	@ NRs.800/ha/yr with annual increment of 20% for 5 years
1.3.1	Issue related to change in social structure, cultural and traditional practices of the rural people due to the exposition to the outside work force	Conflict due to clash of culture and rituals between outside and local work force near settlements such as Hakubesi-Fulbari, Gogane and Mailun	Local people will be prioritized for employment in project construction works	No cost	Included in Contract Bid Document to abide the provision
1.3.2			Outside workers will be encouraged to stay within work camp. For this arrangement of recreational facilities within camp will be arranged by the contractor	No cost	Included in Contract Bid Document to abide the provision

SN	Socioeconomic and Cultural Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
1.3.3			The outside work force will be instructed to respect the local tradition, culture and riots by conducting awareness programme	Specified in the contractor bid document	Included in Contract Bid Document to abide the provision
1.3.4			The project will make necessary arrangement to address grievance of local communities related to the project	Included in project cost	
1.4.1	Implication of Boom effect on the local economy and inflation	Reduce of agricultural work force due to shifting of occupation for project works	Local people specifically women will be encouraged in agricultural practice through agricultural enhancement programme.	No cost	Included in the cost of environmental enhancement programme
1.4.2		Inflation resulting from rise of price of commodity goods	This will be a residual impact of the project.		
1.5.1	Resettlement or relocation issues	Permanent acquisition of 2 residential structures resulting in the loss of shelter of 2 families	The house owners or SPAFs will be compensated of acquired residential structures at current market price	NRs.1040000/-	The compensation of house structures will be as per current market price and the SPAFs will be also assisted in resettling nearby the locality
1.5.2			SPAFs will be prioritized for employment and other support programme of the project	No cost	Included in Contract Bid Document and project policy to abide the provision
1.5.3			The SPAFs will be also compensated in property translocation.	NRs.200000/-	
1.5.4			Mitigation measure as proposed in 1.3.4 and no additional cost is required		
1.5.5		Permanent loss of 2 cow sheds of 2 families	The cow shed owners will be compensated of acquired	NRs.100000/-	The compensation of structures will be as per

SN	Socioeconomic and Cultural Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
		affecting livestock rearing and earning	structures.		current market price
1.6.1	Issue related to compensation of the affected people with especially preference to disadvantage group, indigenous, tribal and gender	Providing of compensation of acquired land and assets in the market price demanded by PAFs	The compensation will be provided as per the prevailing market price.	No cost	
1.6.2			The SPAFs and PAFs will be consulted before the acquisition process and the matter related to compensation will be bilaterally solved in the consensus of the affected families.	No cost	
1.6.3			Mitigation measure as proposed in 1.3.4 and no additional cost is required		
1.6.4		Misuse of compensation by male members of PAFs resulting lifelong poverty and impoverishment	The Project will provide counselling service to PAFs for the effective utilization of the compensation amount that they have received. For this, Public Relation Officer of the Project will develop and implement necessary activities such as counselling during the construction stage	Included in project cost	
1.6.5		Women or female member deprived of utilizing compensation	Mitigation measure as proposed in 1.3.4 and 1.6.3 and no additional cost is required		
1.6.6		Compensation issues related to disadvantaged and tribal group	No mitigation measure is required	No cost	This impact is not envisaged.
1.7.1	Issue related to existing infrastructure facilities such as health and safety, education,	Pressure on educational Institution	The project will assist the school of the Haku VDC to provide education to the children of project staff and workers	Included in the cost of environmental enhancement programme	

SN	Socioeconomic and Cultural Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
1.7.2	communication, water supply etc due to the large number of outside workforce	Pressure on health institution	The project contractor will set up its own heath institution manned by doctors, nurses and staffs within the construction camps to provide health services to the work personnel.	Specified in the contractor bid document	Included in Contract Bid Document to abide the provision
1.7.3			The project will assist the local health institutions.	Included in the cost of environmental enhancement programme	
1.7.4		Pressure on water supply	The project contractor will set up its own persistent water supply system for workforce in all camps without affecting community water supply system	Specified in the contractor bid document	Included in Contract Bid Document to abide the provision
1.7.5		Pressure on management of sanitation condition and consequence of environmental degradation	The project contractor will set up sanitation management unit in each of the construction sites and camps to manage the waste generated from construction sites and camps	Specified in the contractor bid document	Included in Contract Bid Document to abide the provision
1.8.1	Large workforce might pose threat to law and order situation of the project area	Physiological fear of security resulting conflict with project	Public relation programmes like routine discussion with local stakeholders, sport events, health camps will be organized to communicate and interact with local communities. This will assist to build rapport between the local people and Project staff.	Specified in the contractor bid document	Included in Contract Bid Document to abide the provision
1.8.2			Mitigation measure as proposed in 1.3.4 and no additional cost is required		

SN	Socioeconomic and Cultural Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
1.8.3		Occurrence of theft and burglary	Mitigation measures as proposed in 1.3.2 and 1.3.4 and no additional cost is required		
1.8.4			The District Police Office, Rasuwa district will be requested to increase the security personnel in Haku VDC to improve the law & order and the existing police post will be provided with financial assistance for required infrastructures and facilities.	NRs.1500000/- (Lump sum)	
1.8.5		Illegal collection and extraction of vegetation of wildlife from surrounding community forest of Haku VDC and buffer zone of Dhunche VDC	Mitigation measures as proposed in 1.5.1, 1.5.2, 1.5.3, 1.5.4, 1.5.5,1.5.6,1.5.7,1.5.8,1.5.9,1.5.10,1.5.11,1.6.1,1.6.2,1.6.3, 1.6.4, 1.6.5, 1.6.6, 1.6.7,1.6.8 (Table 7.2 : Mitigation Measures for Biological Environmental Impact) and no additional cost is required		
1.8.6		Incidence of anti-social activities like alcohol consumption, gambling, quarrel, etc	The alcohol consumption will be disallowed outside of construction camps and the project staffs involving in such act outside the camp will be penalised as well as terminated from the job	No cost	Included in Contract Bid Document to abide the provision
1.8.7			Gambling will be totally prohibited for construction workers both inside as well as outside camp	No cost	Included in Contract Bid Document to abide the provision
1.8.8			Project staffs will be instructed to maintain discipline and not to get involved in quarrel and conflict.	No cost	Included in Contract Bid Document to abide the provision
1.8.9			Mitigation measure as proposed in 1.3.4 and no additional cost is required		
1.8.10		Personal ego resulting conflict between	Mitigation measure as proposed in 1.3.4 and 1.8.1 and no additional cost is required		

SN	Socioeconomic and Cultural Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
		project personnel and local people			
1.8.11		Deterioration of local law and order condition	Mitigation measure as proposed in 1.3.1, 1.3.4 and 1.8.4 and no additional cost is required		
1.9.1	Occupational and safety hazard related issue	Occurrence of accident and injuries to project personnel	Mitigation measure as proposed in 1.7.2 and no additional cost is required		
1.9.2			The construction sites will be fenced and unauthorized person will be disallowed	Specified in the contractor bid document	Included in Contract Bid Document to abide the provision
1.9.3			First aid health facility will be managed at work site	Specified in the contractor bid document	Included in Contract Bid Document to abide the provision
1.9.4			Personal protective equipments such as helmets, gloves, boots, mask, ear plugs, safety belts etc. will be provided to all workers as per the nature of their work.	Specified in the contractor bid document	Included in Contract Bid Document to abide the provision
1.9.5			Necessary planning and safety approach will be made for emergency rescue. Such contingency planning will include arrangements with project/nearby hospitals, provision of standby ambulance, coping with large-scale spills of hazardous material, slope failures, falling from height, vehicular or equipment related accidents, drowning, road related accidents and providing awareness trainings of road accidents to construction workers and local	Specified in the contractor bid document	Included in Contract Bid Document to abide the provision

SN	Socioeconomic and Cultural Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
			people resettling near access road, displaying of hoarding board regarding road accidents, etc.		
1.9.6		Drowning of project personnel in Trishuli river nearby construction site	Mitigation measure as proposed in 1.9.5 and no additional cost is required		
1.9.7		Occurrence of various disease to labours due to poor hygiene condition in the labour camp	Mitigation measure as proposed in 1.7.5 and no additional cost is required		
1.10.1	Loss of grazing and forest land squeezing the supply of forestry resources such as fodder, fuel wood etc	Local community losing forest resources such as timber, fodder, fuel wood etc	Residual impact of the project		
1.10.2		Local community losing grazing ground for their livestock	Residual impact of the project		
1.11.1	Possibility of uncontrolled settlement expansion	Reducing of aesthetic or natural scenery of project area	Local government will be assisted in planning the expanding settlement	NRs.1000000/- (Lump sum)	
1.11.2		Shortage of water supply	Mitigation measure as proposed in 1.11.1 and no additional cost is required		
1.11.3		Degradation of sanitation condition	Mitigation measure as proposed in 1.11.1 and no additional cost is required		
1.11.4		Additional pressure on solid waste management & construction traffic,	Mitigation measure as proposed in 1.11.1 and no additional cost is required		
1.11.5		Isolation or	Mitigation measure as proposed in 1.11.1 and no additional cost is required		

SN	Socioeconomic and Cultural Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
		abandonment of older settlement			
1.11.6		Alteration of local demography	Mitigation measure as proposed in 1.11.1 and no additional cost is required		
1.12.1	Risk of diminished local traditional occupation, skills such as handicraft, indigenous medical practices	Diminishing of local traditional occupation to newer occupation generated by project	The ethnic group 'Tamang' of the project area will be supported to preserve their, tradition, culture, identity as well as their traditional occupation	Included in the cost of environmental enhancement programme	
1.13.1	Loss of traditional practices and rituals	Losing of indigenousness of the Tamang ethnic group due to interfacing with culture of outside workforce	Mitigation measure as proposed in 1.12.1 and no additional cost is required		
1.13.2		Lack of time due to project works affecting traditional practices and rituals	Mitigation measure as proposed in 1.12.1 and no additional cost is required		
1.14.1	Impact of reduced water flow downstream	Impact on water use of community	No mitigation measure is required	No cost	This impact is not envisaged.
1.15.1	Prostitution and issue related with STD	Occurrence of prostitution	Local governments and local law and order authorities will be informed of in case of occurrence of prostitution activity	No cost	Included in Contract Bid Document to abide the provision
1.15.2			Any workers getting involved in such act will be expelled from the project jobs	No cost	Included in Contract Bid Document to abide the provision
1.15.3			Mitigation measure as proposed in 1.3.4 and no additional cost is required		

SN	Socioeconomic and Cultural Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
1.15.4		Transfer and spreading of diseases such as STDs, HIV/AIDS	Community awareness programme on sexually transmitted disease and ways to prevent such disease will be conducted for both project staffs and local people.	NRs.500000/-	@Rs.100000 per year for 5 years
1.15.5			Regular health checkups of construction workers will be conducted in construction camps.	Specified in the contractor bid document	Included in Contract Bid Document to abide the provision
1.16.1	Impact on Tourism	Impact on tourism infrastructures and tourist flow	No mitigation measure is required	No cost	This impact is not envisaged.
1.17.1	Impact on gender and vulnerable group	Gender discrimination in project employment and payment of daily wages	The contractor will be instructed to maintain gender balance during the employment. Both women and men will be provided with equal opportunity in project works.	No cost	Included in Contract Bid Document to abide the provision
1.17.2			Mitigation measure as proposed in 1.3.4 and no additional cost is required		
1.17.3		Additional burden of workload to women	The local male workers will be frequently suggested to provide time for house, spouse and children.	No cost	
1.17.4		Exploitation of women to satisfy sexual need of work force	Mitigation measure as proposed in 1.15.1 and 1.15.2 and no additional cost is required		
1.17.5		Trafficking of young girls and women	Community awareness programme regarding girl trafficking will be conducted to local people	NRs.500000/-	@Rs.100000/- per year for 5 years
1.17.6			The construction workforce will be informed that such act is a crime and will be better instructed not to get involved in such activity. Any workers if found guilty will be	No cost	Included in Contract Bid Document to abide the provision

SN	Socioeconomic and Cultural Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
			terminated from the project job and handover to security personnel for other legal actions		
1.17.7			Mitigation measure as proposed in 1.3.4 and no additional cost is required		
1.17.8		Incidence of child labor i.e. employment of underage children in project works	Children will not be involved in construction works	No cost	Included in Contract Bid Document to abide the provision
1.17.9			Mitigation measure as proposed in 1.3.4 and no additional cost is required		
1.17.10		Discrimination of disadvantaged group (Dalit) in project works	Dalit group will be prioritized in project works as per their skills and capacities with certain percentage reservation for dalit.	No cost	Included in Contract Bid Document to abide the provision
1.17.11			Mitigation measure as proposed in 1.3.4 and no additional cost is required		
1.18.1	Impact on existing water use rights	Conflict arises regarding water use right of 3 VDCs	This issue/impact is not encountered. in EIA study till date, However, the project will discuss the matter regarding water use right with the concerned representatives with all three VDCs before project construction to sort out this impact	No cost	
1.19.1	Impact on foot trail and movement of the people	Disturbance to foot trail and movement of people	No mitigation measure is required	No cost	This impact is not envisaged.
1.20.1	Impact of safety to people due to sudden release of water along the dewatered stretch of the river	Drowning of people in dewatered stretch	No mitigation measure is required	No cost	This impact is not envisaged.
Operation Phase					
2.1.1	Impact of withdrawal of economic activities,	Recession due to withdrawal of	Residual impact of the project		

SN	Socioeconomic and Cultural Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
	employment opportunity	economic activities and employment opportunities			
2.2.1	Impact on lifestyle	Change in spending habit and livelihood of local people	Residual impact of the project		
2.3.1	Impact on existing water use in down stream	Reduced flow of water at downstream affecting cremation site of Dalit in Haku VDC	The downstream flow of he minimum environmental release of 3.84m^3/sec even in dry season will be sufficient in cremation activity.		
2.3.2			The environmental flows released will be canalized in the stretch of the cremation site	Included in project civil cost	
2.3.3			The cremation site will be maintained with civil works	NRs.300000/-	
2.4.1	Impact on religious, cultural and historical sites	Reduced flow of water at downstream affecting cremation site of Dalit	Mitigation measure as proposed in 2.3.1,2.3.2 and 2.3.3 and no additional cost is required		
2.5.1	Impact on gender and vulnerable group	Discrimination of women, children and disadvantaged group	No mitigation measure is required	No cost	This impact is not envisaged.
2.6.1	Impact of safety of people due to sudden release of water along dewatered stretch	Sudden release of water resulting drowning of people in dewatered stretch	Siren network will be installed at different locations in the dewatered zone	Included in project civil cost	
2.6.2			The sudden release of water from dam will be limited to day hour as far as possible and siren will be blown (3 times) half an hour prior to sudden release	No cost	The project operators will be instructed to release water for such provision in day hour as far as possible
2.7.1	Impact of Induced	Air and noise pollution	All vehicles belonging to the Project	Included in project	Included in project

SN	Socioeconomic and Cultural Issues	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
	Development Activities	due to plying of vehicle in access road	i.e., proponent, contractors, consultants will comply with the national emission standards of the Ministry of Environment, Nepal (with Green Sticker)	civil cost	operation plan to abide the provision
2.7.2			Regular (monthly) maintenance of all vehicles will be made mandatory	Included in project civil cost	Included in project operation plan to abide the provision
2.7.3		Occurrence of road accidents	The traffic signal showing restriction on speed will be installed near settlements namely Hakubesi-Fulbari, Gogane and Mailun	Included in project civil cost	
2.7.4			The local people including children will be provided with safety training programme related to traffic accident.	NRs.750000/-	@NRs.25000/- per year
2.8.1	Cumulative impact of Upper Trishuli-I HEP (216 MW)	Change in water quality downstream of tailrace	The project will apply necessary measures to prevent any pollution of dewatered stretch of the proposed project.	Provisioned and included in project cost	Included in project operation plan to abide the provision

The total Socio economic & Cultural environmental mitigation cost for both construction and operation phase of the proposed project is estimated as **NRs. 253,298,636.60**

7.2 Beneficial Impact

The mitigation measures for beneficial impacts are presented in a matrix form in **Table 7.4** linking environmental impacts and the related mitigation measures

Table 7.4: Mitigation Measures for Beneficial Impact

SN	Beneficial Issue	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
Construction Phase					
1.1.1	Employment generation to local people and economic upliftment	Economic upliftment of local people by generation of income through employment in the project	Local people will be prioritized in project related employment	No cost	
1.2.1	Local entrepreneur and economic opportunity could expand with the advent of in migration	Increase in supply of commodity and locally produced goods	Local people will be provided training on business and trade	Included in Included in cost of environmental enhancement programme	
1.2.2		Establishment of tea stalls, grocery shops, restaurants, hotels, etc. creating business opportunities for local people	Mitigation measures as mentioned in 1.2.1 and no additional cost is required		
1.2.3		Business opportunity for entrepreneur women	Mitigation measures as mentioned in 1.2.1 and no additional cost is required		
1.3.1	Skill enhancement	Increase in employment opportunities in other similar projects	Local people will be prioritized in training in project related works	No cost	
Operation Phase					
2.1.1	Hydro electricity generation and availability of electricity in project area	Generation of 1440 GWh of clean and renewable energy fulfilling energy demand and minimizing energy crisis	No mitigation measure is required		
2.1.2		Economic development of country due to generation of economic activities with enhanced availability of electricity	No mitigation measure is required		

SN	Beneficial Issue	Impact	Mitigation Measures	Mitigation Cost (NRs.)	Remarks
2.1.3		Opportunities related to rural electrification programme in Haku VDC	The project affected VDCs will be supported for rural electrification	Included in Included in cost of environmental enhancement programme	
2.1.4		Improvement of living standard of local people due to availability of electricity	No mitigation measure is required		
2.1.5		Decrease in deforestation due to reduced use of firewood	No mitigation measure is required		
2.1.6		Improvement of health of women and children by the use of electricity instead of fire wood.	No mitigation measure is required		
2.2.1	Increment in revenue and local development activities	Increment in revenue of local area by the operation of proposed hydroelectric plant	No mitigation measure is required		
2.2.2		Utilization of royalty in improvement of existing services	No mitigation measure is required		
2.3.1	Employment generation to local people and economic upliftment	Economic upliftment of local people by generation of income through employment in the project	Local people will be prioritized in project job		
2.3.2		Generation of other employment opportunities associated with project	No mitigation measure is required		
2.4.1	Increased tourism and Trade opportunity	Generation of opportunities related to local tourism and trade	The local people will be provided training related to tourism	Included in Included in cost of environmental enhancement programme	

8 ENVIRONMENTAL ENHANCEMENT PROGRAMME

To address the development aspiration of the local people and community, the proponent has planned various environmental enhancement programmes. The programmes planned here are basically based on the outcome of various consultation meeting, focused group discussion and public hearing carried out with stakeholder, local people and community in different phases of EIA study. Such outcomes are focused and targeted as the local people are more familiar with the pragmatic need for the development of their local area. However, some of the programmes proposed here are based on field level study by the EIA team as well.

The programmes proposed here will help to accomplish the development requirements of the local people of the project area located in rural setting in various ways. All these programmes will be developed as a part of corporate social responsibility with active participation of local people, stakeholder and community incorporating their relevant need and requirement.

The enhancement programme are prioritized for Haku VDC as all of the project structures and facilities apart from weir are situated in this VDC and this VDC will be susceptible to direct adverse impacts of both project construction and operation phase in comparison to other two VDCs.

The proposed programmes of environmental enhancement will help to support sustainable socio-economic activities in the project area, improve the living standard of the local communities, benefit local residents and encompass the atmosphere of trust to the project. All these will play a key role in balancing environment, society and the corporate business. The programmes will be fully developed within the given budgetary limits in specific locations as identified by the local area communities of the three projects affected VDCs.

8.1 Education and Education Facility Support Programme

The schools within the project construction sites of the project area lack fundamental educational facilities. The project will support 2 schools of the Haku VDC located at Hakubesi and Gogane for enhancement of both infrastructure and educational facilities. The enhancement measures will be in the form of construction of new classrooms, upgrading of playground, providing of educational materials, furniture sets and sporting goods, recruiting of new teacher and assistance to school authorities in upgrading of school.

The project will construct new classrooms and upgrading of playground in both schools. Both schools will be provided with sports good such as foot ball, volley ball, chess board, carom board, badminton, etc and educational materials such as blackboard, books, stationeries, etc. Similarly, necessary furniture such a bench, table, bookshelves, etc will be

provided to these schools. The project will also support in the recruitment of some new teachers within project target area and Teacher's Remuneration will be depend on the level of School & level of teacher as well as Govt pay scale. Besides, the project will also support in upgrading of school that depend on the school improvement plan of respective school. All the support will be finalized based on need assessment or close coordination of other district level service providers. The project has allocated **NRs.23,500,000/-** for this programme.

8.2 Health Institution Support Programme

The sub-health post of the Haku VDC is deprived in terms of physical structures, medical supply and human resources. The residents of Haku VDC needs to walk for more than 3 hours to reach the hospital located at Dhunche VDC for treatment of complex ailments. The project will support this VDC for medical supplies and infrastructure development along with the provision of ambulance. Apart from that, the project will support Ramche VDC for necessary infrastructure development and medical supplies and also support hospital of Dhunche with medicinal and instrument supplies and other infrastructure development. The project has allocated **NRs.2,500,000/-** for this programme.

8.3 Road Development Support Programme

Road plays multi-fold role for the overall socio-economic augmentation of the country and contributes to the development of allied productive and social sectors such as agriculture, industry, commerce, education and health sectors. The local people of the Haku VDC also have a general conviction that the road played a key role in the development of their village and showed deep aspiration for the construction of road through their villages. The project will assist in the construction of road in Haku VDC. The project has allocated **NRs.5,000,000/-** for this programme.

8.4 Sanitation Improvement and Management Support Programme

During field survey, Haku VDC was found to have poor sanitation facilities Most of the wards had insignificant numbers of toilets. The project will assist in improvement of sanitation condition by constructing toilets and sewer management in Haku VDC. The project has allocated **NRs.2,500,000/-** for this programme.

8.5 Water Supply Support Programme

The water supply system of the Haku VDC is hardly consistent, sources are scarce and people have to rely on random sources. Moreover, the project will assist in the management of water supply system in Haku VDC. Moreover, the existing source and infrastructure of water supply system are poorly maintained. The project will assist in management of water supply system in Haku VDC by improving the water source. The project has allocated **NRs. 1,250,000/-** for this programme.

8.6 Irrigation Management Support Programme

The project will assist in management of irrigation system of the project affetcted VDCs by channelization of local gullies and constructing stone masonry irrigation canal. The project has allocated **NRs.6,500,000/-** for this programme.

8.7 Agricultural Enhancement Support Programme

Although economy of the local area is mainly based on agriculture, the agricultural production is not satisfying due to absence of modern agricultural practice. People of project affetced VDCs are still relying on traditional methods of farming. For better agricultural yield, the local farmers will be provided training on modern methods of agricultural practice such as land & soil preparation, composting, soil fertility maintenance, seed sowing, thinning, weeding as well as use of hybrid seeds, modern agricultural tools, promotion and marketing of locally produced goods through advertising, exhibition and trade fair, observational tours, etc. The project has allocated **NRs.20,000,000/-** for this programme in three VDCs.

8.8 Animal Husbandry and Poultry Enhancement Support Programme

Poultry is a major component of the project affected VDCs, where at least each household keep a domestic bird, especially chicken not only for meat but also for prestige. Similarly, livestock, adapted to many uses, forms an essential part of the economy. In farm work, bullocks and asses are largely used where as goats are reared for meat and sale. The capital generated from animal husbandry and poultry has indirectly supported the local economy to cater health care, education and other domestic needs. Animal husbandry and poultry in rural project area, though an important component of livelihoods, has not featured seriously as an income generating source as majority of local people are engaged at household levels are subsistence agriculture. Thus, local people need awareness and skill development regarding livestock and animal husbandry. The project has allocated **NRs.500,000/-** for this programme in affected VDCs.

8.9 Women Development Programme

The situation of women in the rural project area is not conducive for a life of self-esteem and self-respect for the women. There are several reasons for this, viz. the traditional belief that confines women to the house and the kitchen. Women have little voice at all in the affairs of their family. They are treated as subservient to the husband and the society. Thus, the project will also launch other programmes for women development such as adult literacy, child care, health care, sewing, sanitation awareness, environmental conservation, local product promotion, project related construction work, account keeping, computer training, saving & credit, etc. Additionally, the project will also conduct trainings related to enhance the skill of women in agriculture, cottage industries, horticulture/vegetables, livestock, etc. The project has allocated **NRs.7,500,000/-** for this purpose.

8.10 Technical Education Support Programme

The project will support for various technical education programme that will be beneficial to the project implementation purpose and also supportive to local people for upgrading their expertise for better living and social benefits. These programmes will help to recruit local people in the project works and also prevent the out-migration of local youth to foreign country. The Project will launch training programmes for local people related to hydropower construction phase such as carpentry, electrical wiring, driving, welding, slope stabilization, Bio-engineering, spoil handling, masonry/ gabion wires weaving, construction of dry walls & gabion walls, house wiring & maintenance, etc The project has allocated **NRs.5,000,000/-** for this purpose.

8.11 Office and Secretarial Training Programmes

Some numbers of staffs are required for the project as office assistant and secretaries. The project will try to fulfill this need from locally available resources by providing training to the local people as per their qualification. The project has estimated **NRs.5,000,000/-** for this purpose.

8.12 Ethnic Group Support Programme

The ethnic group 'Tamang' of the project area will be supported to preserve their tradition, culture, identity as well as their traditional occupation. The fund will be mobilized by establishing a separate committee namely Tamang Janajati Support Committee comprising the representative of Tamang ethnic group of 3 project affected VDCs. The project has estimated **NRs.10,00,000/-** for this programme.

8.13 Langtang National Park (LNP) Support Programme

The project will support LNP in infrastructure development, nursery management and afforestation in necessary area. The project will also assist in compensation and other scheme related to management of conflict between park and people. The project will also assist in construction of infrastructures such as office building, library, prisoner room, etc. The project will assist in purchasing vehicle to improve the park service. The project has allocated NRs.13000000/- for this programme.

8.14 Local Organization Support Programme

The project will provide fund for fund for organizational and infrastructural support for the local developmental organizations and co-operatives of all 3 VDCs. The project has estimated **NRs.4,500,000/-** for the programme.

8.15 Religious Institution Support Programme

The project will assist in upgrading of local temple, stupa and monastery located in the Project affected VDCs. The programme will help to preserve their culture and religion. The project has estimated **NRs.3,000,000/-** for this programme.

8.16 Support to Misyung Khola Micro Hydropower Project

The project will support some funds for upgrading of Misyung Khola Micro Hydropower Project (Peltric Set System) as the electricity generated from is not sufficient to the current electricity users. The project has allocated NRs.1000000/- for this purpose.

8.17 Rural Electrification Extension Programme

Although many settlements of project affected VDCs are facilitated with micro hydropower plants, the project will support rural electrification by constructing transmission line from the power plant of the proposed UT-1HEP. The project has estimated **NRs.5,000,000/-** for this programme.

Table 8.1: Summary of Environmental Enhancement Programme

S.N	Description	Amount (NRs)
1	Education and Education Facility Support Programme	23,500,000/-
2	Health Institution Support Programme	2,500,000/-
3	Road Development Support Programme	5,000,000/-
4	Sanitation Improvement and Management Support Programme	2,500,000/-
5	Water Supply Support Programme	1,250,000/-
6	Irrigation Management Support Programme	6,500,000/-
7	Agricultural Enhancement Support Programme	20,000,000/-
8	Animal Husbandry and Poultry Enhancement Support Programme	5,000,000/-
9	Women Development Programme	7,500,000/-
10	Technical Education Support Programme	5,000,000/-
11	Office and Secretarial Training Programme	5,000,000/-
12	Ethnic Group Support Programme	10,000,000/-
13	Langtang National Park (LNP) Support Programme	13,000,000/-
14	Local Organization Support Programme	4,500,000/-
15	Religious Institution Support Programme	3,000,000/-
16	Support to Misyung Khola Micro Hydropower (Peltric Set system)	1,000,000/-
17	Rural Electrification Extension Programme	5,000,000/-
Total		**64,050,000/-**

Source: Field Survey, 2011

9 REVIEW OF ACTS, REGULATIONS, GUIDELINES, POLICIES, CONVENTION AND OTHER RELATED INSTITUTION

This Chapter reviews acts, regulations, guidelines, policies and other related institution provisions of Nepal as well as other international convention that have a direct relevance with the proposed project development and operation. The Proponent will abide by the laws beside those, which are already mentioned in this chapter, if attracted due to various activities undertaken during the project implementation.

9.1 Constitution of Nepal

9.1.1 Interim Constitution of Nepal, 2063 (2006)

Article 35 (5) of the Interim Constitution of Nepal required the State to give priority to the protection of the environment, and also to the prevention to its further damage due to physical development activities by increasing the awareness of the general public about the environmental cleanliness. The State shall also make arrangements for the special protection of the environment and the rare wildlife. Provision shall be made for the protection of the forest, vegetation and biodiversity, its sustainable use and for equitable distribution of the derived from it. Hence, to prevent such damage the application of this Article requires the study of environmental resources in all development works and assesses their impacts so that the measures could be taken up to prevent any harmful effects on the environment.

9.2 Laws and Acts

9.2.1 Environmental Protection Act, 2053 B.S (1997 A.D)

This act developed by Nepal is the principal regulatory frameworks to make the development programmes and projects environment-friendly, which are now enforced through appropriate regulatory measures. The law contains several provisions to internalize environmental assessment system and to maintain a clean and healthy environment by minimizing the adverse impacts on human beings and other life forms and physical objects.

Major Highlights of EPA 1997 are as follows:

Section 3: It requires the proponent to carryout IEE and EIA as prescribed.

Section 4: No one is supposed to implement the proposal without approval from the concerned agency.

Section 5: In order to implement any proposal, the proponent will submit the proposal along with its report on IEE or EIA to the concerned agency for approval.

Section 6(1): The relevant agency is empowered to grant approval for the IEE report, only if it finds that no significant adverse effects will be caused to environment by the implementation of the proposal. The government agency is required to forward the EIA

report submitted along with proposal to it, with its opinion on the report to the Ministry of Environment.

Section 6(2): While examining the IEE proposal, if it is found necessary to carry out EIA of such a proposal, the concerned agency can issue an order to carry out EIA.

Section 6(3): Any member of the public is entitled to copy the EIA report through the Ministry on their own initiative and at their own expense for the purpose of providing their opinion or suggestions on it.

Section 6(4): MoEnv is empowered to set up a committee to provide opinions on EIA received by it.

Section 6(5): While granting approval to any proposal, MoEnv is required to take into account public comments received on the EIA report and the opinion of the committee, if any. The Ministry can only grant its approval if it does not seem to cause significant adverse impact on the environment.

Section 6(6): If it appears from the IEE or EIA report that significant adverse impact could be mitigated or controlled, the concerned agency or Ministry may grant approval with prescription of necessary terms.

9.2.2 Land Acquisition Act, 2034 B.S (1977 A.D)

The Land Acquisition Act, 1977 empowers the Government to acquire land for development purposes, by paying compensation to the landowner. The act clearly empowers the Government to acquire necessary land at any place in any quantity by providing the compensation pursuant to the Act for the land required for any public purpose or for operation of any development project initiated by government institution (Section 3 and 4). The Government shall provide compensation to the concerned person and organization as decided by the Compensation Fixation Committee. The committee consists of Chief District Officer, Chief District Land Administration and Revenue Officer, Project Chief and the Representative of the DDC. The compensation paid under this Act will be in cash. However, under the Section 14 of the Act it is stated that, the Government may allot land to those people whose land has been acquired, from the land it possess such as Ailani, or Government-owned any other land, and if they prefer land for land. The provision of land for land has not been taken seriously by the government.

9.2.3 Explosive Act, 2018 B.S (1961 A.D)

The act defines the explosive matters and reserves the right to the government to define the explosive as to the requirement by publication of notice.

Section 2 of the act defines the explosive matters as

- granite, nitroglycerin, dynamite, gun-cotton, blasting powder, mercury or fluent net of other metals and any other material whether or not of the same category, produced or used with the objectives of bringing about the practical affect through explosion or the effect of a firecracker nature;
- fog signal, fuse rocket, percussion cap, cape, detonator, quartos and all types of ammunitions and the materials produced or prepared in an identical manner or by making a combination of the Explosives as mentioned above;
- plants, machines or tools that produce or make the Explosives

- the materials declared as explosives by Government of Nepal, by publishing a notice in Nepal Gazette

Section 3 empower GoN to declare explosives and states that that Government of Nepal may, from time to time, by publishing a notice in the Nepal Gazette, declare such materials as Explosives which may cause harm to life or property of persons. Section 4 of the Act forbids production, storage, use, sale, transportation and import of explosives without license for any development projects. The Section also provides the concern to apply for the license to the Chief District Officer with necessary descriptions prescribed in the provisions of the Act. Section 8 states that GoN must be informed of accidents related to explosives substance.

9.2.4 Forest Act, 2049 B.S (1993 A.D)

Forest Act considers forests as "resources oriented" rather than "use oriented". Clause 68 of the Act empowers the government to provide the parts of the forest areas to implement national priority project. This Section has *three* provisions: (i) the project should be of national priority, (ii) there is no alternative other than to use the forest area, and (iii) the project should not have significant impact on environment. Thus, if there is no alternative except the use of forest land is available for the implementation of the project, given it a national priority, the Government of Nepal can permit the use where there will be no adverse effects on the environment. These three criteria must be fulfilled for the implementation of project of any sector in any category of forest areas.

Clause 23 empowers the government to delineate any part of a national forest, which has "special environmental, scientific of cultural importance", as a protected forest. Clause 49 prohibits reclaiming lands, setting fires, grazing, removing forest products, causing trees or plants to fall, wildlife hunting, extracting boulders and sand and soil from the national forest without prior approval of the government.

9.2.5 Land Reform Act, 2021 B.S (1964 A.D)

To reduce inequality in the distribution of agricultural land , this act is being implemented. This act fixes ceilings on the land an individual can own. The Land Act, 1964 aims to divert 'inactive' capital and labour from land to other economic sectors, bring about an equitable distribution of cultivable land, improve the standard of living of 'actual tillers' who depend on land for their livelihood, and maximize agriculture production(preamble). This Act abolishes the zamindari system of land ownership (section 3). Ceilings on ownership are specified in section 7 and vary according to geographical location. Land holding above the land ceiling could be confiscated as per the provisions of the act. However, with the permission of the authorised government officials, landholding ceiling could be increased for the organisations as per the requirement of the organisational works. The maximum size of an agriculture holding is 6.6 hectares, while the largest homestead may cover 0.66 hectares (section 7). Land in excess of these ceilings is to be acquired by the 'prescribed authority' (section 15) upon payment of compensation (section 19). Exemptions on these ceilings may be granted in the case of land held by the government itself, or by industries, or educational and medical institutions (section12).

9.2.6 Local Self Governance Act, 2055 B.S (1998 A.D)

This act provides more autonomy to District Development Committees, Municipalities and Village Development Committee. The Act empowers the VDCs, DDCs and Municipalities to conserve manage and use their natural resources and collect tax, revenue from the sale and use of such resources and use it for local development. Sections 28 and 189 of the Act have made responsible the Village Development Committee (VDC) and District Development Committee (DDC) to formulate and implement the programmemes related to the protection of the environment and biodiversity. Furthermore, Sections 43 and 201 require the VDC and the DDC to give adequate priority to the protection of the environment through the formulation and implementation of the local level plan(s). Section 25(e) of the Act requires the ward to help for protection of environment through plantation over the bare land, cliff and mountains.

9.2.7 Electricity Act, 2049 B.S (1992 A.D)

The Electricity Act, 1992, has been enacted to manage the survey, generation, transmission and distribution of electricity and to standardize and safeguard electricity services. According to Section 4, sub-section (1) of the Act, "Any person or corporate body who wishes to conduct survey, generation, transmission or distribution of electricity over 1 MW, shall be required to submit an application to the prescribed officer along with economic, technical and environmental study report". The Act also forbids negative impacts on environment, such as soil erosion, floods, landslides and air pollution while producing, transmitting, and distributing electricity (Section 24). Section 33 deals with the utilization and acquisition of land and houses. This section allows the license to be submitted with an application to GoN where other's lands or houses need to be acquired. The section further states that GoN may make available land and houses in the same manner as it makes available to any corporate body under the prevailing laws.

9.2.8 Water Resource Act, 2049 B.S (1992 A.D)

The Water Resource Act, 1992 is a comprehensive legislation on water resources, which deals with the development, utilization and conservation of the water resources in the country. The Act strives to minimize environmental damage to water bodies through environmental impact assessment studies and the proponents who wish to use water resources for various purposes should prepare EIA report before a license can be granted. This act grants right to use water by individuals, organizations and private sector. No person shall be entitled to utilize the water resources without obtaining a license under this act. The licensee has to pay prescribed charge for utilizing the water resources.

Drinking water and domestic uses; irrigation and agriculture like animal husbandry and fisheries have top priority for utilization of water resources. Use of water like hydroelectric is ranked only in the fourth priority, so project should make sure that even after implementation people can benefit from this.

Section 16 deals with the utilization and acquisition of the land. Sections 18, 19, and 20 of the act deal with water quality standards, water pollution and adverse effect on environment. Sections 18 and 19 allow the government to prescribe pollution tolerance

limits and water quality standards for various uses. Section 19 (2) states that any discharge of waste into the water body should not exceed the tolerance limit for water resources. Section 20 of the act stipulates that while utilizing water resources, it shall be done in such a way that no significant adverse impact be made on the environment by the way of soil erosion, flood, and landslide or similar other cause.

9.2.9 Wildlife Protection Act, 2015 B.S (1958 A.D)

Initially, the Wildlife and Conservation Act (1958) was the legal means of protecting rhinoceros and their habitat, particularly in Royal Bardia National Park. In 1973, the Act was replaced by more comprehensive legislation, i.e. the National Parks and Wildlife Conservation Act. An important amendment to this Act in 1993 provided for the establishment of buffer zones in areas adjoining parks to facilitate people-centred management of forests and to empower local people within the buffer zones by involving them in all phases of planning and management.

9.2.10 National Park and Wildlife Conservation Act, 2029 B.S (1973 A.D)

This act focuses conservation and protection of wildlife in the national parks, protected areas and their buffer zones. This act provides the basis for park, reserve administration and wildlife conservation. GoN may, if it so deems necessary, declare any area as the National Park, strict nature reserve, wildlife reserve, hunting reserve, conservation area and buffer zone in the country.

In Nepal, all wildlife species within National Parks are protected from exploitation through the National Parks and Wildlife Protection Act, 1973 highlighting conservation of ecologically valuable areas and indigenous wildlife. With regard to species conservation, this act contains a list of protected wild mammals (26 species), birds (9 species) and reptiles (3 species). It means the Project activities should not affect these animal species.

9.2.11Aquatic Life Protection Act, 2016 B.S (1961 A.D)

This act provides some legislative protection of the habitats of aquatic species. Section 3 of the AAPA renders punishable any party introducing poisonous, noxious or explosive materials into a water source, or destroying any weir, bridge or water system with the intent of capturing or killing aquatic life. However, no agency has been designated the responsibility for administering and enforcing this act.

9.2.12 Soil and Watershed Protection Act, 2039 B.S (1982 A.D)

This act was formulated to prevent or save any area from being destroyed from natural calamities such as flood, landslide and soil-erosion and keep the volume and flow of water in a normal condition or keep on maintaining cleanliness by preventing the flow of water from being muddy. The mismanagement of watersheds leads to the degradation of valuable land by flooding, water-logging, and accelerated silt in storage reservoirs. Section 3 states that If Government of Nepal considers it necessary for the soil and watershed conservation, it may, by a notification in the Nepal Gazette, declare any area of Nepal as a conserved watershed area, specifying the borders thereof.

Section 4 highlights that the watershed conservation officer may carry out, or cause to be carried out, the following acts in any conserved watershed area for the conservation of soil and watershed:

- to construct, look after and maintain a prevention or control dam, check dam, embankment, terrace improvement, ditch, feeder ditch or diversion channel or drainage, retaining wall, pond or similar other necessary structure
- to conserve, look after, maintain and support the forests, weeds, grasses and other natural vegetation in the lands where landslide may occur and in the sloppy lands,
- to maintain the soil fertility and the cleanliness of water and environment in a balanced manner,
- to carry out such other soil and watershed conservation related acts as
- prescribed by the Government of Nepal.

As per section 10 of this act, it is stated that Notwithstanding anything contained in the prevailing law, no person shall, without permission of the Watershed Conservation Officer, carry out any of the following acts in such land, out of the lands within a conserved watershed area, as specified by the Watershed Conservation Office as a land that is vulnerable or likely to be vulnerable to floods or landslide or soil-erosion or soil-cutting: Thus, under this section of the act, power is extended to the Watershed Conservation Officer to grant permission to construct dams, drainage ditches and canals, cut privately owned trees, excavate sand, boulders and soil, discharge solid waste, and establish industry or residential areas within any protected watershed. SWCA outlines the essential parameters necessary for proper watershed management (including both rivers and lakes). The Act is applicable only to protected watersheds.

9.2.13 Act, 2049 B.S (1992 A.D)

This act is enforced by GoN on B.S 2049/2/2. This act classified people below 15 years as child and "Nabalik" for the age group of above 14 years and below 18 years. The act has also made provision of labour court and Department of Labour. The act clearly mention that appointment letter should be issued for all the employees which include their working hours, working time, wages and other benefits. The act allows for the time bond contract for the manpower required for development work. The act specifies that working hours for the Nabalik and women must be within the period of 6 AM to 6 PM, which clearly restrict to deploy women in night works. The act also stated that equal opportunity shall be given to women as man. Similarly, working period of other employees must not exceed 8 hours a day and 48 hours in week. If some people work beyond that period, over time allowances must be paid which is 150 % of the normal per hour wages and such overtime must not exceed 4 hours in each day. According to this act, wages rate of the employees shall not be less than rate fixed by the concerned offices of GoN. Furthermore, this act mandates the employer for prioritizing the Nepalese citizen in employment in the company. After completion of 1 year service period, the company or employer has to employ the workers permanently with broadly defined position, roles and responsibilities along with definite pay scale. However, such provision will not be there for the employee under short period contract. The employer or company could terminate the employee with prior consent of the Department

of Labour and prior notice to the employee as defined by the law. The act also ensures the healthy environmental condition of the working place by the employer or company.

9.3 Rules and Regulations

9.3.1 Environmental Protection Rules, 2054 B.S (1998 A.D)

Under the provision of Environment Protection Act,1997, HMG/N has enforce the Environment Protection Regulation (EPR) on 1998. As per the EPR 1997 the planning and approval of the proposal is done in three phases: a) scoping preparation b) report preparation, and c) approval of the report.

Major Highlights of EPR, 1998 are as follows:

Rule 3 : The proponent is required to carry out IEE or EIA as per Schedule 1& 2 respectively.

Rule 4 : Before preparing an EIA report, the proponent will publish a 15 –day's public notice to provide the stakeholders to offer their opinions and concerns in writing on the proposal. The proponent will prepare and submit the scoping report to the concerned agency and forward to MoEnv for approval and MoEnv should determine the scope of EIA study as submitted or amended.

Rule 5 : In case of EIA report, the proponent should prepare and submit the TOR to the concerned agency, which should forward it to MoEnv for necessary approval.

Rule 7(1): The proponent should prepare IEE and EIA report in the format as indicated in schedule 5 of the EPR, 1997.

Rule 7(2): The proponent should conduct a public hearing in the project site to conduct the EIA.

Rule 8(1): It is stipulated that after the proponent prepares the EIA report, proponent must send a copy thereof to the relevant VDC or municipality or DDC to enable them to offer their opinion and suggestion on it.

Rule 8(2): It obliges the proponent to make the EIA report public for a period of 30 days for perusal or study by any interested individuals or institutions; they may offer their opinions and suggestions, if any, to the proponent within 30 days from the date when the report is made public.

Rule 10: The proponent should submit 15 copies of the IEE/EIA report along with the recommendation of the concerned VDC or municipality to the concerned agency for approval.

Rule 11: The concerned agency, after investigation should approve the IEE report within 21 days from the date of its receipt, and forward the ten copies of the EIA report with its suggestion to MoEnv within 21 days from the date of receipt. Upon the receipt of the EIA report, MoEnv should issue a 30 days public notice in the daily newspaper to offer written comments of the stakeholders. MoEnv may also seek the suggestions from the committee, if formed for this purpose, and should approve the EIA report within 60 days from the date of receipt or within 90 days in case of special reason.

Rule 12: The Proponent should implement EIA and other conditions given during the approval process.

Rule 13: The concerned agency (ministry) is made responsible for environmental monitoring and evaluation activities, and issue necessary directives to the proponent to implement environmental protection measures.

Rule 14: MoEnv is responsible to prepare the environmental auditing report after two years of the commencement of the service by the proposal.

Rule 45-47: Anyone wishing to receive compensation may file the application to the Chief District Officer (CDO) and should forward the file to the concerned agency in case the evaluation of effects/loss. Once the loss is evaluated, the CDO should determine the amount of compensation within 60 days of receipt of application. The proponent should pay the compensation amount within 30 days of decision. In case the proponent (individual, institution or proponent) fails to pay within time limit, the victim may submit an application, and the CDO shall auction the property of the proponent and pay the amount of compensation as determined.

Section E, Rule 3 (Amendment 2009): Proposal with electricity generation schemes from 51 MW onwards has to go through EIA process.

9.3.2 Forest Rule, 2051 B.S (1995 A.D)

Rules 65 of the Forest Rules (1995) oblige the proponent to bear the amount of compensation to be paid for any loss or harm to any local individuals or communities. Similarly, the entire expenses for the cutting and transporting of forest products for the use of the project should be borne by the proponent. The rules also provide absolute authority to local communities to manage the forests and get all the benefits from the forests.

9.3.3 Local Self Governance Regulation, 2056 B.S (1999 A.D)

This regulation empowers the local bodies to coordinate and implement development programme and for rationale utilization of local natural resources. Article - 7 (68) empowers the VDCs for monitoring and supervision of development work implemented in the VDC. The Article-4 has provision of three members Agriculture, Forest, and Environment committee to look after the concerned issues. Article- 6 (206) specifies the need of social, economic, environmental and public facilities while planning the project. Article-7 (210) focus on environmental studies and due consideration while implementing the project like sand quarry, stone quarry and coal mine etc. Article 7- (68) empowers the VDCs for monitoring and supervision of development work implemented in the VDC.

9.3.4 Electricity Rules, 2050 B.S (1993 A.D)

The Electricity Rules, 2050, state that the proponent willing to produce and transmit electricity should analyse environmental impacts of the proposed projects and include impact mitigation measures and environment protection measures including arrangements for the settlement of the displaced people (Rules 12 and 13). According to Rule 66, any person or corporate body desiring to produce or transmit electricity shall submit an application requesting, for the use of such land. However, such land if regulated should be compensated (Rule 87), as determined by the Compensation Fixation Committee (Rule 88).

9.3.5 National Park and Wildlife Conservation Rule, 2030 B.S (1974 A.D)

The rule made under National Parks and Wildlife Conservation Act, 2029 provides provides the basis for wildlife conservation. Himalayan National Park regulations, 1979 (2036) prohibit the use of timber, fuel wood, or other forest products, or their purchase from local residents, by any visitor, and require self-sufficiency in kerosene, oil, gas, or other fuel. The regulations authorize the warden to permit local residents to collect timber from specified areas to build or repair houses or for fuel wood. The regulation also stipulates that permission from Government of Nepal, Ministry of Forest and Soil Conservation must be obtained in the case of any plan to be implemented within a mountain national park.

9.3.6 Conservation Area Management Rule, 2053 B.S (1996 A.D)

The Conservation Area Management Rule (1996) promulgated by the GoN pursuant to section 33 of the NPWCA provides institutional framework, systems, mechanisms and processes (management modality) for the management of the Conservation Area. The CAMR was gazetted in 1996 (2053/8/17). The regulation authorizes National park to establish headquarters for the management and the development of the conservation area (Rule 4), divide the area into different sub-areas (Ilakas) as per the need, and establish Unit Conservation Officers and other staff as necessary.

9.4 Plans/Policies/Strategies

9.4.1 Three Years Interim Plan, 2064 B.S (2007 A.D)

The Three Year Interim Plan's objective in energy sector is to develop the hydro- power as an export commodity, expanding hydro- power to rural areas of the country, and providing quality services with low investment, within the framework of the Hydroelectric Development Policy, 2001 and the National Water Plan, 2005.

The three year interim plan document has been built on the basis of previous achievements, and provides continuity to Poverty Reduction Strategy and Millennium Development Goals, and also addresses issues related to post conflict management. The plan has focused to achieve its goal on sustainable basis. Therefore, to meet the agenda of sustainable development, the plan prioritises environment , science and Technology at the top order.

On the electricity sector of economic development, the plan emphasize to encourage domestic and foreign investment for the development of hydro-electricity by adopting clear, simple and transparent procedure to increase the participation of the private sector, the community and local bodies in production, consumption and export of hydro-electricity.

9.4.2 National Environmental Policy and Action Plan I & II, 2050 B.S (1993 A.D) and 2055 B.S (1998)

Nepal Environmental Policy and Action Plan were indorsed by the HMG/N Environment Protection Council in 1993 to institutionalize environmental protection in development projects. Its aims were:

- to manage natural and physical resources efficiently and sustainably
- to balance the development efforts and environmental conservation for sustainable fulfilment of basic needs
- to preserve endemic and endangered species and their habitats; the promotion of private and public institutions for biological resources inventory and conservation; and the strengthening of the capacity of the DNPWC.
- to safeguard national heritage
- to mitigate adverse environmental impacts of development projects and human actions
- to integrate environment and development through appropriate institutions, adequate legislation and economic incentives, and sufficient public resources

The environmental policy outlines EIA as a necessary tool in planning a hydroelectric project and emphasises a greater participatory role of the local communities particularly for the mitigation measures. The policy emphasis on sustainable management of natural resources through land management, soil fertility management, agricultural research and extension, forest management, forestry research and extension, water resource management, watershed protection and management of key watersheds. The plan also highlight on safeguarding natural heritage through biodiversity conservation, management of protected area and preservation of cultural heritage

9.4.3 Agricultural Perspective Plan, 2052 B.S (1995 A.D)

The plan was formulated in 1995 of the Ninth Five Year Plan as a 20 year vision for agricultural led growth and poverty reduction with emphasis on environmental conservation. As per this Plan, the development projects such as roads, irrigation canals, hydroelectric, dams and agro-industries shall undergo initial environmental assessment or environmental impact assessment. The plan emphasis on environmental management through development of forests and other permanent vegetation covers in catchment areas of hydro-powers dams, upper watersheds and water sources; minimization of soil erosion and landslide through combination of biological measures and locally available materials; development of green belt on either side of the agriculture road; promotion of the use of alternative sources of energy such as biogas and fuel-efficient cook for the protection of the environment; implementation of environmentally sound farming systems by introducing strong measures in research and extension for better land use in collaboration of farmers; incorporation of ecological and environmental courses in the syllabi of schools and universities with effective teaching materials and promotion of women's participation in all community organizations and in all development and environment related projects.

9.4.4 Forest Sector Master Plan, 2045 B.S (1988 A.D)

The Master Plan for Forestry Sector has identified sectoral issues and analysed these against existing conditions.. The plan has identified four long term and three medium term objectives to prepare a long-term development plan (GoN/ADB/FINNIDA). The long-term objectives is related with meeting the basic needs of the people, protecting the soil and water resources, conserving ecosystems and gene bases and consolidating local and national economies. These objectives have led to framing the six primary development programmes. One of them is the development of NTFPs with focusing on the development

of medicinal and aromatic plant through cultivation of high value herbs and grasses. This plan has mainly four development imperatives: a) satisfaction of basic needs including medicinal herbs, b) sustainable utilisation of forest resources, c) people participation in decision making and benefit sharing, and d) socio-economic growth. Translating this policy into action, it has emphasized on increasing production of forest products including NTFPs through the promotion of agro-forestry, community and leasehold forestry and research in MAPs. Medicinal and aromatic plants and other non- timber forest products are among six primary programmes formulated in the plan.

9.4.5 Nepal Biodiversity Implementation Plan, 2060 B.S (2003 A.D)

In 2003, Nepal developed a comprehensive Nepal Biodiversity Strategy (NBS) with the participation of a broad cross-section of Nepali society as well as in consultation with international experts to fulfill its obligations of being a party to the Convention on Biological Diversity (CBD) signed during the Earth Summit in 1992 and to streamline all conservation efforts in compliance with the CBD. NBAP formulation includes a review of the policy and institutional framework, the status and trends of biodiversity and an analysis of gaps on key themes such as protected areas, plant resources, wetlands, community forestry, agriculture and livestock to identify issues of national and local concern and set priorities for proposed projects and programmes. The plan is comprised of policies and actions to maintain biodiversity within and outside of protected areas with long- and short-term profile projects to strengthen human resource development and institutional capacities.

The main objective of this plan is to accomplish comprehensive documentation and registration of biological resources in Protected Areas and buffer zones comprising all groups of plant, animals and microbial diversity and conserve biodiversity in and around the protected areas with the operation strategy focusing on the improvement of socio economic and cultural condition of communities. The other objectives of this plan include strengthening of capacity of National park and BZ communities, development of sustainable tourism in protected areas, resolving park and people conflict, controlling of poaching activities and effective implementation of CITES, management of watersheds, linking of biodiversity conservation in development programmes to reduce poverty

9.4.6 Revised Forest Policy, 2058 B.S (2000 A.D)

The Ministry of Forests and Soil Conservation has formulated a Revised Forest Sector Policy, 2000. This is an updated version of the Master Plan and subsequent amendments. The revised policy outlines development strategies and programmes and funds required to develop the forestry sector It emphasizes the protection of soil, water, flora and fauna constituting the main element of forestry to sustain biodiversity. It recognizes that the sustainable forests management is only possible when it give adequate attention to meet the basic needs of the people, sustainable utilization of forest resources, participation in decision making and sharing of benefits and above all on socio-economic growth. The policy has also legitimized the concept of CFUG as an independent, autonomous and self-governing institution responsible to protect, manage and use any patch of national forest with a defined forest boundary and user group members.

9.4.7 National Conservation Strategy, 2045 B.S (1988 A.D)

Based on the World Conservation Strategy, HMG/N in collaboration with IUCN prepared this strategy that highlights the necessary to establish appropriate policies, regulations and management approaches to ensure the sustainable extraction of medicinal plants. The basic objectives of this strategy are:

- To satisfy the basic material, spiritual and cultural needs of the Nepalese people,
- To ensure the sustainable use of land and renewal resources to preserve biological diversity, and
- To maintain ecological and life support system

9.4.8 Poverty Reduction Strategy, 2059 B.S (2002 A.D)

The Tenth Plan has formulated an appropriate poverty reduction strategy based on four pillars - to promote faster and pro-poor economic growth, equitable access to social and economic infrastructure and resources for the poor and marginalized groups, social inclusion and targeted programmes and improved governance. The strategy aims on expanding electricity coverage in a reliable, financially and environmentally sustainable manner by promoting private sector participation in power sector, integrating rural electrification with rural economic development, promoting cooperative based grid-based rural electrification and expanding and reinforcing of power infrastructure.

9.4.9 Water Resources Strategy, 2059 B.S (2002 A.D)

The strategy focuses that every citizen should benefit from Nepal's abundant water supply through the production of food and energy at reasonable cost. Nepal's electricity tariff rate is considered to be one of the highest in the region and the domestic electricity charge is one of the major cost items in household expenditures. To remedy this situation, the strategy seeks to develop hydroelectric with sufficient capacity to meet domestic needs at affordable prices and to allow for export of electricity to neighbouring countries. The strategy has also targeted for maximum investment by private sector in hydroelectric sector. In the Strategy's first five years, emphasis is given on identifying and developing cost-effective small and medium hydroelectric projects that are capable of meeting domestic needs at affordable prices. In the following ten years, substantial benefits will be realized by maximizing hydroelectric development for different markets, including energy-intensive industries and power exports.

9.5 Convention

9.5.1 Convention on International Trade of Endangered Species (CITES)

Nepal became party to Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in 1975. CITES has facilitated international co-operation to regulate international trade in endangered wild flora and fauna with the aim of reducing or eliminating trade in species whose numbers or conditions suggest that further removal from their natural habitat would lead to their extinction. The National Parks and Wildlife Conservation (NPWC) Act, 1973 regulates the trade of species listed in CITES appendices.

The government has designated the Natural History Museum (Tribhuwan University) and the Department of Plant Resources as the scientific authorities for wild fauna and flora respectively. Similarly, the Government has designated the Department of National Park and Wildlife Conservation and the Department of Forest as the management authorities for wild fauna and flora respectively. The Convention urges Parties not to allow trade in specimen of species included in the CITES Appendices I, II, and III except in accordance with the provisions of the Convention.

Pursuant to Section 10 of the NPWC Act, the hunting of animal protected under Schedule 1 is prohibited throughout Nepal. Most of these species are also listed in CITIES appendices.

Under the NPWC Act, it is illegal to collect, obtain or keep any part of a dead animal protected under Schedule1 without a certificate, and such goods are prohibited for sale, purchase or disposal. Pursuant to Section 26, any person illegally killing, wounding, purchasing, selling or transferring a protected animal, or keeping as a trophy, selling or purchasing any part thereof, will incur a fine or imprisonment or both.

9.5.2 Convention on Biological Diversity (CBD), 1992

The Convention on Biological Diversity, 1992 was opened for signature during the UN Conference on Environment and Development in Rio de Janeiro, Brazil. Nepal signed this convention during the Rio Summit. The convention was ratified by the Parliament in 1993 to become its party. The convention has entered into force in Nepal on 21 February 1994.

Article 14 of the Convention urges Parties to introduce appropriate procedures requiring EIA of the proposed project that are likely to have significant adverse effects on biological diversity with a view to avoiding or minimizing such effects and, where appropriate, allow for public participation in such procedures. The convention also focuses on reducing trans-boundary impacts on biodiversity.

There are other international non-legally binding and legally binding instruments that focus on the conservation and protection of the environment and natural resources.

The EIA could contribute to address the convention matters and comply with the international obligations while meeting its national development needs.

The convention contains a series of far-reaching obligations related to the conservation of biological diversity and sustainable uses of its components. One of these obligations is the requirement for environmental study. The purpose of an environmental study in relation to biodiversity conservation is to identify in advance:

- the aspects of the project which is likely to have significant adverse effects on biological diversity at genetic species and ecosystem level, and
- The steps to be taken to avoid or minimize significant adverse effects to ensure that the proposed project comply with existing environmental legislation.

The GoN has included 17 species of plants and 39 species of animals in the protection list. If the project area is the core habitat of these species and the project activity will likely to

affect them, mitigation measures shall be proposed and be implemented to avoid and/ or mitigate the adverse impacts. Nepal is a party to the convention on Biological Diversity and in accordance to the article 14, adequate attention should be given to minimize and or avoid the impacts.

9.5.3 ILO Convention, 169

International labour Organization Convention No.169 is a legally binding international instrument open to ratification, which deals specifically with the rights of indigenous and tribal peoples. Today, it has been ratified by 20 countries. Once it ratifies the Convention, a country has one year to align legislation, policies and programmes to the Convention before it becomes legally binding. Countries that have ratified the Convention are subject to supervision with regards to its implementation. The Legislative Parliament of Nepal has approved the ratification of the Convention on Indigenous and Tribal Peoples (No.169) adopted by the ILO in 1989. Nepal thus becomes the first country in South Asia to ratify this Convention and the only second country in all of Asia to do so.

Nepal's indigenous peoples, or Janajati, make up almost 40 per cent of the country's population. There are 59 recognized Janajati, each with its own language and cultural tradition. Despite their significance, Janajati communities have been economically, socially and politically marginalized throughout Nepal 's modern history. The ratification of ILO Convention No. 169 is an important step in addressing the issues of tribal and indigenous people.

The Article 7 of the convention provide right to the indigenous and tribal people to decide their own priorities for the process of development. However, for the national development plans and programmes, it mandates consultation with them in the formulation of the plans and programmes. Article 12, 13, 14 and 15 safeguards rights of the indigenous people in the land and natural resources in territories traditionally occupied by them. In the event that the state retains the right of the natural resources in their territories, it mandates formulation of special provisions under the state legislation for participation in the decision making process and resettlement process with full compensation of the resulting loss or injury (Article 16)

9.6 Guidelines

9.6.1 National EIA Guideline, 2050 B.S (1993 A.D)

As recommended by National Conservation Strategy and Nepal's Seventh Five Year Plan, National Planning Commission (NPC) with assistance from IUCN prepared the National EIA Guidelines, which provides the procedural guideline for integrating environmental aspects in the development projects. Those guidelines were prepared entirely through a participatory process with a view to suit the local context. The guidelines were endorsed by the Government of Nepal on 27 September 1992 and gazetted on 19 July 1993 in volume 45, number 5. The guidelines contain objective, criteria for project screening, IEE, scoping, preparation of ToR, format for EIA report, impact identification and prediction, mitigation measures, report review, monitoring, evaluation and auditing. Community participation, schedules and annexes to IEE and EIA.

Project screening criteria is provided under sub-section 1 of section 8. To further assist in the screening decision, development projects are divided under three broad categories as mentioned in schedule 1, 2, and 3 reflecting various degrees of potential impacts on the environment. Sub-section 2, 3, and 4 help to determine whether to undertake an IEE or EIA study based on under which Schedule the proposed project falls. Section 13, 14, 15 and 16 deals with scoping, its methods, responsible agencies and the appropriate for scoping respectively.

Section 18 provides the guidelines for TOR preparation according to the format as given in schedule 4. Section 19 of the guideline requires the proponent to prepare the EIA report upon completion of EIA exercise of a project. The EIA report must be concise; pay attention to significant issues, impact studies; analyse the extent and depth of impact commensurate with the nature of potential impact; and due consideration must be paid to the responsibilities of target users such as project proponent, designers and decision-makers. Section 20 and 21 requires the proponent to follow the Format and Annexes to EIA report as per the schedule 5 and 6 respectively.

The Guideline includes elaborated procedures for EIA report preparation. It calls for identifying socio-economic, biological, physical and cultural impacts. These impacts could be categorized as direct, indirect or cumulative. (Section 23) Section 24 requires the proponent to identify the possible positive and negative impacts of the project and analyse them on the basis of their extent using different methods. Under section 25 of the guideline the proponent is required to pay special attention to the magnitude, extent and duration of impact. Section 26 facilitates the comparison of different project alternatives using Impact Ranking Methodology for which the magnitude, extent and duration of the types of impacts associated with the projects will be ascertained and a numerical scale need to be developed to provide a quantitative assessment of predicted impacts.

In order to reduce, remove undesirable impacts and maximize the benefits, the mitigation and reduction measures, Consideration of alternatives, Compensatory measures, Corrective measures and Preventive measures will be adopted (Section 27). Section 28 states that EIA report must be released for public review and comments. The comments received will be made available for review by the project proponent along with other stakeholders.

The guidelines require the proponent to consider alternatives to the proposed project. The proponent must consider the alternatives of scale, technology, location, fuel, raw materials, design, time schedule, and economic aspects

Section 32 requires monitoring of the environmental impacts to ensure that the impact does not exceed the legal standards, to check the implementation of mitigation measures to see whether it is in conformity with the EIA report and to provide a timely warning on the potential environmental damage. After the project has been operational for some time, the environmental auditing is recommended under section 42 to assess the accuracy of prediction, effectiveness of environmental impact mitigation and enhancement measures and functioning of monitoring mechanism.

Community participation has received prominent place in the guidelines. The guidelines mention that the effectiveness of an EIA is determined largely by how successfully the community has been involved and that community participation is necessary during project identification; feasibility and scoping; IEE, detailed EIA study; monitoring, evaluation and auditing phases. Section 49 of the guideline also stipulates that local beneficiaries, target groups, user groups, affected groups, special interest groups, relevant government and private sector agencies, local leaders and academic groups, relevant non-governmental organizations and experts must be involved in the EIA process.

9.6.2 EIA Guideline for Forest Sector, 2052 B.S (1995 A.D)

GoN has also implemented a separate EIA guideline for Forestry Sector, 1995. The guidelines facilitate the sustainable use of forest resources for the socio-economic development and meeting the basic needs of the communities. The positive and negative impacts of any development project in the forest area are to be identified and plans must be developed to minimize environmental damage, conserving genetic resources and bio-diversity. It encourages the Proponent to identify the likely impacts of the projects particularly on the forests, propose mitigation measures and monitoring and evaluation system to ensure least impacts on forests and biodiversity (MFSC, 1995).

9.6.3 Community Forest Guideline, 2058 B.S (2001 A.D)

The community forests are national forests handed over to the local user groups for protection, management and utilization according to the Forest Act, 1993. The guidelines aim to support user group members, field level staff from government and non-government institutions, forest technicians and facilitators in the implementation of community forestry programme. The objective of the community forestry guideline is to develop the community forest through the active participation of the local community. The guideline sets process and procedures to identify and capacitate the community groups, establish and registration of the community forest user groups, preparation of the forest management plan and registration, regulations and implementation of forest management plan, amendments of regulation and management plan, and roles and responsibilities of the forest stakeholders.

9.6.4 Community Forest Inventory Guideline, 2062 B.S (2005)

This guideline details the process and procedures for evaluating the forest stock and its harvesting potentials while preparing the operational plans, the objective is to ensure sustainable harvesting by limiting the extraction within the annual increment.

9.6.5 National Health Care and Waste Management Guideline, 2059 B.S (2002 A.D)

Unless good construction management practices are followed, construction activities can cause serious environmental pollution, ecological degradation and health and safety concerns to both workers and the public. The stakeholders that get impacted due to construction activities generally include the workers, the public and the environment

The guideline provides a minimum standard for safe and efficient waste management. The purpose of the guideline is to provide a framework of waste management strategies to

assist in the long-term management of health care waste by implementing the essential strategies. The guideline aims to protect public health and safety, provide a safer working environment, and minimize waste generation and environmental impacts of waste treatment.

The guideline sets procedures for handling of health care waste, which includes details of collection, separation, and final disposal of the waste for the safety of human health and hygiene vis a vis environmental contamination.

9.6.6 Environmental Management Guidelines (Road), 2054 (1997)

This guideline prepared by Department of Road explains the process and methods of study in different cycle of environmental studies and maters to be included in the EIA report. All the new and upgrading road development projects are mandated to comply with the guideline provisions to ensure that the road development project is environmentally sustainable.

9.6.7 Buffer Zone Management Guideline, 1999 B.S (2056 A.D)

The buffer zones are designed as an interface between parks and people, to reduce the impact of a park on local communities, rather than only to protect the park from the impacts of outside intervention. The Ministry of Forests and Soil Conservation (MoFSC) approved the Buffer Zone Management Guidelines in August 1999. The guideline has been made for assisting the national parks and reserves for the sustainable utilization and conservation of natural resources in the buffer zone as well as to carry out community development programmes with the local people through users, in an effective and uninterrupted manner in the buffer zone. Moreover, if any government, local or external agency, institution, etc. intends to execute any project in the buffer zone, the concerned agency should contact and coordinate with the warden and concerned user's committee of the area before implementing the project. Thus, the guideline facilitates the work of government staff and User Committees in Buffer Zone Programmes. The Guidelines have been implemented in different Buffer Zones declared by Nepal.

10 ENVIRONMENT MANAGEMENT PLAN

10.1 Introduction

Environmental Management Plan (EMP) is an important management tool to ensure the proper implementation of the mitigation measures for minimizing the adverse environmental impacts and maximizing the beneficial impacts. It set out environmental management requirements and develops procedures to ensure that all mitigation measures and monitoring requirements specified in this EIA study report will be carried out in subsequent stages of project development. An EMP basically includes project monitoring, auditing, and project management. The project has the prime responsibility for the implementation of the environmental management plan.

The key objectives of EMP are:

- to formulate project management activities for the implementation of EMP;
- to formulate a monitoring programme for baseline, impact and compliance monitoring; and
- to formulate an environmental auditing programme to be implemented after project construction

Thus, the Environmental Management Plan (EMP) of the project includes 4 essential components namely (a) Environmental Management Structure (b) Environmental Mitigation Management Plan (c) Environmental Monitoring Management Plan and (d) Environmental Auditing Plan.

The EMP prepared for UT-1HEP (216 MW) is based on the experiences of previously constructed hydroelectric projects of similar nature, findings of the EIA study, and review of other EMPs prepared for the Environmental Management as well as Act, Regulations and Guidelines relevant to the hydropower projects of Government of Nepal.

10.2 Relevant Legislation, Environmental Standard and Permit & Approvals

10.2.1Legislation

The relevant constitution, laws, acts, rules, regulations, guidelines, plans, policies, strategies of Government of Nepal along with international conventions relevant to implementation of UT-1HEP (216 MW) are listed as under:

Interim Constitution of Nepal, 2063 (2006), Environmental Protection Act, 2053 B.S (1997 A.D), Land Acquisition Act, 2034 B.S (1977 A.D), Explosive Act, 2018 B.S (1961 A.D), Forest Act, 2049 B.S (1993 A.D), Land Reform Act, 2021 B.S (1964 A.D), Local Self Governance Act, 2055 B.S (1998 A.D), Electricity Act, 2049 B.S (1992 A.D), Water Resource Act, 2049 B.S (1992 A.D), Wildlife Protection Act, 2015 B.S (1958 A.D), National Park and Wildlife Conservation Act, 2029 B.S (1973 A.D), Aquatic Life Protection Act, 2016 B.S (1961 A.D), Soil

and Watershed Protection Act, 2039 B.S (1982 A.D), Labor Act, 2049 B.S (1992 A.D), Environmental Protection Rules, 2054 B.S (1998 A.D), Forest Rule, 2051 B.S (1995 A.D), Local Self Governance Regulation, 2056 B.S (1999 A.D), Electricity Rules, 2050 B.S (1993 A.D), National Park and Wildlife Conservation Rule, 2030 B.S (1974 A.D), Conservation Area Management Rule, 2053 B.S (1996 A.D), National EIA Guideline, 2050 B.S (1993 A.D), EIA Guideline for Forest Sector, 2052 B.S (1995 A.D), Community Forest Guideline, 2058 B.S (2001 A.D), Community Forest Inventory Guideline, 2062 B.S (2005), National Health Care and Waste Management Guideline, 2059 B.S (2002 A.D), Environmental Management Guidelines (Road), 2054 (1997), Buffer Zone Management Guideline, 1999 B.S (2056 A.D), Three Years Interim Plan, 2064 B.S (2007 A.D), National Environmental Policy and Action Plan I & II, 2050 B.S (1993 A.D) and 2055 B.S (1998), Agricultural Perspective Plan, 2052 B.S (1995 A.D), Forest Sector Master Plan, 2045 B.S (1988 A.D), Nepal Biodiversity Implementation Plan, 2060 B.S (2003 A.D), Revised Forest Policy, 2058 B.S (2000 A.D), National Conservation Strategy, 2045 B.S (1988 A.D), Poverty Reduction Strategy, 2059 B.S (2002 A.D), Water Resources Strategy, 2059 B.S (2002 A.D), Convention on International Trade of Endangered Species (CITES), Convention on Biological Diversity (CBD), 1992, ILO Convention, 169.

10.2.2 Environmental Standard

Various environmental standards are proposed for the construction and operation of UT-1HEP (216 MW) and these standards shall be treated as other acts and regulations until GoN enforces standards in the specified sector for environmental compliance.

Table 10.1: Standards for Effluents Discharged into Inland Water from the Construction Sites and Camps

S.N.	Parameters	Tolerance Limits
1.	Total Suspended solids, mg/L, Max	30-200
2.	Particle size of total suspended particles	Shall pass 850-micron Sieve
3.	pH	5.5 to 9.0
4.	Temperature	Shall not exceed 40oC in any section of the stream within 15 meters downstream from the effluent outlet
5.	Biochemical oxygen demand (BOD) for 5 days at 20 degree C, mg/L, Max	30-100
6.	Oils and grease, mg/L, Max	10
7.	Phenolic compounds, mg/L, Max	1
8.	Cyanides (as CN), mg/L, Max	0.2
9.	Sulphides (as S), mg/L, Max	2
10.	Radioactive materials:	
	a. Alpha emitters, c/ml, Max	7 OCT
	b. Beta emitters, c/ml, Max	8 OCT
11.	Insecticides	Absent
12.	Total residual chlorine, mg/L	1
13.	Fluorides (as F), mg/L, Max	2
14.	Arsenic (as As), mg/L, Max	0.2
15.	Cadmium (as, Cd), mg/L, Max	2
16.	Hexavalent chromium (as Cr), mg/L, Max	0.1
17.	Copper (as Cu), mg/L, Max	3

S.N.	Parameters	Tolerance Limits
18.	Lead (as Pb), mg/L, Max	0.1
19.	Mercury (as Hg), mg/L, Max	.01
20.	Nickel (as Ni), mg/L, Max	3
21.	Selenium (as Se), mg/L, Max	0.05
22.	Zinc (as Zn), mg/L, Max	5
23.	Ammonical nitrogen, mg/L, Max	50
24.	Chemical Oxygen Demand, mg/L, Max	250
25.	Silver, mg/L, Max	0.1

Table 10.2: Drinking Water Quality Standards for Construction Camps and Construction Sites

S.N.	Parameters	Desirable Limits	Maximum Tolerable Limit
1.	Colour, Hazen units, Max	10	15
2.	Odour	Unobjectionable	
3.	Taste	Agreeable	
4.	Turbidity, NTU, Max	5 103	10
5.	Total Dissolved Solids, mg/l, Max	500	1500may be relaxed upto 3000
6.	pH value	6.5 – 8.5	May be relaxed up to 5.5 on the lower and up to 9 on higher side
7.	Total Hardness (as CaCO3) mg/l, Max	250	may be extended upto 600
8.	Calcium (as Ca), mg/l, Max	75	may be extended upto 200
9.	Magnesium (as Mg), mg/l, Max	30	may be extended upto 100
10.	Copper (as Cu), mg/l, Max	1 .05	may be extended upto 1.5
11.	Iron (as Fe), mg/l, Max	0.3	may be extended upto 1.0
12.	Manganese (as Mn), mg/l, Max	0.1	may be extended upto 0.5
13.	Chlorides (as Cl), mg/l, Max	250	may be extended upto 1000
14.	Sulphate, (as SO4), mg/l, Max	1504	May be extended upto 400 provided magnesium does not exceed 30
15.	Nitrate (as NO3), mg/l, Max	45	No relaxation
16.	Fluoride (as F), mg/l, Max	1.50.6 to 1.2	May be extended up to 1.5 if no alternate source available
17.	Phenolic compounds, (as C6H5OH), mg/l, Max	0.001	May be relaxed up to 0.002
18.	Mercury (as Hg), mg/l, Max	0.001	No relaxation
19.	Cadmium (as Cd), mg/l, Max	0.01 0.01(PFA 0.003)	No relaxation
20.	Selenium (as Se), mg/l, Max	0.01	No relaxation
21.	Lead (as Pb) mg/l, Max	0.01 (WHO 0.01)	No relaxation
22.	Arsenic (as As), mg/l, Max	0.05 (WHO 0.01)	No relaxation
23.	Cyanide (as CN), mg/l, Max	0.05	No relaxation
24.	Chromium (as Cr6+), mg/l, Max	0.05	No relaxation

3 Value for turbidity is 5 in FAR(for mineral water), PFA, BS, WHO
4 Value for Sulphate BS:200, FAR (for mineral water) and PFA:250

S.N.	Parameters	Desirable Limits	Maximum Tolerable Limit
25.	Residual free Chlorine, (as Cl), mg/l, Min	0.2	
26.	Ammonia, mg/l, Max	1.5	
27.	Aluminum, mg/l, max	0.2 (0.05 – 0.2 EPA)	
28.	Boron mg/l, max	0.3	
29.	Nickel, mg/l, max	0.02	
30.	Hydrogen sulphide, mg/l, max	0.1	
31.	Zinc, mg/l, max	3	

Source: Standards adopted from Department of Water Supply & Sewerage

Table 10.3: Ambient Air Quality Standards in the Project Area

Parameters	Units	Averaging Time	Concentration in Ambient Air, maximum
TSP (Total Suspended Particulates)	µg/m3	Annual	-
		24-hours*	230
PM10	µg/m3	Annual	-
		24-hours*	120
Sulphur Dioxide	µg/m3	Annual	50
		24-hours**	70
Nitrogen Dioxide	µg/m3	Annual	40
		24-hours**	80
Carbon Monoxide	µg/m3	8 hours**	10,000
		15 minute	100,000
Lead	µg/m3	Annual	0.5
		24-hours	-
Benzene	µg/m3	Annual	20****
		24-hours	-

Source: National Ambient Air Quality Standards adopted from MoE

**Note: 24 hourly values shall be met 95% of the time in a year. 18 days per calendar year, the standard may be exceeded but not on two consecutive days.*

***Note: 24 hourly standards for NO2 and SO2 and 8 hours standard for CO are not to be controlled before MOE has recommended appropriate test methodologies.*

Table 10.4: Emissions Standards for 'in-use' Vehicles

Fuel	Wheelers Type	Manufacturing Date	Emissions
Petrol	Four-Wheelers	Up to 1980	4.5% CO-1,000 ppm HC*
	Four-Wheelers	After 1981	3.0% CO-1,000 ppm HC*
	Three-Wheelers	Up to 1991	4.5% CO-7,800 ppm HC*
	Three-Wheelers	After 1991	3.0% Co-7,800 ppm HC*
	Two-Wheelers		4.5% CO-7,800 ppm HC*
Diesel	-	Up to 1994	75 HSU
		After 1994	65 HSU
LPG/CNG	All categories		3.0% CO*-1,000 ppm HC*

Source: Nepal Gazette, BS 2054-9-8, Ministry of Works and Transport

** Nepal Gazette, BS 2057-7-7, Ministry of Population and Environment*

CO – carbon monoxide; HC – Hydrocarbon; HSU – Hertridge Smoke Unit

Table 10.5 Proposed Noise Exposure Limits for the Work Environment

SN	Noise Exposure (dBA)	Permissible Exposure (Hours and Minutes)
1.	85	16 hrs
2.	87	12 hrs-18 min
3.	90	8 hrs
4.	93	5 hrs-18 min
5.	96	3 hrs-30 min
6.	99	2 hrs-18 min
7.	102	1 hr-30 min
8.	105	1 hr
9.	108	40 min
10.	111	26 min
11.	114	17 min
12.	115	15 min
13.	118	10 min
14.	121	6.6 min
15.	124	4 min
16.	127	3 min
17.	130	1 min

Source: March 1991. (Adopted from Occupational Safety and Health Administration (OSHA)

Table 10.6: Proposed Average Equivalent Sound Levels Recommended for Public Health and Welfare

S. N	Land Use	Measure	To Protect Against Activity Interference and Hearing Loss Effects (dBA)
1.	Residential including farm residences	Leq (24)	55
2.	Commercial	Leq (24)	70
3.	Hospitals	Leq (24)	55
4.	Industrial	Leq (24)	70
5.	Educational	Leq (24)	55
6.	Recreational Areas	Leq (24)	70
7.	Farmland and general unpopulated land	Leq (24)	70

Source: U.S, Environmental Protection Agency, 1974
Note: Leq (24) = Equivalent Sound Level in decibels for 24 hours.

Table 10.7: Permit and Approval

Issues	Authority	Approval and permits
Environmental Impact Assessment Reports and Environmental Management Plan	Ministry of Environment	Approval
Construction License	Ministry of Energy and Department of Electricity Development	Approval and License
Tree clearing and Government owned land	Ministry of Forests and Soil Conservation and District Forest Office, Langtang National Park	Approval and permits
Tree clearing in Community Forest	Forest User Groups	Approval
Works on private land and property	Landowner	Approval
Permits and Approval of Local Governments for proposal activities	DDC and VDCs	Approval and permits

10.3 Environmental Management Structure

The Environmental Management Structure of UT-1HEP (216 MW) is arranged (***Figure 10.1 and 10.2)*** to illustrate the connection with different parties and stakeholders to be involved directly or indirectly during the different phases of construction and operation of project by fulfilling the existing legislations. The proponent of UT-1HEP (216 MW) is mainly responsible of project management office.

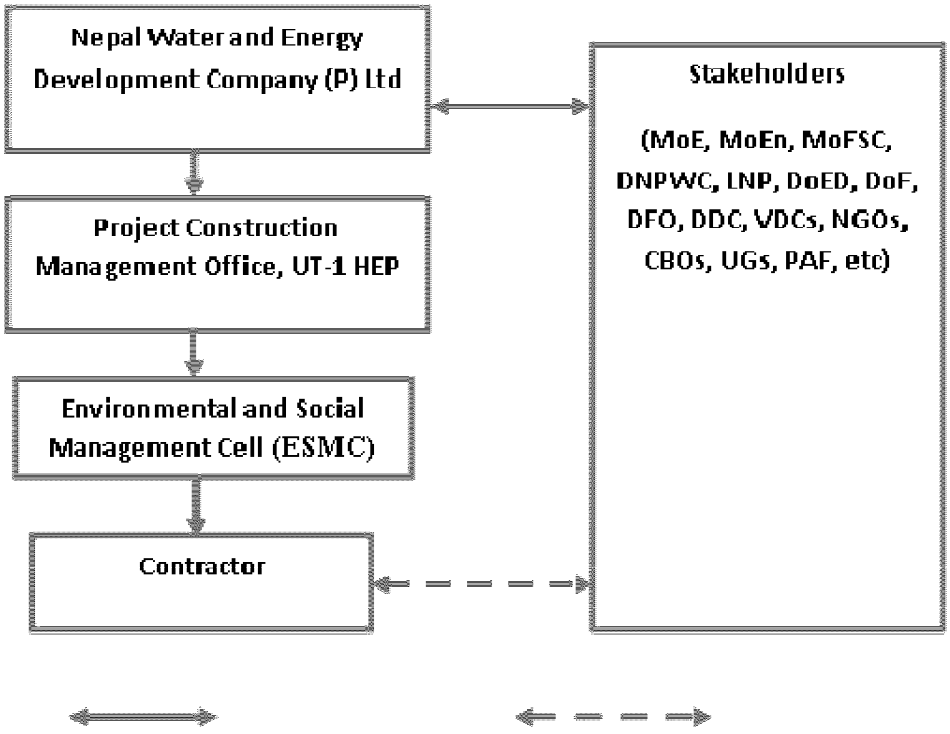
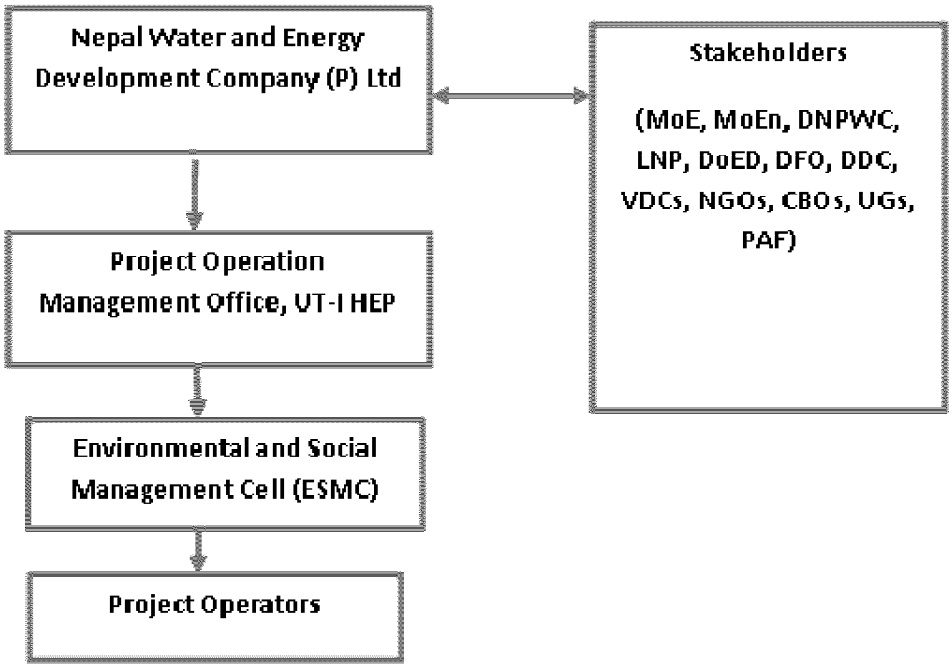


Figure 10-1: Environmental Management Structure, Pre- Construction/Construction Phase



Note: Direct Linkage ⟷
Figure 10-2: Environmental Management Structure, Operation Phase

Nepal Water and Energy Development Company (P) Ltd will establish a separate project construction management office (PCMO) and project operation management office (POMO) during construction and operation phase of the project. The main purpose of setting up of these offices is to ensure that the recommended mitigation and monitoring actions are properly put into practiced, monitored, assessed and distributed to the concerned stakeholders for response and enhancement. A separate environmental and social management cell (ESMC) will be established under PCMO and POMO in both construction and operation phase for the appropriate implementation of environmental requirements that includes both environmental mitigation management plan and environmental monitoring management plan of the project. As these works require official responsibilities, the members of ESMC will be the regular members of the proponent organization with past experience in the implementation of environmental provisions and also in the operation of Public Information Centre (PIC) and grievance handling. ESMC comprises of different experts namely environmental engineers, environmentalist, sociologist, surveyor, ecologist, etc.

The regular staffs of the project will execute the assignment related to environmental mitigation management plan such that the administrative, organization, management and other cost related to this assignment is included in project cost where as the project will hire necessary experts or consultant in addition to regular staffs to execute several assignments related to environmental monitoring management plan which will work under ESMC related to construction and operation phase. Thus, the additional cost is allocated for environmental monitoring management plan.

The key tasks of ESMC under PCMO in construction phase of the project are:

- Dissemination of information to the concerned stakeholders of the project and co-ordinate with the different line agencies
- Organizing meetings with concerned stakeholders and documenting the minutes of meetings
- Implementation and documentation of the environmental management plans of the project
- Monitoring (compliance) of environmental mitigation measures and enhancement measures and its performance as per EIA and EMP and preparation of the report of the same
- Executing baseline and impact monitoring as per the requirement of monitoring management plan and preparation of report of the same
- Coordinating with the project officers and contractors for the implementation of Environmental Mitigation Management Plan

The key tasks of ESMC under POMO in operation phase of the project are:

- Organizing meetings with concerned stakeholders and documenting the minutes of meetings
- Implementation and documentation of the environmental management plans of the project
- Monitoring (compliance) of environmental mitigation measures as per EIA and EMP and preparation of report of the same
- Implementation and documentation of the environmental management plans of the project

10.4 Environmental Mitigation Management Plan

The environmental mitigation measures and the environmental enhancement programme presented in chapters VII and VIII will be implemented in various phases of construction and operation phase of the project. The project has the prime responsibility for the implementation of the environmental management plan. To ensure implementation of the mitigation measures, an environmental management plan has been prepared as a part of the project activity. The responsible authority, timing of action as well as estimated mitigation cost is presented in following tables.

Table 10.8: Mitigation Management Plan for Physical Environmental Adverse Impact

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
1.Construction Phase					
1.1.1	Permanent change of forest land use (21.39 hectares) by the establishment of various project structures and facilities.	Residual impact of the project	N/A	N/A	N/A
1.1.2	Permanent change of agricultural land use (9.35 hectares) by the establishment of various project structures and facilities.	Residual impact of the project	N/A	N/A	N/A
1.1.3	Temporary change of agricultural land use (12.40 hectares) by the establishment of project facilities	Residual impact of the project	N/A	N/A	N/A
1.1.4		The temporary acquired agricultural land will be re-established into original form matching the original landscape after completion of the project.	Contractor	Post construction phase	Included in Contract Bid Document
1.1.5	Conversion of temporary acquired Bagar (Flood Plain) into elevated lands in the spoil & muck disposal sites	Residual impact of the project	N/A	N/A	N/A
1.1.6		The temporary acquired Bagar (flood plain) will be re-established into original form after completion of the project	Contractor	Post construction phase	Included in Contract Bid Document
1.2.1	Small tremors, dust pollution and instabilities inside the tunnel	Careful selection of overburden depth and selection of proper alignment (with respect to rock type and geological structures) for tunnel excavation.	Contractor	Construction phase	No cost
1.2.2		Control blasting and careful use of explosive materials for excavating tunnel to avoid unnecessary breakage of rock mass than required.	Contractor	Construction phase	No cost

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
1.2.3	Damage of structures (mud/ mortar houses and sheds) located nearby access road and Adit1 at Hakubesi due to development of crack	Survey of structures (house and shed) located within 250m on either side of Adit 1 and access road at Hakubesi before construction to verify the condition of these structures.	Project Proponent	Pre-construction phase	NRs.200000/- (Lump sum)
1.2.4		Compensation will be provided to structures if reported to be damaged by blasting activities during construction period.	Contractor	Construction phase	NRs.5000000/- (Lump sum) provisioned in project civil cost
1.2.5	Changes in Noise level within the construction site of Adit Portals and Access Road	Regular maintenance of construction vehicles, machineries and equipments will be carried out to control mechanical noise	Contractor	Construction phase	Included in project civil cost
1.2.6		The ventilators at adit portals will be fitted with noise control device	Contractor	Construction phase	Included in project civil cost
1.2.7		Restriction on the use of pressure horn near school and residential site by placing traffic signs and signal	Contractor	Construction phase	Included in project civil cost
1.2.8		Procurement of low noise generating compressors, and diesel generating sets	Contractor	Construction phase	Included in project civil cost
1.2.9		Blasting activities will not be carried out at night hour.	Contractor	Construction phase	No cost
1.2.10		Local communities will be pre-informed about blasting	Contractor	Construction phase	No cost
1.2.11	Disturbance due to vibration in the construction site of Adit Portals and Access Road	The equipments or machineries generating vibration will be placed in strong foundation. Further, the equipment used in the construction should meet minimum safe guards for natural areas and cause minimum ground vibrations.	Contractor	Construction phase	Included in project civil cost

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
1.2.12		Controlled blasting will be practiced at all times near such structures to have a minimum vibration impact.	Contractor	Construction phase	No cost
1.3.1	Land instability and erosion of deposited spoil and muck	The generated spoil and muck will be disposed behind the gabion structures of required size and capacity for the protection of spoil/muck disposal toe to prevent from instability and erosion	Contractor	Construction phase	Included in project civil cost
1.3.2		Establishment of appropriate drainage system in and around spoil and muck disposal areas.	Contractor	Construction phase	Included in project civil cost
1.3.3		The surface of spoil and muck disposal area will be properly compacted by making layers of preferably 15 cm to prevent from settling and furthermore, the area will be planted with vegetation such as *Alnus nepalensis*.	Contractor	Construction phase	Included in project civil cost
1.3.4		The generated muck and spoil will be disposed at authorized site only.	Contractor	Construction phase	No cost
1.3.5		Preparation of muck and spoil management plan	Contractor	Pre-construction phase	Included in project civil cost
1.3.6	Sedimentation of water bodies by disposal of spoil and muck	The mitigation measure mentioned in 1.3.1, 1.3.2, 1.3.4 and 1.3.5 will be implemented and additional cost is not required	Contractor	Construction and Pre-construction phase	Already included in project civil cost
1.3.7		The generated spoil and muck will not be disposed in the river or river sources.	Contractor	Construction phase	No cost
1.3.8	Destruction of productive land and forest vegetation by	The generated spoil and will not be disposed on fragile slopes, farmland, forest areas,	Contractor	Construction phase	No cost

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
	disposal of spoil and muck	natural drainage path, etc.			
1.3.9		The mitigation measure mentioned in 1.3.1 and 1.3.4 will be implemented and additional cost is not required.	Contractor	Construction phase	Already included in project civil cost
1.3.10	Increase of turbidity in the river affecting water quality by disposal of spoil and muck	The mitigation measure mentioned in 1.3.1 and 1.3.4 will be implemented and additional cost is not required.	Contractor	Construction phase	Already included in project civil cost
1.3.11	Additional Potentiality of Landslide along access road at Hakubesi landslide	The 'Landslide Stabilization Plan' will be prepared and implemented for the construction of road at landslide susceptible area that include: Pegging and flagging of landslide area boundary Maintenance of slope less than the angle of repose to the extent possible, mostly above 35 degree. The steep slope cutting above 35 degree will be protected through necessary civil structures such as breast wall, gabion structure or concreting as per the requirement of the site and further, bio-engineering will be applied for long-term stabilization wherever necessary. Drainage will be provided both vertically and horizontally No surface would be left exposed and Bio-engineering works will be carried out.	Contractor	Pre-construction phase and construction phase	Already included in project civil cost
1.3.12		Control blasting will be practiced near the landslide susceptible area.	Contractor	Construction phase	No cost

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
1.3.13	Land stability and erosion along other portion of access road	The construction of access road will be carried out in balancing depth principle where the volume of cut and fill of the spoil will be equal to the extent possible.	Contractor	Construction phase	No cost
1.3.14		Maintenance of slope less than the angle of repose to the extent possible, mostly above 35 degree and cut batter slopes above 1.5 heights will be protected by bio-engineering works.	Contractor	Construction phase	Included in project civil cost
1.3.15		Control blasting will be practiced at access road construction site	Contractor	Construction phase	No cost
1.3.16	Alteration of natural drainage due to construction of access road	The side drains along with drainage bypass will be constructed at appropriate location in access road to safely divert the water from the hill slope.	Contractor	Construction phase	Included in project civil cost
1.3.17		The generated spoil will be disposed at authorized site only.	Contractor	Construction phase	No cost
1.3.18	Land stability and erosion in the quarry sites	Benching of slope will be managed at every 7m to avoid land stability	Contractor	Construction phase	Included in project civil cost
1.3.19		Quarrying will be avoided at steep slopes (greater than 70 degree)	Contractor	Construction phase	No cost
1.3.20		After the completion of extraction, the site will be rehabilitated to suit the local landscape preferably by re-vegetating	Contractor	Post construction phase	Included in project civil cost
1.3.21		Use of explosives will be minimized to the extent possible	Contractor	Construction phase	No cost
1.3.22		Adequate drainage will be constructed to avoid erosion due to disturbance of natural drainage	Contractor	Construction phase	Included in project civil cost

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
1.3.23		Quarry Management Plan will be prepared	Contractor	Pre-construction phase	Included in project civil cost
1.4.1	Degradation of air quality due to release of carbon monoxide, sulphur oxide, hydrocarbons, hydrogen sulphides, etc by the construction activities and equipments	All vehicles belonging to the Project i.e., proponent, contractors, consultants will comply with the national emission standards of the Ministry of Environment, Nepal (with Green Sticker)	Contractor, Consultant, Proponent	Construction phase	Included in project civil cost
1.4.2		Regular (monthly) maintenance of all vehicles will be made mandatory	Contractor, Consultant, Proponent	Construction phase	Included in project civil cost
1.4.3		The burning of biomass will be prohibited in the construction camps	Contractor	Construction phase	No cost
1.4.4	Increase in suspended particulates (PM_{10})	Open storage and spillage of loose soil in and around construction site will be prohibited	Contractor	Construction phase	No cost
1.4.5		Regular maintenance of project access road mainly in dry season by sprinkling water particularly nearby the settlement areas namely Hakubesi-Fulbari, Gogane and Mailun.	Contractor	Construction phase	Included in project civil cost
1.4.6		Truck loads will be covered during transportation to prevent blowing of loose construction materials	Contractor	Construction phase	No cost
1.4.7	Change in noise level at batching plants, construction yards, access road	Mitigation measures as proposed in 1.2.5, 1.2.7 and 1.2.8 and additional cost is not required	Contractor	Construction phase	Already included in project civil cost
1.4.8		The construction activities will be limited to working hours and will not be carried night hour	Contractor	Construction phase	No cost

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
1.4.9	Vibration due to movement of vehicle and blasting activities	Mitigation measures for impact due to blasting activities is already addressed in 1.2.3 and 1.2.4 and additional cost is not required.	Contractor, Project Proponent	Pre-construction and construction phase	Already included
1.4.10		The project vehicle plying on the road will be restricted to limit speed nearby the settlement area by providing proper instruction and placing traffic signs and signal	Contractor	Construction phase	Included in project civil cost
1.4.11		Cracks caused, if any, by vibration due to movement of vehicle will be compensated	Mitigation measures as proposed in 1.2.3 and 1.2.4 and no additional cost	Construction phase	Already included
1.5.1	Lowering of ground water table and drying of springs	No mitigation measure is required	N/A	N/A	**N/A**
1.6.1	Degradation of river water quality by inappropriate disposal of muck & spoil	The mitigation measure mentioned in 1.3.1 and 1.3.4 will be implemented and additional cost is not required.	Contractor	Construction phase	Already included in project civil cost
1.6.2	Degradation of water quality by effluents released from crushers & other sources	The effluents released from crusher and other sources will be settled into sedimentation tank before releasing into water sources	Contractor	Construction phase	Included in project civil cost
1.6.3	Degradation of water quality by sewage discharged from construction camp (labor camp and engineering camps)	Separate washing, bathing, urination and toilet facilities will be provided at the labor camps and engineering camps - Fulbari	Contractor	Construction phase	Included in project civil cost

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
1.6.4		The liquid waste discharged from the construction camp will be properly treated (as per the standard of Ministry of Environment) before releasing into water sources.	Contractor	Construction phase	Included in project civil cost
1.6.5		Prohibition of urination and defecation in open areas and water bodies by construction workers	Contractor	Construction phase	No cost
1.6.6	Degradation of water quality by solid waste generated from construction camp (labor camp and engineering camps)	Establishment of proper solid waste management system in the construction camp for collection, segregation and disposal of solid waste.	Contractor	Construction phase	Included in project civil cost
1.6.7		Prohibition of haphazard disposal of solid waste in construction camp	Contractor	Construction phase	No cost
1.6.8	Degradation of water quality by construction waste	Establishment of proper solid waste management system for collection, segregation and disposal of solid waste in construction site.	Contractor	Construction phase	Included in project civil cost
1.6.9		Prohibition of haphazard disposal of construction waste in construction site	Contractor	Construction phase	No cost
1.6.10	Degradation of water quality by liquid waste such as lubricants, paints, cleaning, chemical and other aqueous oil based materials	The liquid waste generated from construction sites such as lubricants, paints, cleaning, chemical and other aqueous oil based materials will be collected separately and stored in suitable storage tank for final management with the advice of the authorized officer.	Contractor	Construction phase	Included in project civil cost
1.6.11		The lubricants and other petroleum products will be stored on the platform with concrete	Contractor	Construction phase	Included in project civil cost

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
		or cemented floor with adequate draining system connecting oil and grease trapping unit for collection of discharges of the floor			
1.6.12		Prohibition of haphazard disposal of liquid waste such as lubricants, paints, cleaning, chemical and other aqueous oil based materials in construction site	Contractor	Construction phase	No cost
1.6.13	Semi-liquid waste generated from batching areas degrading the quality of water	The semi-liquid waste generated from batching plant will be settled into sedimentation tanks before releasing into water sources.	Contractor	Construction phase	Included in project civil cost
1.6.14		Prohibition of haphazard disposal of Semi-liquid waste generated from batching areas	Contractor	Construction phase	No cost
1.7.1	Change in sediment distribution pattern in the river due to diversion of flow and removal of boulder	Residual impact of the project	N/A	N/A	**N/A**
1.8.1	Acquisition of forest land (2.61 ha) of Buffer zone of LNP resulting in change of land use	Residual impact of the project	N/A	N/A	**N/A**
1.9.1	River bank erosion on the quarry site	Extraction of material (boulder, sand, etc) from river bed will be carried out in balanced way and only in required quantity by preparing quarry area management plan	Contractor	Construction phase	Included in project civil cost
1.9.2	Change in sedimentation distribution pattern of river in quarry site	Mitigation measures as proposed in 1.9.1 and additional cost is not required	Contractor	Construction phase	Already included in project civil cost
1.9.3	Change in land use of quarry site	Residual impact of the project	N/A	N/A	**N/A**
1.9.4		The temporary acquired land for Quarry site	Contractor	Post	Included in project

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
		(9.62 ha) will be re-established into original form matching the original landscape after completion of the project		construction phase	civil cost
1.9.5	Change in topographical features of quarry site	Residual impact of the project	N/A	N/A	**N/A**
1.9.6		Utilization of not more than required land and additional cost is not required not required	Contractor	Construction phase	No cost
1.9.7	Land instability in the quarry sites	Mitigation measures for land stability in the quarry sites are already addressed in 1.3.18, 1.3.19, 1.3.20, 1.3.2 and 1.3.23.	Contractor	Construction phase and post construction phase	Already included in project civil cost
1.9.8	Generation of dust in quarry site	Water will be sprinkled at quarry site and the provision is included in Quarry site management plan	Contractor	Construction phase	Included in project civil cost
1.9.9	Degradation of aesthetic beauty of project site by haphazard stockpiling of construction material	Construction materials will be stored in the designated site.	Contractor	Construction phase	Included in project civil cost
1.9.10		Stockpiling will be prohibited in unauthorized site.	Contractor	Construction phase	No cost
1.10.1	Air pollution from haphazard disposal of muck and spoil	Water will be sprinkled at quarry site and the provision is included in muck and spoil management plan	Contractor	Construction phase	Included in project civil cost
1.10.2		The mitigation measures mentioned in 1.3.1, 1.3.3, 1.3.4, 1.3.5 will be implemented and additional cost is not required	Contractor	Construction phase and pre-construction phase	Already included in project civil cost
1.10.3	Land pollution from haphazard disposal of muck and spoil	The mitigation measures mentioned in 1.3.1, 1.3.3, 1.3.4, 1.3.5 will be implemented and additional cost is not required.	Contractor	Construction phase and pre-construction phase	Already included in project civil cost

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
1.10.4	Degradation of water quality by haphazard disposal of muck and spoil near river	The mitigation measures mentioned in 1.3.1, 1.3.2, 1.3.3, 1.3.4, 1.3.5 will be implemented and additional cost is not required	Contractor	Construction phase and pre-construction phase	Already included in project civil cost
1.11.1	Degradation of water quality by Disposal of grease, mobils, lubricants, toxic chemicals into river	The mitigation measures mentioned in 1.6.10, 1.6.11 and 1.6.12 will be implemented and additional cost is not required	Contractor	Construction phase	Already included in project civil cost
1.11.2	Degradation of water quality due to seepage of the petroleum products from the store, construction yard etc	The mitigation measures mentioned in 1.6.10, 1.6.11 and 1.6.12 will be implemented and additional cost is not required	Contractor	Construction phase	Already included in project civil cost
1.11.3	Degradation of water quality due to release of wastewater of mechanical yard into the water bodies	The mitigation measures mentioned in 1.6.13 and 1.6.14 will be implemented and additional cost is not required	Contractor	Construction phase	Already included in project civil cost
1.12.1	Drying of springs	N/A	N/A	N/A	**N/A**
1.13.1	Degradation of fertility of soil	The top soil preservation plan will be prepared to collect top soil (10 to 30cm) of agricultural land (both khet and bari) to reuse afterward.	Contractor	Pre-construction phase	Included in project civil cost
1.13.2		Prohibition on haphazard disposal of topsoil	Contractor	Construction phase	No Cost
1.14.1	Land instability and erosion	The mitigation measures mentioned in 1.3.13 , 1.3.14 and 1.3.15 will be implemented and additional cost is not required	Contractor	Construction phase	Already included in project civil cost
1.14.2	Alteration of natural drainage	The mitigation measures mentioned in 1.3.16 and 1.6.17 will be implemented and additional cost is not required	Contractor	Construction phase	Already included in project civil cost

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
2.Operation Phase					
2.1.1	Change in topography at project construction sites	N/A	N/A	N/A	N/A
2.2.1	Erosion of river bank downstream of weir by the release of sediments	The erosion of river bank will be minimized by implementing river bank protection measures in susceptible site downstream of weir.	Contractor	Operation phase	Included in project civil cost
2.2.2	Damage to turbine	The turbine will be designed to withstand the wear and tear by suspended particles	Project Proponent	Operation phase	Included in project civil cost
2.2.3		The hydropower plant will be closed for some period when the sediment load entering Desander basin exceeds more than 10000 ppm	Project Operators		No cost
2.3.1	Reduction of water in dewatered zone and widening of dewatered zone	Residual impact of the project	N/A	N/A	N/A
2.3.2	Eroding of river bed by sediment released from weir	The mitigation measures mentioned in 2.2.1 will be implemented and additional cost is not required	Contractor	Operation phase	Already included in project civil cost
2.4.1	Reduction in dissolve oxygen level of water and self cleaning capacity of river	In driest month, the environmental release is 3.84 m^3/s is sufficient to maintain the dissolved oxygen level and self cleaning capacity as the dewatered stretch is devoid of any pollutant sources.	Project Operators	Operation phase	No Cost
2.5.1	Changes in ground water level	N/A	N/A	N/A	**N/A**
2.6.1	Slight decrease in temperature of river water in dewatered zone	The rise in temperature	N/A	N/A	**N/A**
2.7.1	Impact due to GLOF located	No mitigation measure is required	N/A	N/A	**N/A**

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
	nearby the project development site				
2.8.1	Inundation and erosion of river bank	The mitigation measures mentioned in 2.2.1 will be implemented and additional cost is not required	Contractor	During operation phase	Already included in project civil cost
2.9.1	Increase in noise level due to vehicular movement in and around the powerhouse area	Residual impact of the project	N/A	N/A	**N/A**
2.10.1	Decrease in water temperature downstream of tailrace	N/A	N/A	N/A	**N/A**
2.11.1	Slope failure of tunnel portal (adit)	The structural rigidness of tunnel portals (adits) will be checked annually (twice a year) and repair works such as slope stabilization works, bioengineering, etc will be implemented as per the requirement.	ESMC under POMO	Operation Phase	Included in project civil cost

Table 10.9: Mitigation Management Plan for Biological Environmental Adverse Impact

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
1. Construction Phase					
1.1.1	Permanent loss of 18.29 hectares of community forest	The area equivalent to occupied forest area (27.20 hectares) for project physical infrastructures will be afforested and protected for 5 years and handed over to concerned stakeholders as per the **Forest Guideline for the Allocation of the Forest land to other Development Projects**. The afforestation area will be as per the area designated by the respective district forest office and LNP	ESMC under PCMO/Project Proponent	Construction Phase	NRs.15000000/-
1.1.2	Permanent loss of 2.61 hectares of government forest (forest of buffer zone				

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
	of LNP).				
1.1.3	Permanent loss of 0.50 hectares of private forest				
1.1.4	Temporary loss of 4.72 hectares of community forest				
1.1.5	Temporary loss of 1.09 hectares of private forest				
1.2.1	Loss of *Shorea robusta* and *Bombax ceiba* i.e. protected plant species listed under GoN.	The compensatory afforestation programme will focus on planting maximum number of protected species	ESMC under PCMO	Construction Phase	Cost is included in compensatory afforestation programme (1.10.2)
1.2.2		The felling down or clearance of protected species is avoided as much as possible	ESMC under PCMO	Construction Phase	
1.2.3	Loss of feeding and resting ground of *Ursus tibetans* at weir area of buffer zone of LNP	This impact is unavoidable for the construction period; however, the proper afforestation programme will bring back these animals after completion of construction phase.	N/A	N/A	N/A
1.2.4	Illegal poaching and wildlife trade of *Ursus tibetans*	Proper fencing will be constructed at a minimal height of 3 meters around the weir site to prevent unauthorized access of workers to the forest.	ESMC under PCMO	Construction Phase	NRs.700000/- (Lump sum)
1.2.5		Awareness programme will be provided to construction workers for protection of black bears.	ESMC under PCMO	Construction Phase	NRs.200000/- (Lump sum)
1.2.6		Black bear gives birth to cubes in hollow trees or cave during November to March. These months will be avoided	Contractor	Construction Phase	No Cost

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
		while clearing trees. If such habitat are observed, these habitat would be protected by informing LNP authorities			
1.2.7		Outside workforce and staff found in illegal poaching of black bear will be terminated from project jobs and punished as per legal provision of LNP.	Contractor	Construction Phase	No Cost
1.2.8		Hoarding board will be kept in buffer zone of LNP at weir site to provide information that the hunting and trade of these animals is punishable offence. The conservation significance of black bear will be also displayed in the hoarding board.	ESMC under PCMO	Construction Phase	NRs.25000/-
1.2.9		Restoration of habitat in weir area of buffer zone after construction of the project	Contractor	Post Construction Phase	Included in project civil cost
1.2.10	Loss of feeding and resting ground of *Naemorhedus goral, Macaca mulatta, Semnopithecus hector* in community forest of Haku VDC	This impact is unavoidable for the construction period; however, the proper afforestation programme will bring back these animals after completion of construction phase	N/A	N/A	N/A
1.2.11	Illegal poaching and wildlife trade of *Naemorhedus goral*	Outside workforce and staff involved in illegal poaching of these animals will be terminated from project jobs and punished as per legal provision of GoN.	Contractor	Construction phase	No cost
1.2.12		Awareness programme will be provided to construction workers for protection of this protected mammal	ESMC under PCMO	Construction Phase	NRs.25000/-
1.2.13		Hoarding board will be kept in buffer zone of LNP at weir site to provide information that the hunting and trade of this animal is punishable offence. The conservation significance of will be also displayed in the hoarding board	ESMC under PCMO	Construction Phase	NRs.50000/-

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
1.2.14	Disturbance to protected wildlife by construction activities	Blasting and noise generating activities will be limited to day time zone and will not be carried out in night zone.	Contractor	Construction Phase	No cost
1.3.1	Trapping of fish in the dewatered stretch created by diversion of weir.	The fish trapped in the dewatered stretch will not be disturbed or killed	Contractor	Construction phase	No Cost
1.3.2	Increase in turbidity of river water affecting fish species and fishery habitats	The riverbed will not be disturbed unless required for establishment of weir and other structures. The impact is residual.	Contractor	Construction phase	No Cost
1.3.3	Disturbance to spawning and rearing ground of ground of Snow Trout	The spawning and rearing ground will not be disturbed by implementing proper construction plan in weir construction site.	Contractor	Construction phase	Included in project civil cost
1.3.4	Increased fishing activities in dewatered area	The construction workers will be prohibited to catch fish in dewatered stretch and if found culpable, will be terminated from the job	Contractor	Construction phase	No cost
1.4.1	Disturbance to aquatic ecosystem due to removal of boulders and extraction of construction materials from river	Extraction of material (boulder, sand, etc) from river bed will be carried out in balanced way and only in required quantity by preparing quarry area management plan	Contractor	Pre-Construction phase	Included in project civil cost
1.4.2	Fortuitous discharge of spoil, cement slurry, lubricants, fuel, chemicals, etc	Mitigation measures as proposed in 1.6.10, 1.6.11, 1.6.12 (Table 7.1: Mitigation Measures for Physical Environmental Impact) and no additional cost is required.	Contractor	During construction phase	Already included in project cost

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
	polluting river water and affecting fish and other aquatic life				
1.4.3	Waste water discharged from construction camp polluting river water quality and in turn, affecting aquatic ecosystem	Mitigation measures as proposed in 1.6.2, 1.6.3, 1.6.4, 1.6.8 (Table 7.1.Mitigation Measures for Physical Environmental Impact) and no additional cost is required	Contractor	During construction phase	
1.5.1	Illegal collection of firewood, NTFPs, valuable floral species, etc. by construction workers from the buffer zone areas of LNP	All the project personnel will be informed through awareness programme that the illegal collection of floral species from buffer zone areas of LNP is a punishable offense	ESMC under PCMO	Construction phase	Specified in the contractor bid document
1.5.2		Any project personnel found involved in such offense will be terminated from the project job.	Contractor	Construction phase	No cost
1.5.3		LNP will be supported in recruiting additional staffs to increase monitoring and surveillance activities in buffer zone of LNP at weir site as well as LNP area nearby project construction site.	ESMC under PCMO	Construction phase	NRs.1500000/-
1.5.4		Hoarding board will be kept in buffer zone of LNP at weir site mentioning such act is illegal.	ESMC under PCMO	Construction phase	NRs.25000/-
1.5.5	Illegal harvesting of forest product for fuel wood, timber and NTFPs by construction workers in local community forest of Haku VDC	The construction workers will be prohibited to collect firewood, timber and other forest products from the local community forest of Haku VDC and such act will be termed illegal.	Contractor	Construction phase	No cost
1.5.6		Any project personnel found involved in such offense will be terminated from the project job	Contractor	Construction phase	No cost
1.5.7		The construction workers will be subjected to awareness	ESMC under	Construction	Specified in the

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
		programmes on the issues of deforestation and afforestation to let them know the consequences of environmental conservation.	PCMO	phase	contractor bid document
1.5.8		The constructed workers will be provided with cooking fuels such as kerosene and LPG and will be encouraged to stay in their camp.	Contractor	Construction phase	No cost
1.5.9		Firewood will be strictly prohibited in the construction camps for cooking or any other purpose	Contractor	Construction phase	No cost
1.5.10		Hoarding board will be kept in forest area of Haku VDC mentioning such act is prohibited and illegal.	ESMC under PCMO	Construction phase	NRs.125000/-
1.5.11		Local forest user group will be supported in surveillance activities for conservation of forest and wildlife.	ESMC under PCMO	Construction phase	NRs.2500000/-
1.6.1	Illegal hunting and poaching of wild animal in buffer zone area of LNP	All the project personnel will be informed through awareness programme that the illegal hunting and poaching of wild animal in buffer zone areas of LNP is a punishable offense	ESMC under PCMO	Construction phase	Specified in the contractor bid document
1.6.2		Outside workforce and staff found in illegal poaching of wild animals will be terminated from project jobs and punished as per legal provision of LNP.	Contractor	Construction phase	No cost
1.6.3		Hoarding board will be kept in buffer zone of LNP at weir site mentioning such act is illegal.	ESMC under PCMO	Construction phase	NRs.25000/-
1.6.4		The wildlife meat will be prohibited in the camp.	Contractor	Construction phase	No cost
1.6.5	Illegal hunting and poaching of wild animal in community forest of Haku VDC	All the project personnel will be informed through awareness programme that the illegal hunting and poaching of wild animal in community forest of Haku VDC is a punishable offense	ESMC under PCMO	Construction phase	Specified in the contractor bid document
1.6.6		Outside workforce and staff found in illegal poaching of wild animals will be terminated from project jobs and punished	Contractor	Construction phase	No cost

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
		as per legal provision of Nepal			
1.6.7		Hoarding board will be kept in forest area of Haku VDC mentioning such act is prohibited and illegal	ESMC under PCMO	Construction phase	NRs.125000/-
1.6.8		The wildlife meat will be prohibited in the camp.	Contractor	Construction phase	No Cost
1.6.9		Mitigation measures as proposed 1.5.11 and no additional cost is required.	ESMC under PCMO	Construction phase	Already included
1.7.1	Permanent loss of 17.75 hectares of community forest as a part of site clearance for the construction of access road.	Mitigation measures as proposed 1.1.1 and no additional cost is required	ESMC under PCMO	Construction phase	Already included
1.7.2	Permanent loss of 0.30 hectares of private forest	Mitigation measures as proposed 1.1.1 and no additional cost is required	ESMC under PCMO	Construction phase	Already included
1.7.3	Degradation of forest and wildlife habitat	Mitigation measures as proposed in 1.2.14, 1.5.5, 1.5.6, 1.5.7, 1.5.8, 1.5.9, 1.5.10, 1.6.5, 1.6.6, 1.6.7 and no additional cost is required	Contractor, ESMC under PCMO	Construction phase	Already included
1.7.4	Loss of feeding and resting ground of wildlife species	This impact is unavoidable for the construction period; however, the proper afforestation programme will bring back these animals after completion of construction phase.	N/A	N/A	N/A
1.7.5	Exploitation of forest resource and wildlife by local community for commercial benefit	Awareness programmes will be launched to local community with the help of wildlife and forest expert for conservation of forest and wildlife to let them know about the negative consequences arises of such activities.	ESMC under PCMO	Construction phase	NRs.500000/-
1.7.6		The community user group of Haku VDC will be provided with technical assistance in the form of saplings, tools, equipments, skilled manpower to control deforestation &	ESMC under PCMO	Construction phase	NRs.2000000/- (Lump sum)

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
		further degradation and increase forest cover & density in order to conserve community forest.			
1.7.7		The security personnel of the VDC will be informed to take legal action against people involved in illegal exploitation of forest resource and wildlife	Contractor	Construction phase	No cost
1.7.8	Driving away of terrestrial wildlife due to increment of noise level.	Mitigation measures as proposed in 1.2.14	Contractor	Construction Phase	No cost
1.8.1	Increase in turbidity of river water affecting spawning ground of fish	Mitigation measures as proposed in 1.3.1,1.3.2, 1.3.3,1.3.4,1.3.5,1.3.7,1.3.8 (Table 7.1: Mitigation Measures for Physical Environmental Impact) and no additional cost is required	Contractor	Construction phase and pre-construction phase	Already included
1.8.2	Death of fish due to blocking of gills by turbid water				
1.9.1	Disturbance on animal and bird movement at weir construction site due to human and heavy equipment´s movement, noise and vibration	Mitigation measures as proposed 1.2.14, 1.5.1,1.5.2,1.5.3,1.5.4,1.6.1,1.6.2,1.6.3,1.6.4 and no additional cost is required	Contractor, ESMC under PCMO	Construction phase	Already included
1.10.1	Loss of 12001 tree species (Seedling 4858, Sapling-2346, Pole-3880 and Tree-917) of community,	The trees will be felled not more than required for establishing project structures and facilities.	ESMC under PCMO	Construction phase	No cost
1.10.2		The project will carried out compensatory plantation of 4797 felled trees at a ratio of 25 seedlings for each lost tree equivalent to 119925 numbers as per the Forest Guideline,	ESMC under PCMO	Construction phase	NRs.10200000/-

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
	government and private forest	2006 in an area as directed by the District Forest office of Rasuwa district and LNP authorities			
1.10.3		The project will clear the forest and stockpile the materials as per the guideline of Forest Produces Collection, Sale and Distribution Guidelines, (1998) in the presence of officials of District Forest Office & LNP and will be handed over to the respective owners. This will prevent haphazard clearance of trees and preserve resource value of forest products.	ESMC under PCMO	Construction phase	NRs.3000000/- (Lump sum)
1.10.4		The district forest officer as well as the concerned owner will be requested to provide the felled trees to the project at market price which will hep to fulfil the requirement of timber for construction of house or furniture for the project works, which will help to reduce additional loss of tree required for project works..	ESMC under PCMO	Construction phase	No cost
1.10.5	Disturbance to wildlife due to clearance of forest	or their related belongings found safer	ESMC under PCMO	Construction phase	No cost
1.10.6	Disturbance to fish habitat due to construction activity of weir	Mitigation measures as proposed in 1.3.2,1.3.3,1.3.4 and no additional cost is required	Contractor	Construction phase	Already included
2. Operation Phase					
2.1.1	Obstruction of the route of mid distant Snow Trout by the placement of weir in Trishuli River	*Schizothorax richardsonii* (Buchche Asala) and *Schizothoraichthys progastus* (Chuchche Asala) are mid-distant migratory and fast swimming fish species in the river, for which a fish ladder is provided in weir structure.	Project Proponent	Construction Phase	Included in project civil cost
2.1.2	Change in aquatic habitat in dewatered	Release of stated environmental flow (10% of monthly flow) at all times during project operation will be carried out	Project Operator	Operation Phase	No Cost

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
	zone due to diversion of water from weir resulting decrease of fish population				
2.1.3	Decline of other aquatic lives	The study related to fish (Tenant, 1976) he minimum environmental release of 3.84m^3/sec even in dry season will be sufficient for survival of aquatic species.	Project Operator	Operation Phase	No Cost
2.2.1	Illegal collection of the forest products, in particular the timber, firewood and NTFPs from the local forest of Haku VDC	The roaming of unauthorized people in local forest will be prohibited by coordinating and supporting local forest user group committee in surveillance activities for protection of forest and wildlife	ESMC under POMO	Operation Phase	NRs.3000000/-
2.2.2		Annual awareness programme will be conducted for local people for conservation of local forest and wildlife	ESMC under POMO	Operation Phase	NRs.3000000/-
2.2.3		Hoarding board will be kept in forest area of Haku VDC mentioning such act is prohibited	ESMC under POMO	Operation Phase	NRs.125000/-
2.2.4		The security personnel of the Haku VDC will be informed to take legal action against people involved in illegal exploitation of forest resource in coordination with local forest user group committee	ESMC under POMO	Operation Phase	No cost
2.2.5	Degradation and fragmentation of the forest due to unregulated collection of the forest products of local forest of Haku	Mitigation measures as proposed in 2.2.1, 2.2.2, 2.2.3, 2.2.4 and additional cost is not required	ESMC under POMO	Operation Phase	Already included

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
	VDC				
2.2.6	Disturbance to feeding and resting ground of wildlife due to fragmentation of forest	Mitigation measures as proposed in 2.2.1, 2.2.2, 2.2.3, 2.2.4 and additional cost is not required	ESMC under POMO	Operation Phase	Already included
2.2.7	Illegal collection of the forest products in buffer zone of LNP	LNP will be supported in recruiting additional staff to increase monitoring and surveillance activities in buffer zone of LNP at weir site as well as LNP area nearby project construction site.	ESMC under POMO	Operation Phase	NRs.4500000/-
2.2.8		Except project staffs, other people will be prohibited to enter the weir premises located at buffer zone of LNP.	ESMC under POMO	Operation Phase	No Cost
2.2.9		Hoarding board will be kept in buffer zone of LNP at weir site prohibiting entry of unauthorized people.	ESMC under POMO	Operation Phase	NRs.25000/-
2.2.10		The security personnel of the VDC as well as LNP authorities will be informed to take legal action against people involved in illegal exploitation of forest resource and wildlife.	ESMC under POMO	Operation Phase	No Cost
2.2.11	Disturbance to wildlife habitat in LNP	Mitigation measures as mentioned in 2.2.7, 2.2.8,2.2.9, 2.2.10 and no additional cost is required	ESMC under POMO	Operation Phase	Already included
2.3.1	Disturbance to forest and wildlife of Haku and buffer zone of LNP by regular events of reconstruction, renovation, maintenance and transportation	The reconstruction, renovation, maintenance work will not be carried out in night hour.	ESMC under POMO	Operation Phase	No Cost
2.3.2		The vehicular movement will be limited to day hour as far as possible	ESMC under POMO	Operation Phase	No Cost
2.4.1	Illegal collection and harvesting of forest	Mitigation measures as proposed in 2.2.1, 2.2.2, 2.2.3, 2.2.4 and no additional cost is required	ESMC under POMO	Operation Phase	Already included

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
	products for timber, firewood and NTFPs from the forest of Haku VDC				
2.4.2	Encroachment of forest land of Haku VDC	Mitigation measures as proposed in 2.2.1, 2.2.2, 2.2.3, 2.2.4 and no additional cost is required	ESMC under POMO	Operation Phase	Already included
2.4.3	Illegal collection and harvesting of forest products from Buffer zone of LNP	Mitigation measures as proposed in 2.2.7, 2.2.8.2.2.9 , 2.2.10 and no additional cost is required	ESMC under POMO	Operation Phase	Already included
2.4.4	Encroachment of forest land in buffer zone of LNP	Mitigation measures as proposed in 2.2.7, 2.2.8.2.2.9, 2.2.10 and no additional cost is required	ESMC under POMO	Operation Phase	Already included
2.5.1	Exploitation of forest products within access road of Haku VDC	Mitigation measures as proposed in 2.2.1, 2.2.2, 2.2.3, 2.2.4 and no additional cost is required	ESMC under POMO	Operation Phase	Already included
2.5.2	Exploitation of forest products of buffer zone of LNP	Mitigation measures as proposed in 2.2.7, 2.2.8.2.2.9, 2.2.10 and no additional cost is required	ESMC under POMO	Operation Phase	Already included
2.6.1	Illegal hunting and poaching of wild animal by the visitor in Haku VDC	Mitigation measures as proposed in 2.2.1, 2.2.2, 2.2.3, 2.2.4 and no additional cost is required	ESMC under POMO	Operation Phase	Already included
2.6.2	Illegal hunting and poaching of wild animal by the visitor in Buffer zone area of	Mitigation measures as proposed in 2.2.7, 2.2.8.2.2.9, 2.2.10 and no additional cost is required	ESMC under POMO	Operation Phase	Already included

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
	LNP				
2.7.1	Driving away of terrestrial wildlife due to increment of noise level at Haku VDC	The vehicular movement of both project as well as local people will be limited to day hour as far as possible and this mitigation measure will be enlisted in the awareness programme proposed in 2.2.2	ESMC under POMO	Operation Phase	Already included
2.7.2	Driving away of terrestrial wildlife due to increment of noise level at Buffer zone, LNP	N/A	N/A	N/A	N/A
2.8.1	Collection of forest products and illegal hunting of wild animals of LNP	Mitigation measures as proposed in 2.2.7, 2.2.8.2.2.9, 2.2.10 and no additional cost is required	ESMC under POMO	Operation Phase	Already included
2.8.2	Accidental washout or drowning of wild animals by sudden release of water from weir	Siren network will be installed at different locations in the dewatered zone	Contractor	Post Construction Phase	Included in project cost
2.8.3		The sudden release of water from dam will be limited to day hour as far as possible	Project operator	Operation Phase	No cost
2.8.4	Reduction in discharge of water and decrease river depth in dry month affecting river ecology including habitat of fish of LNP area	Mitigation measures as proposed in 2.1.2 and 2.1.3	Project Operator	Operation Phase	No cost

Table 10.10: Mitigation Management Plan for Socioeconomic and Cultural Environmental Adverse Impact

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
1.Construction Phase					
1.1.1	Permanent loss of 9.35 ha of agricultural land affecting 14 households	The loss of permanently acquired agricultural land will be compensated at the current market price. Furthermore, land will not be acquired forcefully and will be acquired with bilateral negotiation with land owners and with their consent. This cost also includes rehabilitaion benefit to the affected land owners.	ESMC under PCMO	Pre-construction phase	NRs. 190079264/-
1.1.2	Permanent loss of agricultural production	The loss of standing crops of one year will be provide to PAFs	ESMC under PCMO	Pre-construction phase	NRs.1501826/-
1.1.3	Temporary loss of 12.40 ha of agricultural land affecting 27 households	The loss of temporarily acquired agricultural land will be compensated through land rental. Furthermore, land will not be acquired forcefully and will be acquired with bilateral negotiation with land owners and with their consent. This cost also includes rehabilitaion benefit to the affected land owners.	ESMC under PCMO/Contractor	Pre-construction phase	NRs.46990056/-
1.1.4	Temporary loss of agricultural production	The loss of standing crops of one year will be provided to PAFs	ESMC under PCMO/Contractor	Pre-construction phase	NRs.1833774/-
1.1.5	Hardship faced by the people due to loss of land	PAFs will be prioritized for employment and other support programme of the project	ESMC under PCMO/Contractor	Construction phase	No cost
1.1.6		Mitigation measure as proposed in 1.3.4 and no additional cost is required	ESMC under PCMO	Pre-construction Phase	Included in project cost
1.2.1	Permanent Loss of 16.61 ha of community land used for cattle grazing, fuel wood collection, etc	The lost community land will be compensated to the concerned stakeholder as per the lease price of the Forest Regulation for the period of land occupancy (30 years)	ESMC under PCMO	Pre-construction Phase	NRs.6725960.37/-

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
1.2.2	Temporary loss of 38.88 ha of community land used for cattle grazing, fuel wood collection, etc	The lost community land will be compensated to the concerned stakeholder as per the lease price of the Forest Regulation for the period of land occupancy (5 years)	ESMC under PCMO	Pre-construction Phase	NRs.277756.23/-
1.3.1	Conflict due to clash of culture and rituals between outside and local work force near settlements such as Hakubesi-Fulbari, Gogane and Mailun	Local people will be prioritized for employment in project construction works	Contractor	Construction phase	No cost
1.3.2		Outside workers will be encouraged to stay within work camp. For this arrangement of recreational facilities within camp will be arranged by the contractor	Contractor	Construction phase	No cost
1.3.3		The outside work force will be instructed to respect the local tradition, culture and riots by conducting awareness programme	ESMC under PCMO	Construction phase	Specified in the contractor bid document
1.3.4		The project will make necessary arrangement to address grievance of local communities related to the project and the same will provide the necessary information related to the project to local people.	ESMC under PCMO	Construction phase	Included in project cost
1.4.1	Reduce of agricultural work force due to shifting of occupation for project works	Local people specifically women will be encouraged in agricultural practice through agricultural enhancement programme.	ESMC under PCMO	Construction phase	Included in the cost of environmental enhancement programme
1.4.2	Inflation resulting from rise of price of commodity	This will be a residual impact of the project.	N/A	N/A	N/A

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
	goods				
1.5.1	Permanent acquisition of 2 residential structures resulting in the loss of shelter of 2 families	The house owners or SPAFs will be compensated of acquired residential structures at current market price	ESMC under PCMO	Pre-construction phase	NRs.1040000/-
1.5.2		SPAFs will be prioritized for employment and other support programme of the project	ESMC under PCMO/Contractor	Construction phase	No cost
1.5.3		The SPAFs will be also compensated in property translocation.	ESMC under PCMO	Pre-construction phase	NRs.200000/-
1.5.4		Mitigation measure as proposed in 1.3.4 and no additional cost is required	ESMC under PCMO	Construction Phase	Included in project cost
1.5.5	Permanent loss of 2 cow sheds of 2 families affecting livestock rearing and earning	The cow shed owners will be compensated of acquired structures.	ESMC under PCMO	Pre-construction phase	NRs.100000/-
1.6.1	Providing of compensation of acquired land and assets in the market price demanded by PAFs	The compensation will be provided as per the prevailing market price.	ESMC under PCMO	Pre-construction phase	No cost
1.6.2		The SPAFs and PAFs will be consulted before the acquisition process and the matter related to compensation will be bilaterally solved in the consensus of the affected families.	ESMC under PCMO	Pre-construction phase	No cost
1.6.3		Mitigation measure as proposed in 1.3.4 and no additional cost is required	ESMC under PCMO	Pre-construction phase	Already included
1.6.4	Misuse of compensation by male	The Project will provide counselling service to PAFs for the effective utilization of the compensation amount that they have received. For this, Public Relation Officer of the Project will	ESMC under PCMO	Pre-construction and	Included in project cost

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
	members of PAFs resulting lifelong poverty and impoverishment	develop and implement necessary activities such as counselling during the construction stage		construction phase	
1.6.5	Women or female member deprived of utilizing compensation	Mitigation measure as proposed in 1.3.4 and 1.6.3 and no additional cost is required	ESMC under PCMO	Pre-construction phase	Included in project cost
1.6.6	Compensation issues related to disadvantaged and tribal group	No mitigation measure is required	N/A	N/A	N/A
1.7.1	Pressure on educational Institution	The project will assist the school of the Haku VDC to provide education to the children of project staff and workers	ESMC under PCMO	Construction phase	Included in the cost of environmental enhancement programme
1.7.2	Pressure on health institution	The project contractor will set up its own heath institution manned by doctors, nurses and staffs within the construction camps to provide health services to the work personnel.	Contractor	Construction phase	Specified in the contractor bid document
1.7.3		The project will assist the local health institutions.	ESMC under PCMO	Construction phase	Included in the cost of environmental enhancement programme
1.7.4	Pressure on water supply	The project contractor will set up its own persistent water supply system for workforce in all camps without affecting	Contractor	Construction phase	Specified in the contractor bid

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
		community water supply system			document
1.7.5	Pressure on management of sanitation condition and consequence of environmental degradation	The project contractor will set up sanitation management unit in each of the construction sites and camps to manage the waste generated from construction sites and camps	Contractor	Construction phase	Specified in the contractor bid document
1.8.1	Physiological fear of security resulting conflict with project	Public relation programmes like routine discussion with local stakeholders, sport events, health camps will be organized to communicate and interact with local communities. This will assist to build rapport between the local people and Project staff.	ESMC under PCMO	Construction phase	Specified in the contractor bid document
1.8.2		Mitigation measure as proposed in 1.3.4 and no additional cost is required	ESMC under PCMO	Construction phase	Included in project cost
1.8.3	Occurrence of theft and burglary	Mitigation measures as proposed in 1.3.2 and 1.3.4 and no additional cost is required	Contractor/ ESMC under PCMO	Construction phase	Included in project cost
1.8.4		The District Police Office, Rasuwa district will be requested to increase the security personnel in Haku VDC to improve the law & order and the existing police post will be provided with financial assistance for required infrastructures and facilities.	ESMC under PCMO	Construction phase	NRs.1500000/- (Lump sum)
1.8.5	Illegal collection and extraction of vegetation of wildlife from surrounding community forest of Haku VDC and buffer	Mitigation measures as proposed in 1.5.1, 1.5.2, 1.5.3, 1.5.4,1.5.5,1.5.6,1.5.7,1.5.8,1.5.9,1.5.10,1.5.11,1.6.1,1.6.2,1.6.3, 1.6.4, 1.6.5, 1.6.6, 1.6.7,1.6.8 (Table 7.2 : Mitigation Measures for Biological Environmental Impact) and no additional cost is required	ESMC under PCMO/Contractor	Construction phase	Already included

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
	zone of Dhunche VDC				
1.8.6	Incidence of anti-social activities like alcohol consumption, gambling, quarrel, etc	The alcohol consumption will be disallowed outside of construction camps and the project staffs involving in such act outside the camp will be penalised as well as terminated from the job	Contractor	Construction phase	No cost
1.8.7		Gambling will be totally prohibited for construction workers both inside as well as outside camp	Contractor	Construction phase	No cost
1.8.8		Project staffs will be instructed to maintain discipline and not to get involved in quarrel and conflict.	Contractor	Construction phase	No cost
1.8.9		Mitigation measure as proposed in 1.3.4 and no additional cost is required	ESMC under PCMO	Construction phase	Already included
1.8.10	Personal ego resulting conflict between project personnel and local people	Mitigation measure as proposed in 1.3.4 and 1.8.1 and no additional cost is required	ESMC under PCMO	Construction phase	Included in project cost and specified in the contractor bid document
1.8.11	Deterioration of local law and order condition	Mitigation measure as proposed in 1.3.1, 1.3.4 and 1.8.4 and no additional cost is required	Contractor, ESMC under PCMO	Construction phase	Already included
1.9.1	Occurrence of accident and injuries to project personnel	Mitigation measure as proposed in 1.7.2 and no additional cost is required	Contractor	Construction phase	Specified in the contractor bid document
1.9.2		The construction sites will be fenced and unauthorized person will be disallowed	Contractor	Construction phase	Specified in the contractor bid document
1.9.3		First aid health facility will be managed at work site	Contractor	Construction phase	Specified in the contractor bid document

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
1.9.4		Personal protective equipments such as helmets, gloves, boots, mask, ear plugs, safety belts etc. will be provided to all workers as per the nature of their work.	Contractor	Construction phase	Specified in the contractor bid document
1.9.5		Necessary planning and safety approach will be made for emergency rescue. Such contingency planning will include arrangements with project/nearby hospitals, provision of standby ambulance, coping with large-scale spills of hazardous material, slope failures, falling from height, vehicular or equipment related accidents, drowning, road accident and providing awareness trainings of road accidents to construction workers and local people resettling near access road, displaying of hoarding board regarding road accidents, etc	Contractor	Construction phase	Specified in the contractor bid document
1.9.6	Drowning of project personnel in Trishuli river nearby construction site	Mitigation measure as proposed in 1.9.5 and no additional cost is required	Contractor	Construction phase	Already included
1.9.7	Occurrence of various disease to labours due to poor hygiene condition in the labour camp	Mitigation measure as proposed in 1.7.5 and no additional cost is required	Contractor	Construction phase	Already included
1.10.1	Local community losing forest resources such as timber, fodder, fuel	Residual impact of the project	N/A	N/A	N/A

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
	wood etc				
1.10.2	Local community losing grazing ground for their livestock	Residual impact of the project	N/A	N/A	N/A
1.11.1	Reducing of aesthetic or natural scenery of project area	Local government will be assisted in planning the expanding settlement	ESMC under PCMO	Construction phase	NRs.1000000/- (Lump sum)
1.11.2	Shortage of water supply	Mitigation measure as proposed in 1.11.1 and no additional cost is required	ESMC under PCMO	Construction phase	Already included
1.11.3	Degradation of sanitation condition	Mitigation measure as proposed in 1.11.1 and no additional cost is required	ESMC under PCMO	Construction phase	Already included
1.11.4	Additional pressure on solid waste management & construction traffic,	Mitigation measure as proposed in 1.11.1 and no additional cost is required	ESMC under PCMO	Construction phase	Already included
1.11.5	Isolation or abandonment of older settlement	Mitigation measure as proposed in 1.11.1 and no additional cost is required	ESMC under PCMO	Construction phase	Already included
1.11.6	Alteration of local demography	Mitigation measure as proposed in 1.11.1 and no additional cost is required	ESMC under PCMO	Construction phase	Already included
1.12.1	Diminishing of local traditional	The ethnic group 'Tamang' of the project area will be supported to preserve their, tradition, culture, identity as well as their	ESMC under PCMO	Construction phase	Included in the cost of

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
	occupation to newer occupation generated by project	traditional occupation			environmental enhancement programme
1.13.1	Losing of indigenousness of the Tamang ethnic group due to interfacing with culture of outside workforce	Mitigation measure as proposed in 1.12.1 and no additional cost is required	ESMC under PCMO	Construction phase	Already included
1.13.2	Lack of time due to project works affecting traditional practices and rituals	Mitigation measure as proposed in 1.12.1 and no additional cost is required	ESMC under PCMO	Construction phase	Already included
1.14.1	Impact on water use of community	No mitigation measure is required	N/A	N/A	N/A
1.15.1	Occurrence of prostitution	Local governments and local law and order authorities will be informed of in case of occurrence of prostitution activity	ESMC under PCMO/Contractor	Construction phase	No cost
1.15.2		Any workers getting involved in such act will be expelled from the project jobs	Contractor	Construction phase	No cost
1.15.3		Mitigation measure as proposed in 1.3.4 and no additional cost is required	ESMC under PCMO	Construction phase	Already included

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
1.15.4	Transfer and spreading of diseases such as STDs, HIV/AIDS	Community awareness programme on sexually transmitted disease and ways to prevent such disease will be conducted for both project staffs and local people.	ESMC under PCMO	Construction phase	NRs.500000/-
1.15.5		Regular health checkups of construction workers will be conducted in construction camps.	Contractor	Construction phase	Specified in the contractor bid document
1.16.1	Impact on tourism infrastructures and tourist flow	No mitigation measure is required	N/A	N/A	N/A
1.17.1	Gender discrimination in project employment and payment of daily wages	The contractor will be instructed to maintain gender balance during the employment. Both women and men will be provided with equal opportunity in project works	Contractor	Construction phase	No cost
1.17.2		Mitigation measure as proposed in 1.3.4 and no additional cost is required	ESMC under PCMO	Construction phase	Already included
1.17.3	Additional burden of workload to women	The local male workers will be frequently suggested to provide time for house, spouse and children.	ESMC under PCMO	Construction phase	No cost
1.17.4	Exploitation of women to satisfy sexual need of work force	Mitigation measure as proposed in 1.15.1 and 1.15.2 and no additional cost is required	ESMC under PCMO/Contractor	Construction phase	No cost
1.17.5	Trafficking of young girls and women	Community awareness programme regarding girl trafficking will be conducted to local people	ESMC under PCMO	Construction phase	
1.17.6		The construction workforce will be informed that such act is a crime and will be better instructed not to get involved in such	SMC under PCMO/Contractor	Construction phase	No cost

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
		activity. Any workers if found guilty will be terminated from the project job and handover to security personnel for other legal actions			
1.17.7		Mitigation measure as proposed in 1.3.4 and no additional cost is required	ESMC under PCMO	Construction phase	Already included
1.17.8	Incidence of child labor i.e. employment of underage children in project works	Children will not be involved in construction works	Contractor/ ESMC under PCMO	Construction phase	No cost
1.17.9		Mitigation measure as proposed in 1.3.4 and no additional cost is required	ESMC under PCMO	Construction phase	Already included
1.17.10	Discrimination of disadvantaged group (Dalit) in project works	Dalit group will be prioritized in project works as per their skills and capacities with certain percentage reservation for dalit	Contractor	Construction phase	No cost
1.17.11		Mitigation measure as proposed in 1.3.4 and no additional cost is required	ESMC under PCMO	Construction phase	Already included
1.18.1	Conflict arises regarding water use right of 3 VDCs	This issue/impact is not encountered. in EIA study till date, However, The project will discuss the matter regarding water use right with the concerned representatives with all three VDCs before project construction to sort out this impact	N/A	N/A	No cost
1.19.1	Disturbance to foot trail and movement of people	No mitigation measure is required	N/A	N/A	N/A
1.20.1	Drowning of people in dewatered stretch	No mitigation measure is required	N/A	N/A	N/A
2. Operation Phase					

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
2.1.1	Recession due to withdrawal of economic activities and employment opportunities	Residual impact of the project	N/A	N/A	N/A
2.1.2	Change in spending habit and livelihood of local people	Residual impact of the project	N/A	N/A	N/A
2.3.1	Reduced flow of water at downstream affecting cremation site of Dalit in Haku VDC (water use impact)	The downstream flow of he minimum environmental release of 3.84m^3/sec even in dry season will be sufficient in cremation activity.	Project operator	Operation phase	No cost
2.3.2		The environmental flows released will be canalized in the stretch of the cremation site	Project proponent/ ESMC under PCMO	Post construction phase	Included in project civil cost
2.3.3		The cremation site will be maintained with civil works	Project proponent/ ESMC under PCMO	Post construction phase	NRs.300000/-
2.4.1	Reduced flow of water at downstream affecting cremation site of Dalit (religious and cultural impact0	Mitigation measure as proposed in 2.3.1,2.3.2 and 2.3.3 and no additional cost is required	Project proponent/ ESMC under PCMO	Post construction phase, Operation phase	Already included
2.5.1	Discrimination of women,	No mitigation measure is required	N/A	N/A	N/A

SN	Adverse Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
	children and disadvantaged group				
2.6.1	Sudden release of water resulting drowning of people in dewatered stretch	Siren network will be installed at different locations in the dewatered zone	Contractor	Post Construction Phase	Included in project cost
2.6.2		The sudden release of water from dam will be limited to day hour as far as possible and siren will be blown (3 times) half an hour prior to sudden release	Project operator	Operation Phase	No cost
2.7.1	Air and noise pollution due to plying of vehicle in access road	All vehicles belonging to the Project i.e., proponent, contractors, consultants will comply with the national emission standards of the Ministry of Environment, Nepal (with Green Sticker)	ESMC under POMO	Operation Phase	Included in project civil cost
2.7.2		Regular (monthly) maintenance of all vehicles will be made mandatory	ESMC under POMO	Operation Phase	Included in project civil cost
2.7.3	Occurrence of road accidents	The traffic signal showing restriction on speed will be installed near settlements namely Hakubesi-Fulbari, Gogane and Mailun	ESMC under POMO	Operation Phase	Included in project civil cost
2.7.4		The local people including children will be provided with safety training programme related to traffic accident.	ESMC under POMO	Operation Phase	NRs.750000/-
2.8.1	Change in water quality downstream of tailrace	The project will apply necessary measures to prevent any pollution of dewatered stretch of the proposed project.	ESMC under POMO	Operation Phase	Provisioned and included in project cost

Table 10.11: Mitigation Management Plan for Beneficial Impact

SN	Beneficial Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
1. Construction Phase					
1.1.1	Economic upliftment of local people by generation of income through employment in the project	Local people will be prioritized in project related employment	ESMC under PCMO/Contractor	Construction phase	No cost
1.2.1	Enhancement of business opportunity due to increase in supply of commodity and locally produced goods	Local people will be provided training on business and trade	ESMC under PCMO	Construction phase	Included in the cost of environmental enhancement programme
1.2.2	Establishment of tea stalls, grocery shops, restaurants, hotels, etc creating business opportunities for local people	Mitigation measures as mentioned in 1.2.1 and no additional cost is required	ESMC under PCMO	Construction phase	Already included
1.2.3	Business opportunity for entrepreneur women	Mitigation measures as mentioned in 1.2.1 and no additional cost is required	ESMC under PCMO	Construction phase	Already included
1.3.1	Increase in employment opportunities in other similar projects	Local people will be prioritized in training in project related works	ESMC under PCMO/Contractor	Construction phase	No cost
2. Operation Phase					
2.1.1	Generation of 1440 GWh of clean and renewable energy fulfilling energy demand and minimizing energy crisis	No mitigation measure is required	N/A	N/A	N/A
2.1.2	Economic development of country due to generation of economic activities with enhanced availability of electricity	No mitigation measure is required	N/A	N/A	N/A
2.1.3	Opportunities related to rural electrification programme in Haku VDC	The project affected VDCs will be supported for rural electrification	ESMC under POMO/Project Proponent	Post construction phase	Included in the cost of environmental enhancement programme
2.1.4	Improvement of living standard of local people due to availability of electricity	No mitigation measure is required	N/A	N/A	N/A
2.1.5	Decrease in deforestation due to	No mitigation measure is	N/A	N/A	N/A

SN	Beneficial Impact	Mitigation Measures	Responsible Authority (Who will do)	Time (When to do)	Mitigation Cost (NRS.)
	reduced use of firewood	required			
2.1.6	Improvement of health of women and children by the use of electricity instead of firewood.	No mitigation measure is required	N/A	N/A	N/A
2.2.1	Increment in revenue of local VDCs by the operation of proposed hydropower plant	No mitigation measure is required	N/A	N/A	N/A
.2.2.2	Utilization of royalty in improvement of existing services	No mitigation measure is required	N/A	N/A	N/A
2.3.1	Economic upliftment of local people by generation of income through employment in the project	Local people will be prioritized in project job	ESMC under POMO	Operation phase	Included in project operation policy
2.3.2	Generation of other employment opportunities associated with project	No mitigation measure is required	N/A	N/A	N/A
2.4.1	Generation of opportunities related to local tourism and trade	Local people will be encouraged for tourism enhancement.	ESMC under POMO		No cost

Table 10.12: Mitigation Management Plan for Environmental Enhancement Programmes

SN	Environmental Enhancement Programmes	Responsibility Authority (Who will do)	Time (When to do)	Mitigation Cost (NRs.)
1	Education and Education Facility Support Programme	ESMC under PCMO	Construction Phase	23,500,000/-
2	Health Institution Support Programme	ESMC under PCMO	Construction Phase	2,500,000/-
3	Road Development Support Programme	ESMC under PCMO	Construction Phase	5,000,000/-
4	Sanitation Improvement and Management Support Programme	ESMC under PCMO	Construction Phase	2,500,000/-
5	Water Supply Support Programme	ESMC under PCMO	Construction Phase	1,250,000/-
6	Irrigation Management Support Programme	ESMC under PCMO	Construction phase	6,500,000/-
7	Agricultural Enhancement Support Programme	ESMC under PCMO	Construction phase	20,000,000/-
8	Animal Husbandry and Poultry Enhancement Support Programme	ESMC under PCMO	Construction phase	5,000,000/-
9	Women Development Programme	ESMC under PCMO	Construction phase	7,500,000/-
10	Technical Education Support Programme	ESMC under PCMO	Pre-construction phase	5,000,000/-
11	Office and Secretarial Training Programmes	ESMC under PCMO	Construction phase	5,000,000/-
12	Ethnic Group Support Programme	ESMC under PCMO	Construction phase	10,000,000/-
13	Langtang National Park (LNP) Support Programme	ESMC under PCMO	Construction phase	13,000,000/-
14	Local Organization Support Programme	ESMC under PCMO	Construction phase	4,500,000/-
15	Religious Institution Support Programme	ESMC under PCMO	Construction phase	3,000,000/-
16	Support to Misyung Khola Micro Hydropower (Peltric Set system)	ESMC under PCMO	Construction phase	1,000,000/-
17	Rural Electrification Extension Programme	ESMC under POMO/Project Proponent	Operation phase	5,000,000/-
Total				**64,050,000/-**

10.5 Environmental Monitoring Management Plan

Environmental Monitoring Management plan is the third essential component of environmental management plan. This section outlines the environmental monitoring plans to be implemented during the pre-construction, construction and operation phase of the proposed UT-1HEP. This plan comprises of collection and analysis of data to measure environmental changes associated with construction and operation of the project and follow up the mitigation measures suggested in earlier sections. Thus, this plan evaluates the execution of proposed mitigation measures & monitoring actions and evaluates the effectiveness of the implemented measures. As stated earlier, the environmental monitoring management plans will be carried out by the outsourcing the necessary experts or consultants in addition to regular staffs of the project and will be executed under ESMC related to PCMO and POMO.

The major objectives of environmental monitoring management plan are:

- To continuously monitor changes to baseline environmental conditions during construction and operation activities
- To measure the success of compliance of mitigation measures proposed for minimizing the potential environmental impacts
- To make sure that the impacts related to the project are within the limits of envisaged impact of EIA study and to implement corrective actions or new adaptive management programmes, as required, if proposed mitigation measures are unable to reduce and/or eliminate potential project related impacts, or meet the predetermined level of performance

Taking into account of the above objectives, three types of monitoring plan are included in the proposed plan which are termed as Baseline Monitoring Plan, Compliance Monitoring Plan and Impact Monitoring Plan.

10.5.1Baseline Monitoring Management Plan

This plan is required to compile and maintain the database on environmental conditions prior to the project implementation, which is especially important if the project is delayed due to unforeseen circumstances. Such data recorded before the project implementations will facilities comparison of information obtained in monitoring activities conducted during the project construction. Majority of environmental baseline information have been already enlisted in the EIA study except for the noise quality, landslide, air quality, law & order and land pollution. Thus, these information needs to be incorporated through Baseline Monitoring Management Plan before the start of construction phase.

Table 10.13: Baseline Monitoring Management Plan

SN	Monitoring Issues	Monitoring Indicator	Monitoring Method	Monitoring Location	Monitoring Frequency	Monitoring Schedule	Responsible Agency	Monitoring Costs (NRs.
1	Noise quality	Noise Level	Measurement of noise using Noise Level Meter	Hakubesi-Fulbari, Gogane and Mailun villages	Once	Prior to construction phase		NRs.60000/
2	Landslide (stability of slopes)	Hakubesi Landslide	Site observation and mapping of the same in appropriate scale	Hakubesi-Fulbari	Once	Prior to construction phase		Included in Project Manageme t Cost
3	Air quality	Ambient air quality (TSP/PM_{10})	High/Low volume sampler, inspection, measurement and comparison of data with ambient standards	Hakubesi-Fulbari, Gogane and Mailun villages	Once	Prior to construction phase		NRs.150000 /-
4	Law and order	Incidence and record of crime such as theft, burglary, trafficking, etc	Discussion with local people and information from local police post	Hakubesi-Fulbari, Gogane and Mailun villages	Once	Prior to construction phase		Included in Project Manageme t Cost
5	Land Pollution	Sites of open defecation and garbage or solid waste disposal	Observation	Hakubesi-Fulbari, Gogane and Mailun villages and areas nearby headworks and powerhouse	Once	Prior to construction phase		Included in Project Manageme t Cost
6	Structural condition of built structures	Number of houses, construction material, development of cracks, name of house owner	Field observation; documentation of structures through write-up , maps and photographs	Hakubesi-Fulbari village	Once	Prior to construction phase		NRs.200000 /-

The total cost estimated for Baseline Monitoring Management Plan that is not inlcuded in project mangement cost and needs involvement of outsource expert or consultant is **NRs.410,000/-**

10.5.2 Compliance Monitoring Management Plan

Compliance monitoring management plan is essential in order to encourage and promote the proponent to comply with the requirements as listed in the mitigation measures and any condition set forth during the project approval. The compliance monitoring will monitor whether the mitigation measures and environmental enhancement programmes recommended in Chapter VII and Chapter VIII of this EIA report were actually implemented as designed for the construction phase. Hence, it is desirable to ensure the integration of mitigation measures in the document, if any, which should fully reflect environmental obligation to be compiled with by the proponent or by the contractor. The management of UT-1HEP will incorporate the contractors' responsibility in the bid document. Furthermore, the plan consist of obligating legal standards and guideline issued by the government of Nepal and the approval and permit conditions as given in section 10.14.

Table 10.14: Compliance Monitoring Management

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Responsibility	Monitoring Cost (NRs.)
Construction Phase						
Mitigation and Enhancement Measures	All mitigation measures proposed in Chapter 7 and environmental enhancement programmes proposed in Chapter 8	All the sites of project structures, facilities and their surroundings	Direct observation, documentation, discussions with the local communities, consultation with local government	Daily/weekly/monthly depending upon the measure		Included in Contractor cost and Project Management cost
Air Quality inside Tunnel	PM_{10}, CO, SOx, NOx	Active tunnel working face, and midway between active tunnel working face and tunnel outlet portal	As per concentration limit of parameters enlisted in Table 10.3	Monthly	Contractor/ Reporting to	Included in Contractor cost
Water Quality at construction	Parameters as enlisted in Table	Immediate points after the	As per the tolerance limit of Standards for	Monthly	Contractor/ Reporting to	Included in Contractor cost

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Responsibility	Monitoring Cost (NRs.)
Sites	10.1 i.e. Standards for Effluents Discharged into Inland Water from the Construction Sites and Camps	treatment units of tunnel discharge, discharge from aggregate crushing plant & batching plant and sanitary discharge	Effluents Discharged into Inland Water from the Construction Sites and Camps			
Drinking Water quality in the construction camps	Parameters as enlisted in Table 10.2 i.e. Drinking Water Quality Standards for Construction Camps and Construction Sites	Water supply reservoir and one end tap of the camps (12 Nos.)	As per Table 10.2 i.e. Drinking Water Quality Standards	Monthly	Contractor/ Reporting to	Included in Contractor cost
Public Health	Outbreak of disease in the village	Nearby villages of construction camps	workers	Twice a month		The cost is included in Project Management cost
Occupational Health (Ambulance, medical doctor, first aid, PPE)	Outbreak of disease in construction camps, Number of workers reporting sickness, no of workers injured, No of construction accident, Number	Construction camps	Site Supervision and H	Twice a month	Contractor/ Reporting to	The cost is included in contractor cost

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Responsibility	Monitoring Cost (NRs.)
	of fatal incidents					
Law & order and Security	Burglary Theft, , quarrels, social unrest, Number of police case etc.	Construction areas, labor camps	/R	Monthly		The cost is included in Project Management cost
Operation Phase						
Mitigation and Enhancement Measures	All mitigation measures proposed in Chapter 7 and environmental enhancement programmes proposed in Chapter 8	All the sites of project structures, facilities and their surroundings	Direct observation, documentation, discussions with the local communities, consultation with local government	Daily/weekly/monthly depending upon the measure		Included in Project Management Cost
Water quality in the operation camp	Parameters as enlisted in Table 10.2 i.e. Drinking Water Quality Standards for Construction Camps and Construction Sites	Supply water reservoir and one end tap of the camps (2 Nos.)	As per Table 10.2 i.e. Drinking Water Quality Standards)	Once every year		NRs.1500000/- for 30 years

10.5.3 Impact Monitoring Management Plan

The actual impacts that have occurred due to project implementation should be closely monitored during the construction and operation of the project for the effectiveness of the mitigation measures. The impact monitoring comprises monitoring of the well documented baseline indicators elaborated from the baseline environment for a comparative environmental assessment in various stages of project development.

Table no: 15

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Responsibility	Monitoring Cost (NRs.)
Construction Phase						
Landslide and Slope instability	Nos. of incidence of landslide, slope failure, debris flow	Access road, Tunnel adits	Site observation and mapping of the same in appropriate scale	6 times a year		Included in Project Management Cost
Soil erosion	Erosion of soil and deposition in down slopes	Access road, Tunnel adits, Spoil & muck disposal sites, quarry sites	Site observation and mapping of the same in appropriate scale	6 times a year		Included in Project Management Cost
Noise quality	Noise level	Hakubesi-Fulbari, Gogane and Mailun villages	Measurement of noise using Noise Level Meter	3 times a year		NRs.300000/-
Water quality of Trishuli River	Parameters as enlisted in Table 10.1 i.e. Standards for Effluents Discharged into Inland Water from the Construction Sites and Camps	Three locations - Upstream of Weir, Between weir and powerhouse and below Powerhouse	As per the tolerance limit of Standards for Effluents Discharged into Inland Water from the Construction Sites and Camps	3 times a year		NRs.1560000/-
Air quality	Ambient air quality (TSP/PM_{10})	Hakubesi-Fulbari, Gogane and Mailun villages	High/Low volume sampler, inspection, measurement and comparison of data with ambient standards	3 times a year		NRs.2250000/-

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Responsibility	Monitoring Cost (NRs.)
Structural condition of built structures	Number of houses, construction material, development of cracks, name of house owner	Hakubesi-Fulbari village	Field observation; documentation of structures through write-up , maps and photographs	Whenever complain is registered		Provisioned as NRs.200000/-
Land pollution	Sites of open defecation and garbage or solid waste disposal	Hakubesi-Fulbari, Gogane and Mailun villages and areas nearby headworks and powerhouse	Direct observation	Daily		Included in Project Management Cost
Ecological status of forest and vegetation	Status of forest	Forest within 1 km distance of dam site, access road & switchyard as well as monitoring plots of baseline studies	Direct observation and plot studies in forest areas of Dam site, access road, switchyard and monitoring plots	Twice a year		Included in Project Management Cost
Wildlife	Status of wildlife	Sites of Raider wildlife (monkey, barking deer, wild boar, golden jackal, porcupine, common goral)	Community consultations; Record keepings that include raiding season, raiding frequency and raided sites of such wildlife	Twice a year		Included in Project Management Cost
Aquatic Ecology	Fish diversity and catch in unit time	Upstream of weir site, downstream of weir site, upstream of powerhouse site and downstream of powerhouse site	Fish sampling	Twice a year		NRs.1200000/-

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Responsibility	Monitoring Cost (NRs.)
Quality of Life	Economic and social status of people of the affected communities/VDCs	Communities of Hakubesi-Fulbari, Gogane and Mailun	Interviews , observation, and structured questionnaire survey of selected groups	Once a year		Included in Project Management Cost
Inflation	Prices of the commodities goods such as cereals & cash crops, kerosene, meat, sugar, salt, spices, soap, milk, ghee, etc in project affected sites	Hakubesi-Fulbari, Gogane and Mailun villages	Record keeping of prices of commodities goods in local villages	Every month		Included in Project Management Cost
Trade and Business Development	No of Hotels/Tea stall and Restaurants	Hakubesi-Fulbari, Gogane and Mailun villages	Direct enumeration and record keeping	Thrice a year		Included in Project Management Cost
Usefulness of environmental enhancement programmes	People perception of environmental enhancement programmes	Hakubesi-Fulbari, Gogane and Mailun villages and VDC offices of Dhunche and Ramche VDCs	Discussions with local people, officials and representatives of project affected VDCs	Twice a year		Included in Project Management Cost
Operation Phase						
Landslides and Slope instability	Nos. of incidence of landslide, slope failure, debris flow	Access road, Tunnel adits	Site observation and mapping of the same in appropriate scale	Twice a year for first 5 years of project operation		Included in Project Management Cost
Soil erosion	Erosion of soil and deposition in down slopes	Access road, Tunnel adits, Spoil & muck disposal sites, quarry sites	Site observation and mapping of the same in appropriate scale	Twice a year for first 5 years of project		Included in Project Management Cost

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Responsibility	Monitoring Cost (NRs.)
				operation		
Water Quality of Trishuli River	Parameters as enlisted in Table 10.1 i.e. Standards for Effluents Discharged into Inland Water from the Construction Sites and Camps	Three locations - Upstream of Weir, Between weir and powerhouse and below Powerhouse	As per the tolerance limit of Standards for Effluents Discharged into Inland Water from the Construction Sites and Camps	Once every year for 30 years		NRs.3120000/-
Noise quality	Noise level	Powerhouse area	Measurement of noise using Noise Level Meter	Once after operation		NRs.20000/-
Ecological status of forest and vegetation	Status of forest	Forest within 1 km distance of dam site, access road & switchyard as well as monitoring plots of baseline studies	Direct observation and plot studies in forest areas of Dam site, access road, switchyard and monitoring plots	Twice a year for first 5 year of project operation		Included in Project Management Cost
Wildlife	Status of wildlife	Sites of Raider wildlife (monkey, barking deer, wild boar, golden jackal, porcupine, common goral)	Community consultations; Record keepings that include raiding season, raiding frequency and raided sites of such wildlife	Twice a year for first 5 year of project operation		Included in Project Management Cost
Aquatic Ecology	Fish diversity and catch in unit time	Upstream of weir site, downstream of weir site, upstream of powerhouse site	Fish sampling	Twice a year for first 5 years of project operation		NRs.1200000/-

Monitoring Issues	Monitoring Indicator	Monitoring Location	Monitoring Method	Monitoring Frequency	Monitoring Responsibility	Monitoring Cost (NRs.)
		and downstream of powerhouse site				
Quality of Life	Economic and social status of people of the affected communities/VDCs	Communities of Hakubesi-Fulbari, Gogane and Mailun	Interviews , observation, and structured questionnaire survey of selected groups	Once after 2 years of project operation		Included in Project Management Cost
Inflation	Prices of the commodities goods such as cereals & cash crops, kerosene, meat, sugar, salt, spices, soap, milk, ghee, etc in project affected sites	Hakubesi-Fulbari, Gogane and Mailun villages	Record keeping of prices of commodities goods in local villages	Thrice a year for first two years of project operation		Included in Project Management Cost
Trade and Business Development	No of Hotels/Tea stall and Restaurants	Hakubesi-Fulbari, Gogane and Mailun villages	Direct enumeration and record keeping	Thrice a year for first two years of project operation		Included in Project Management Cost
Usefulness of environmental enhancement programmes	People perception of environmental enhancement programmes	Hakubesi-Fulbari, Gogane and Mailun villages and VDC offices of Dhunche and Ramche VDCs	Discussions with local people, officials and representatives of project affected VDCs	Twice a year for first two years of project operation		Included in Project Management Cost

The total cost estimated for Impact Monitoring Management Plan that is not inlcuded in project mangement cost and needs involvement of outsource expert or consultant is **NRs.9,850,000/-**

10.6 Environmental Auditing

Environmental Examination is an integral part of EIA. Environment Protection Regulation 1997 (amended 1999) suggests conduction of environmental Examination by Ministry of Environment (MoE) after two years of commencement of the project. Examination refers to a general class of environmental auditing that is used to vary past and current environmental performances.

Environmental Impact Audit of the proposed project will be performed after two years following its operation and its facilities to assess the actual environmental and health impacts, the accuracy of predictions, the effectiveness of mitigation measures and the functioning of monitoring mechanisms.

The project proponent will be primarily responsible for carrying out all the proposed audit activities and will make necessary arrangements for environmental audit through GoN or its nominated auditor. On behalf of GoN, Ministry of Environment is responsible for the environmental auditing of the projects. The environmental audit must be carried out as specified as in National EIA Guideline (1993). The role of the environmental auditor is to identify environmental change arising from the project and to assess the effectiveness of the mitigation measures adopted, suggesting additional measures where appropriate. In addition, auditing of the project will indicate where initial predictive methods were weak or environmental knowledge lacking, thus indicating areas where further research or attention to detail may be necessary.

The environmental audit team will comprise of an environmental expert experienced in EIA study, monitoring and auditing works as team leader accompanied by environmental engineer, sociologist and ecologists.

10.6.1 Environmental Audit Framework

The environmental audit framework is presented in Table 10.16.

Table 10.15: Environmental Audit Framework

SN	Parameters	Location	Methods	Indicators
Physical Aspects				
1	Change in river morphology downstream of weir	Downstream of weir and downstream of tailrace	Inspection	Erosion of river bank and sediment deposition pattern
2	Air quality	Sites of construction of project structures and facilities	Measurement laboratory analysis, and visual inspection	PM10, CO, SOx, NOx ;Dust accumulated on roofs, vegetation and surrounding area
3	Noise quality	Settlements area (Hakubesi-Fulbari, Gogane and Mailun villages)	Measurement of noise using Noise Level Meter	Noise Level
4	Water quality	Weir site and	Analysis of water	DO, pH, BOD, turbidity

SN	Parameters	Location	Methods	Indicators
		powerhouse site	samples	Total suspended solid, hardness
5	Land use pattern and land acquisition area	Sites of project structures and facilities	Inspection	Change in the Land use
6	Environmental release	Downstream of weir	Measurement of minimum release	Discharge in the river
Biological Environment				
1	Change in vegetation cover	Project construction site	Visual observation and counting	Decrease in vegetation cover, Number of trees and shrubs cut down from forest
2	Numbers of trees felled	Project construction site	Visual observation and counting	Nos. of stumps of cut trees
3	Wildlife diversity	Project construction site	Interview with local people and observation, Photographs	Decrease in sight of wildlife than earlier
4	Change in fish species in Trishuli River	Trishuli River	Sampling at the river stretch of project sites and interview with local fishermen	Population of fish Species in the river
5	Migration of Fish	Trishuli River	Sampling at the river stretch of project sites and interview with local fishermen	Population of migratory fish species in the river
Socioeconomic and Cultural Environment				
1	Status of paid out of compensation	Project site	Questionnaire survey and interview	Condition of the affected people, useful utilization of compensation
2	Employment to local people	Project site	Direct observation, Questionnaire survey and interview	Project records and local people
3	Water supply and sanitation	Project construction camps and Settlements area (Hakubesi-Fulbari, Gogane and Mailun villages)	Direct observation, Review of records and interview with workers and local people	Records of complaints, epidemic disease
4	Public health	Settlements area (Hakubesi-Fulbari, Gogane and Mailun villages)	Review of records and interview with local people	Records of health post and local people
5	Child labour	Construction camps and settlements	Review of contractor records	Number of child labour employed

SN	Parameters	Location	Methods	Indicators
		area (Hakubesi-Fulbari, Gogane and Mailun villages)	and interview with local people	
6	Occupational health and safety	Construction camp	Review of contractor records and interview with construction workers	Number and type of accidents/diseases
7	Economic status of PAFs and SPAFss	Project site	Direct observation, Questionnaire survey and interview	Economic status of the PAFs and SPAFs

The overall cost estimated for environmental auditing is **NRs.800,000/-**

11 PROJECT COST

11.1 Project Cost

The construction cost of the project is NRs.36483792675/- including project financing, inflation, interest, insurance and environmental mitigation and improvement measures.

11.2 Resource Loss

The project will require 104.45 hectares of land (47.58 hectares permanently and 56.88 hectares temporarily) including agricultural land, forest and other government land.

11.3 Production loss

The monetary value of loss of annual food grain production from the permanent and temporary acquisition of 19.35 ha and 12.40 agricultural land by the project is estimated as **NRs. 3,335,600/-**

11.4 Economic Benefit

The operation of project will generate 1440 GWh of clean and renewable energy fulfilling energy demand and minimizing energy crisis. The annual sale of energy is **NRs.6,480,000,000/-**

11.5 Employment Generation

The project will generate employment for 1200 people in construction (1100 numbers in construction) and operation phase (100 numbers in operation) of the project.

Table 11.1: Cost Estimates of Environmental Mitigation, Monitoring and Environmental Enhancement

Particulars	Costs (NRs)
Mitigation (Construction and Operation Phase)	
Physical Environment	5,200,000
Biological Environment	46,650,000
Socioeconomic and Cultural Environment	253,298,637
Grand Total (Mitigation)	305,148,637
% of Project Cost	0.84
% of Annual Energy Sale	4.71
Monitoring Management Plan	
Baseline Monitoring Management Plan	410,000
Compliance Monitoring Managemnet Plan	1,500,000
Impact MonitoringManagement Plan	9,850,000
Grand Total (Monitoring)	11,760,000

Particulars	Costs (NRs)
% of Project Cost	0.032
% of Annual Energy Sale	0.181
Environmental Audit	
Environmental Audit	800,000
% of Project Cost	0.002
% of Annual Energy Sale	0.012
Environmental Enhancement	
Environmental Enhancement	64,050,000
% of Project Cost	0.18
% of Annual Energy Sale	0.99
Grand Total Mitigation, Monitoring Management Plan, Audit and Environmental Enhancement	381,758,637
% of Project Cost	1.046
% of Annual Energy Sale	5.89

12 CONCLUSION

The EIA study has been carried in accordance with existing act, regulation and guidelines pertinent to EIA study. Although located in nearby LNP, the proposed UT-I 216 MW HEP as indicated in the present level of the study is found to be feasible from environmental perspective as it causes minimal impacts to the surrounding environment and society.

The project will need 104.45 hectares of land for the construction and implementation of the project with permanent and temporary land acquisition of 47.58 hectares and 56.88 hectares respectively. The land uses of project construction site are Bagar (30.31%), forest (26.05%), cultivated land (19.83%), cliff (13.71%), Bushes (7.14%), Khar Bari (1.00%), river (0.90%) and existing road (1.07%). Hill sal, chirpine and alder comprise the main forest component of the project area. 41 households will lose their land and assets due to acquisition of land by the project.

The project will permanently acquire 21.39 hectare forest and 9.35 hectares agricultural land. The loss of permanently acquired agricultural land will be compensated at the current market price and with the consent of land owner

Most of the impacts are low and moderate, as compared to the project scale. Thus, the key environmental impacts of the project could be mitigated to acceptable levels through the implementation of the mitigation measures and need no further EIA appraisal. Nonetheless, monitoring and follow-up studies need to be carried out by the project, in view of assessing the effectiveness of environmental mitigation measures during construction and operation phase

Furthermore, the project is viable from technical, environmental and economical aspects. Moreover, the location of all project components is feasible from the geological and topographical point of view.

Thus, the development of this Project is envisaged to play a critical role in furthering the economic activities of the country with positive contribution to the development of the locality as well as economic growth of nation.

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