

Environmental Impact Assessment



Budhi Ganga Hydropower Project (20 MW)

Achham & Bajura districts, Nepal



Volume I: Main Report

Submitted to
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Ministry of Energy, Water Resources and Irrigation

Submitted by
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Budhi Ganga Hydropower Project
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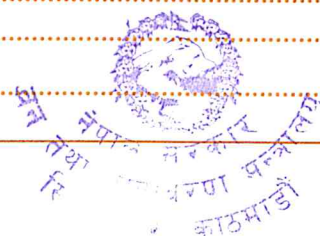
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ABBREVIATIONS AND ACRONYMS

Abbreviations/Acronyms	Description
AD	Anno Domini
ADB	Asian Development Bank
AIDS	Acquired Immune Deficiency Syndrome
APD	Auditory Processing Disorder
ARI	Acute Respiratory Infection
BHP	Budhi Ganga Hydropower Project
BS	Bikram Sambat
°C	Degree Celsius
CBS	Central Bureau of Statistics
CFC	Compensation Fixation Committee
CFUG	Community Forest User Group
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CIWEC	Canadian International Water and Energy Consultants
CSR	Corporate Social Responsibility
CTEVT	Council for Technical Education and Vocational Training
DBH	Diameter at Breast Height
dBA	A-weighted decibels
DCC	District Coordination Committee
DED	Detailed Engineering Design Report, Budhiganga HPP
DFO	Division Forest Office
DHM	Department of Hydrology and Meteorology
DHQ	District Headquarter
DoED	Department of Electricity Development
DoF	Department of Forests
DO	Dissolved Oxygen
EA	Environmental Audit
EIA	Environmental Impact Assessment
EMP	Environment Management Plan
EMU	Environment Monitoring Unit
EPA	Environment Protection Act
EPR	Environment Protection Rule
ESMU	Environment and Social Management Unit
FDD	Fisheries Development Directorate
FM	Frequency Modulation
FSL	Full Supply Level
GHG	Green House Gas
GoN	Government of Nepal
HH	Household

Abbreviations/Acronyms	Description
HPP	Hydropower Project
ICIMOD	International Center for Integrated Mountain Development
IEE	Initial Environmental Examination
ILO	International Labor Organization
INGO	International Non Government Organization
INPS	Integrated Nepal Power System
IRG	International Resources Group
IUCN	International Union for Conservation of Nature and Natural Resources
KII	Key Informant Interview
KM	Kilometer
LCF	Local Consultative Forum
KFAED	Kuwait Fund for Arab Economic Development
M	Meter
M ³	Cubic Meter
MBT	Main Boundary Thrust
MCT	Main Central Thrust
MHSP	Medium Hydropower Study Project
mm	Millimeter
MoEWRI	Ministry of Energy, Water Resources and Irrigation
MoFE	Ministry of Forests and Environment
MOL	Minimum Operating Level
MPAF	Marginally Project Affected Families
MT	Metric Ton
MW	Mega Watt
NARC	Nepal Agriculture Research Council
NBSAP	National Biodiversity Strategy and Action Plan
NDNM	Norwegian Directorate for Nature Management
NEA	Nepal Electricity Authority
NGOs	Non-Governmental Organizations
NOx	Nitrogen oxides
NPWCA	National Park and Wildlife Conservation Act
NPC	National Planning Commission
NTFP	Non Timber Forest Product
NWP	National Water Plan
ODF	Open defecation free
PAFs	Project Affected Families
PGA	Maximum Peak Ground Acceleration
PIC	Project Information Center
PM	Particulate Matter
PMO	Project Manager Office
PPE	Personal Protective Equipment

Abbreviations/Acronyms	Description
PRA	Participatory Rural Appraisal
PRoR	Pondage Run of River
PVO	Pyrexia of Unknown Origin
RNG	Royal Norwegian Government
SFD	Saudi Fund for Development
SMEC	Snowy Mountains Engineering Corporation
SMEC-UDAYA JV	SMEC International Pty Ltd in Joint Venture with Udaya Consultancy Pvt. Ltd
SO ₂	Sulfur dioxide
SPAF	Severely Project Affected Family
SPM	Suspended Particulate Matter
SPS	Safeguard Policy Statement
STD	Sexually Transmitted Disease
SWCA	Soil and Water Conservation Act
ToR	Terms of Reference
TSP	Total Suspended Particles
UDAYA	Udaya Consultancy Pvt. Ltd.
USAID	United States Agency for International Development
UN	United Nation
VDC	Village Development Committee
WECS	Water and Energy Commission Secretariat
WHO	World Health Organization
WRS	Water Resources Strategy
RM	Rural Municipality



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कार्यकारी सारांश

१. परिचय

बुढीगंगा जलविद्युत आयोजना उर्जा, जलस्रोत तथा सिंचाई मन्त्रालय, विद्युत विकास विभागद्वारा बुढीगंगा नदीमा प्रस्तावित गरिएको छ। प्रस्तावित आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन वातावरण संरक्षण नियमावली, २०५४ अनुसार गरिएको छ। यस वातावरणीय प्रभाव मूल्याङ्कन अध्ययनमा जलविद्युत आयोजनाको विद्युत उत्पादन पक्ष, यसका संरचनाहरू तथा यी संरचनाहरूसम्म पुग्न निर्माण गरिने बाटोलाई समावेश गरिएको छ। विद्युत प्रसारण लाईनको संरचना यस अध्ययनको कार्यक्षेत्र भित्र पर्दैन।

२. आयोजनाको विवरण

प्रस्तावित आयोजना सुदूरपश्चिम प्रदेशको बाजुरा र अछाम जिल्लाहरूमा पर्दछ। यस आयोजना क्षेत्र भित्र अछाम जिल्लाको साँफेवगर नगरपालिकाको वडा नं. ४, १० र १३, मेल्लेख गाउँपालिकाको वडा नं. ४ र ८ तथा बाजुरा जिल्लाको बुढीगंगा नगरपालिकाको वडा नं. १० पर्दछन्। आयोजना क्षेत्र राष्ट्रिय निकुञ्ज, संरक्षित क्षेत्र, वन्य जन्तु आरक्ष, मध्यवर्ती क्षेत्र तथा वातावरणीय दृष्टिकोणले संवेदनशील क्षेत्र भित्र पर्दैन। आयोजना स्थल साँफे-मार्तडी सडकले जोडिएको छ।

आयोजनाको बाँध निर्माण स्थल बुढीगंगा-ईकरीगाडको दोभान भन्दा करीव २०० मी.तल प्रस्ताव गरिएको छ। प्रस्तावित बाँधको उचाई जगस्तर बाट ४४ मी. तथा लम्बाइ ८६ मी. रहेको छ। यस आयोजनाको बाँध निर्माण पश्चात बुढीगंगा नदीमा २.०६ कि.मी. लामो तथा १३.४ हे. क्षेत्रफल बराबरको जलाशय निर्माण हुनेछ। आयोजना अन्तर्गत ५.५८ कि. मी. सुरङ्ग, भूमिगत सर्ज सैफ्ट, १८५.१५ मी. पेनस्टक, थापागाँऊ नजिक सतही विद्युत गृह तथा टेलरेस निर्माण गरिनेछ। विद्युत उत्पादन पश्चात पानीलाई टेलरेस मार्फत पुनः बुढीगंगा नदीमा खसालिनेछ।

प्रस्तावित आयोजना Pondage Run of River (PRoR) किसिमको हो र यसबाट २० मेगावाट विद्युत शक्ति उत्पादन गरिनेछ। आयोजनाको Design discharge २६ घनमीटर प्रति सेकेण्ड रहेको छ। आयोजना निर्माणको कूल अनुमानित लागत रु ५,४५०.३२ मिलियन र निर्माण अवधि ४ वर्षको रहेको छ।

३. आवश्यक तथ्याङ्क तथा तथ्याङ्क संकलन विधि

यस आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन कार्य वातावरण विद्, वातावरण इन्जिनियर, वनस्पति विज्ञ, वन्यजन्तु विज्ञ, माछा विज्ञ, सामाजिक आर्थिक विशेषज्ञ तथा समाजशास्त्रीहरूको संयुक्त टोलीद्वारा गरिएको छ। आयोजनाको वातावरणीय प्रभाव अध्ययनको लागि स्थलगत सर्वेक्षण कार्य सन् २०१६ र २०१८ मा गरिएको थियो। अध्ययनको क्रममा विभिन्न अध्ययन विधि जस्तै सन्दर्भ सामग्रीहरूको पुनरावलोकन, विज्ञहरूको टोलीद्वारा स्थलगत सर्वेक्षण, नमुना परीक्षण, आयोजनाबाट प्रभावित परिवारहरूको घरधुरी सर्वेक्षण, सरोकारवालाहरूसँग समुहगत छलफल र अध्ययनका प्रारम्भिक नतिजाउपर सरोकारवालाहरूसँग छलफलहरू रहेका छन्।

४. विद्यमान वातावरणीय अवस्थाको विवरण

४.१ भौतिक वातावरण

आयोजना क्षेत्र लेसर हिमालय क्षेत्रमा पर्दछ र यो क्षेत्र समुद्र सतहबाट करीव ६०० मी. देखि ८०० मी. उचाइसम्म रहेको छ ।

बुढीगंगा नदीको औषत वहाव ५३.४ घन मी./प्रति सेकेण्ड रहेको छ भने औषत न्यूनतम तथा अधिकतम मासीक वहाव क्रमशः ९.९० घन मी./प्रति सेकेण्ड (January) तथा १९७.०२ (August) घन मी./प्रति सेकेण्ड रहेको छ । आयोजनाका मुख्य संरचनाहरु जस्तै बाँध, Inlet portal, सुरुङ्ग र विद्युतगृह बुढीगंगा Gneiss मा रहेका छन् ।

आयोजनाको प्रस्तावित बाँधस्थलमा विभिन्न समयमा (दः३० देखि १९:००) रेकर्ड गरिएको ध्वनीको औषत स्तर L_{10} 61 dBA र L_{90} 57 dBA तथा विद्युतगृह स्थलमा L_{10} 52 dBA र L_{90} 42 dBA रहेको छ । विद्युतगृह क्षेत्रको अधिकतम तापक्रम ३८.१८ डिग्री से. (March, 2017) तथा न्यूनतम तापक्रम ३.०५ डिग्री से. रेकर्ड गरिएको छ ।

४.२ जैविक वातावरण

४.२.१ स्थलीय वातावरण

आयोजना क्षेत्रमा पाईने वन सालको बाहुल्यता रहेको मिश्रित वन रहेको छ । यस क्षेत्रमा पाईने मुख्य वनस्पतिहरुमा साल, खयर, हल्दु, सेतो शिरिष, कालो शिरिष, भोर्ला, बडकाउलो, गुहेलो, खनायो, सिन्दुरे, खिर्रो, भिमल र अमला रहेका छन् । आयोजना स्थलका सबै वनहरु सामुदायिक वन उपभोक्ता समुहहरुले व्यवस्थापन गरेका छन् ।

आयोजना क्षेत्रमा १३ प्रजातिका जनावरहरु पाईएका छन् । आयोजना क्षेत्रमा पाईने मुख्य प्रजातिका जनावरहरुमा बाँदर, लङ्गुर बाँदर, स्याल, बदेल र मृग रहेका छन् । आयोजना क्षेत्रमा कुल ४७ प्रजातिका चराहरु पाईएका छन् । यो क्षेत्र चराहरुको आप्रवासन मार्गमा पर्दैन । काग (वन/घर), सारौ (मैना) र सुगा यस भेगमा पाईने मुख्य चराहरु हुन । आयोजना क्षेत्रमा ६ प्रजातिका सरीसृपहरु पाईन्छन् । आयोजना क्षेत्रमा पाईने १३ प्रजातिका स्तनधारी जनावरहरुमध्ये ६ प्रजातीका जनावरहरु साइटिस सूचीमा तथा १२ प्रजातिका जनावरहरु IUCN को रातो सूचीमा सूचीकृत गरिएका छन् । आयोजना क्षेत्रमा पाईने चराहरुमा ३२ प्रजातिका IUCN को रातो सूचीमा सूचीकृत छन् भने एक प्रजाति साइटिस सूचीमा समावेस गरिएको छ ।

४.२.२ जलीय वातावरण

सर्वेक्षण र स्थानीय व्यक्तिहरुले दिएको जानकारीका अनुसार बुढीगंगा नदिमा कुल २५ प्रजातिका माछाहरु पाईन्छन् । चुच्चे असला, कत्ले, गर्दि, ठेड, वाम, कालंच र सहर प्रजातिका माछाहरु सर्वेक्षणको क्रममा पाईएका छन् । बुढीगंगा नदीमा पाईने माछाहरु मध्ये २१ प्रजातिका माछाहरु IUCN को रातो सूचीमा पर्दछन् ।



४.३ सामाजिक आर्थिक तथा सांस्कृतिक वातावरण

आयोजना क्षेत्रको कूल जनसंख्या १८,९२६ रहेको छ। जसमध्ये ४५.७% पुरुष तथा ५४.३% महिला छन्। आयोजना क्षेत्रमा जम्मा ३,५६३ घरधुरी छन् तथा औषत परिवार संख्या ५.३० छ। आयोजना क्षेत्रमा बसोवास गर्ने १० भन्दा बढी जात/जातिहरूमा क्षेत्री (६२.९%) तथा दलित (२९.२%) को बाहुल्यता रहेको छ। आयोजना क्षेत्रको साक्षरता दर ६० % रहेको छ। आयोजना क्षेत्रमा खानेपानीको मुख्य श्रोत धाराको पानी (६९.७%) रहेको छ भने अन्य स्रोतहरूमा मूल (१८.५%), कुवा (९.४ %) र नदी/नाला रहेका छन्।

५. वातावरणीय प्रभाव

५.१. सकारात्मक प्रभावहरू

निर्माण चरण:

- आयोजनामा दक्ष, अर्धदक्ष तथा अदक्ष गरी कूल ४०० जना व्यक्तिहरूले रोजगारी पाउनेछन्।
- व्यापार व्यवसाय जस्तै पसल/किराना पसल, होटल/लज, रेष्टुरेन्ट र चिया पसलहरूको संख्यामा वृद्धि तथा घर बहालमा लगाउने कार्यमा वृद्धि।
- स्थानीय व्यक्तिहरूको सुरुङ निर्माण, ठुला/भारि यन्त्रहरूको संचालन, डकमी, सुख्खा पर्खाल लगाउने, गेविन पर्खाल लगाउने र वायो इन्जिनियरिङ जस्ता प्राविधिक कामको ज्ञान/सीपमा वृद्धि।
- आयोजना क्षेत्रमा नगद प्रवाह, सरकारी र गैरसरकारी कार्यालयहरूको स्थापना, बजारीकरण, बैंक, स्वास्थ्य र शैक्षिक संस्थाहरूको स्थापना आदिले गर्दा आर्थिक क्रियाकलापहरूमा वृद्धि हुने।

संचालन चरण:

- जलविद्युत केन्द्र संचालनका लागि ३० जना व्यक्तिहरू लाई रोजागारीका साथै केन्द्रको मर्मत संभारको बेला स्थानीय लाई आवधिक रोजगारीको अवसर प्राप्त हुने।
- आयोजनाबाट १०९.६१ मेगावाट घण्टा विद्युत उत्पादन भई राजश्व तथा देश विकासमा सघाउ पुग्ने।
- आयोजना क्षेत्रमा राम्रो पूर्वाधार र सेवा सुविधा उपलब्ध भई जग्गाको मूल्य वृद्धि एवं पर्यटन विकासमा सकारात्मक असर पर्ने।

५.२ नकारात्मक प्रभावहरू

५.२.१ भौतिक वातावरण

निर्माण पूर्व:

- बाँधस्थल तल नदीको दुवैतर्फका गोरेटो बाटोहरूलाई अन्य ठाँउ बाट लैजाने।



निर्माण चरण:

- आयोजनाको कार्यान्वयनले २०.८४ हे. खेतीयोग्य जमिन (खेत), १२.१५ हे. वन, ५ हे. पर्ती जग्गा तथा १३.७५ हे. खोला वगर आदि गरी कूल ५१.७४ हे. भू-उपयोग प्रभावित हुने ।
- विभिन्न मेसिनहरूको संचालन, सवारी साधनहरूको ओहोर दोहोरो र विष्फोटन जस्ता कार्यहरूले गर्दा धुलोको तथा ध्वनीको मात्रामा वृद्धि ।
- करिब ३,१८,१५० घन मी. काम नलाग्ने माटो/दुङ्गाको व्यवस्थापन, सिमेन्ट तथा अन्य पेट्रोल जन्य रसायनिक पदार्थबाट नदीको पानी धमीलो हुनुका साथै नदी प्रदूषणको मात्रा बढ्न सक्ने ।
- फोहोरको उचित व्यवस्थापन नहुँदा वायु, जल र माटोमा प्रदूषणको प्रभाव बढ्न सक्ने ।

संचालन चरण:

- नदीमा पानीको मात्रा बढ्ने/घट्ने हुनाले गर्दा पानीको बहावमा परिवर्तन तथा वालुवा थुप्रिने प्रक्रियामा परिवर्तन भई भू-क्षय तथा पहिरोको समस्या उत्पन्न हुन सक्ने ।
- वाटो नजिक बस्तीको विस्तार, पुर्वाधार निर्माण आदिले गर्दा भू-उपयोगमा परिवर्तन हुन सक्ने ।

५.२.२ जैविक वातावरण**५.२.२.१ स्थलीय वातावरण****निर्माणपूर्व:**

- आयोजना निर्माणले १८.२० हे. वन क्षेत्र अधिग्रहण हुने जसमध्ये ५ वटा सामुदायिक वनहरूको १२.१५ हे. वनक्षेत्र तथा ६.०५ हे. वनसित जोडिएका खोला तथा वगर पर्दछन् ।
- सामुदायिक वनभित्र रहेका १६ प्रजातिका ४,८०९ वटा रुखहरूको (४४८१ बल्ला आकारका र ३२८ रुख आकारका) नोक्सानी हुने ।
- आयोजना निर्माण क्षेत्रमा असुरो, अमला, जामुन, ऐसेलु तथा सिस्ना जस्ता गैरकाष्ठ वन पैदावार प्रजातिका विरुवाहरूको नोक्सानी हुने ।

निर्माण चरण:

- आयोजनाको लागि आवश्यक कामदारहरूले गर्दा स्थानीय स्तरमा दाउराको मागमा वृद्धि भई स्थानीय वनमा चाप पर्न सक्ने ।
- निर्माण कार्यले वन्य जन्तुको आहार बिहारमा असर पर्न सक्ने ।

संचालन चरण:

- साल तथा अन्य महत्वपूर्ण काठ प्रजातिका रुखहरूको अवैधानिक कटानीमा वृद्धि हुने ।



निर्माण चरणः

- निर्माण गतिविधि तथा काम नलाग्ने माटो/ढुङ्गा फाल्नाले माछाको वासस्थानमा असर पर्न सक्ने ।

- लामो दुरी तथा मध्यम दुरी सम्म ओहोर दोहोर गर्ने माछाको आवत जावतमा असर पर्न सक्ने
- नदीको ६.८ कि.मी.खण्डमा पानीको मात्रा कम भई बाँध देखि जलविद्युत गृह खण्डमा पाईने माछालाई असर पर्न सक्ने ।

निर्माणपूर्वः

- आयोजना निर्माणको लागि ८० परिवारको १७.३४ हे. जग्गा अधिकरण हुने र यसवाहेक अस्थायी संरचनाहरुलाई ८ हे. निजी जग्गा भाडामा लिइने ।
- आयोजना निर्माणले १० परिवारहरुको ६ वटा कच्ची घरहरु तथा ५ वटा गोठहरु अधीकरण हनेछ ।

- निर्माणको समयमा हुने विभिन्न गतिविधिले चोटपटक लाग्ने तथा दुर्घटना बढ्न सक्ने ।
- स्थानीय खानेपानीको स्रोतहरुमा चाप बढ्नुका साथै स्थानीय बजारहरुमा पनि चाप पर्न सक्ने
- विभिन्न वर्ग, समुदाय तथा जात/जातिका धेरैकामदारहरु एकै ठाउँमा जुट्ने हुँदा कामदार-कामदार, कामदार-स्थानीय व्यक्ति तथा स्थानीय व्यक्ति र आयोजना व्यवस्थापन बिच निहित स्वार्थले विभिन्न विवादहरु श्रजना हुनसक्ने ।

- निर्माण कार्य सम्पन्न भए पछि आयोजना क्षेत्रमा आर्थिक क्रियाकलाप घट्न जानेछन् र यसले गर्दा स्थानीय व्यक्तिहरुको आयमा पनि कमी भई उनीहरुको जीवनशैलिमा असर पर्न सक्ने ।
- बाँधबाट पुर्व सूचना बिना पानी छाडिदा खोलाको नजिक भएका गाईवस्तु तथा मानिसहरु दुर्घटनामा पर्न सक्ने
- आयोजना निर्माणको लागि स्थायी रुपमा जग्गा अधिकरण हुन गई ४१.०६ मे.टन खाद्यान्नको उत्पादन तथा ५.९६ मे.टन नगदे बालीको उत्पादनमा वार्षिक कमी भई प्रभावित परिवारहरुको जीवनयापनमा असर पर्न सक्ने ।

५.३ समग्र प्रभावहरु:

विद्युत विकास विभागद्वारा प्रस्तावित बुढीगंगा खोला साना जलविद्युत आयोजना तथा बुढीगंगा जलविद्युत आयोजना (२० मे.वा.) हरुबाट वातावरणमा पर्न सक्ने समग्र प्रभावहरुको अध्ययन गरिएको छ।

६. वैकल्पिक अध्ययन

यस अन्तर्गत बुढीगंगा नदीमा १८ मेगावाट देखि २२ मेगावाट सम्मको विभिन्न ४ वटा विकल्पहरुको अध्ययन मेटकन कन्सल्टेन्ट प्रा.लि. द्वारा सन् १९९८ मा गरिएको थियो। यी विकल्पहरु मध्ये सम्भाव्यता अध्ययनको क्रममा विकल्प १ उत्तम विकल्प देखिएकाले यसको आधारमा विकल्प १ को विस्तृत ईन्जिनियरिङ डिजाईन गरिएको छ।

संभव भए सम्म स्थानीय श्रोतको अधिकतम सदुपयोगका साथै सघन प्राविधिक निर्माण यन्त्र हरुको प्रयोग गर्ने निर्माण पद्धति अँगालीने छ। भूसतही निर्माण कार्य सुख्खा मौसममा गरिने छ।

७. अभिवृद्धि तथा न्यूनीकरणका उपायहरु

प्रस्तावित अभिवृद्धि तथा न्यूनीकरणका उपायहरु लागु गर्ने मुख्य दायित्व प्रस्तावकको हुनेछ। वातावरणीय प्रभाव न्यूनीकरणका कार्यक्रमहरु सरोकारवाला निकायसँग समन्वय गरी गरिने छ।

७.१ सकारात्मक प्रभाव अभिवृद्धिका उपायहरु

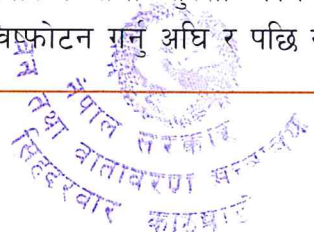
स्थानीय व्यक्तिहरुलाई आयोजना निर्माण र आयोजनाका अन्य कार्यमा रोजगारीका लागि दक्षता अनुसार प्राथमिकता दिईने छ। प्राथमिकता तय गर्दा आयोजनाबाट व्यक्तिहरुमा पर्न गएको प्रभावको आधारमा गरिने छ।

७.२ नकारात्मक प्रभाव न्यूनीकरण तथा अभिवृद्धिका उपायहरु

७.२.१ रोकथाम तथा बचाउका उपायहरु

भौतिक वातावरणमा पर्न सक्ने प्रभाव न्यून गर्न अस्थाई रुपमा आवश्यक पर्ने जग्गा कमसल खालको प्रस्ताव गरिएको छ भने सतही खन्ने कार्य सुख्खा समयमा गर्ने, ब्लाष्टिङ न्यून गर्ने तथा क्रसिड प्लान्ट वस्ती तथा संवेदनशील क्षेत्र भन्दा टाढा राख्ने प्रस्ताव गरिएको छ। कर्मचारीहरुको लागि केन्द्रीय भोजन गृहको व्यवस्था, वनक्षेत्रमा कामदारहरुलाई अनावश्यक रुपमा हिँडुलमा रोक, सूचनामूलक तथा निर्देशनात्मक होर्डिङ बोर्डको व्यवस्था, कामदार परिचालन गरी रुखहरुको कटानी र कानुनी प्रावधान अनुसार चोरी सिकारी नियन्त्रण जस्ता सुरक्षात्मक उपायहरु जैविक वातावरणमा पर्न सक्ने प्रभाव रोकथाम गर्न प्रस्ताव गरिएको छ।

स्वास्थ्य तथा सुरक्षा कार्ययोजना, आयोजनाका सवारी साधनहरुको संचालन निर्देशिका, विस्फोटन गर्नु अघि र पछि साईरन बजाउने, सुपथ मूल्य पसल संचालन, स्थानीयको मागमा



असर नपर्ने गरी खानेपानीका श्रोतको प्रयोग, जात वर्ण, लिङ्ग र उत्पत्ति स्थानको विभेद बिना रोजगारीमा समान अवसर, सामाजिक, आर्थिक र सांस्कृतिक वातावरणीय प्रभाव रोकथाम तथा बचाउ गर्न मुख्यरूपमा प्रस्ताव गरिएका छन् ।

७.२.२ न्यूनीकरण तथा अभिवृद्धिका उपायहरु

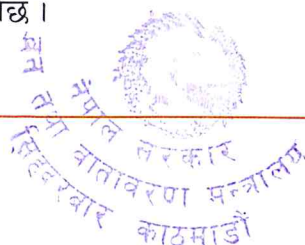
७.२.२.१ भौतिक वातावरण

- संरचना निर्माण गर्दा कटान गरिएको भिरालो जग्गालाई जैविक इन्जिनियरिङ्ग प्रविधि प्रयोग गरी व्यवस्थापन गरिनेछ ।
- अस्थायी रूपमा प्रयोग गरिएको जग्गा लाई पुरानै रूपमा व्यवस्थित गरिने छ र मौजुदा जग्गाको भिरालोपन लाई व्यवस्थित गरिनेछ ।
- सुख्खा तथा गर्मी याममा बाटो तथा अन्य निर्माण क्षेत्रमा कम्तिमा दिनको २ पटक पानी छर्किने छ ।
- आयोजना अन्तर्गत संचालित सवारी साधनहरुलाई मापदण्ड अनुसार संचालन गरिनुका साथै बढि ध्वनी हुने निर्माण क्षेत्रमा ध्वनी प्रदुषण कम गर्ने उपायहरु अवलम्बन गरिनेछ ।
- वेचिङ्ग प्लान्टबाट निस्कने फोहोर र ट्रक सफा गरेको पानीलाई बिर्सजन पूर्व थिग्राउने टंकीमा संकलन गरिनेछ ।
- प्रत्येक क्यापमा स्याप्टी टैंक सहितको चर्पीको व्यवस्था गरिने छ ।
- सुरुङ्ग तथा अन्य क्षेत्रबाट निस्कने माटो तथा ढुङ्गाहरुलाई बिर्सजन गर्ने ठाउँलाई उचितरूपमा व्यवस्थापन गरिनेछ ।
- उपरोक्त कार्यहरु लागु गर्ने मुख्य दायित्व ठेकेदारको हुनेछ । यसको सुनिश्चितताका लागि ठेक्का सम्झौतामा उक्त कुराहरु सर्तका रूपमा राखिने छन् ।

७.२.२.२ जैविक वातावरण

७.२.२.२.१ स्थलीय वातावरण

- प्रस्तावकले स्थायी रूपमा प्रयोग गर्ने आवश्यक १८.२० हे. वन क्षेत्रको जग्गाको सट्टाभर्ना वापत सम्बन्धित वन कार्यालयलाई जग्गा उपलब्ध गराउनेछ अथवा सो वापतको एकमुष्ट रकम वन विकास कोषमा जम्मा गरिनेछ ।
- प्रस्तावकले रुखहरु काटेको वापतका १:१० अनुपातमा ४८,०९० विरुवाहरु वृक्षारोपण गर्ने छ । यसका अतिरिक्त १८.२० हे. वन क्षेत्रको जग्गा स्थायीरूपमा लिएको वापतप्रति हे. १,६०० विरुवाका दरले २९,१२० विरुवाहरु वृक्षारोपण गर्ने छ ।
- प्राथमिकता प्राप्त आयोजनालाई वन क्षेत्रको जग्गा उपलब्ध गराउने कार्यविधि २०७६ वमोजिम प्रस्तावकले वृक्षारोपण क्षेत्रको ५ वर्ष सम्म व्यवस्थापन गर्नेछ वा वृक्षारोपण र व्यवस्थापन खर्चवापत आवश्यक रकम वन विकास कोषमा जम्मा गरिनेछ ।
- आयोजना क्षेत्रका सामुदायिक वनको आय वृद्धि गर्ने उद्देश्यले ३०,००० गैह्र काष्ठ वन पैदावारका विरुवाहरु वितरण गरिनेछ ।



- मजदुर, सुपरभाइजर तथा स्थानीय व्यक्ति तथा सामुदायिक वनका प्रतिनिधिहरूलाई वन संरक्षण सम्बन्धी २ ठाँउमा सचेतना मुलक तालिम दिइनेछ ।
- वन संरक्षण सम्बन्धी सचेतना/जानकारी मुलक होडीङ्ग बोर्डहरु र सर्तकता चिन्हहरु सार्वजनिक स्थान तथा निर्माण क्षेत्रमा राखिने छन् ।
- सामुदायिक वन उपभोक्ता समुहका प्रतिनिधिहरूलाई सामुदायिक वन व्यवस्थापन, अभिलेखन र वन क्षेत्रभित्र आयआर्जन गर्ने सम्बन्धी तालिमहरु दिइनेछ ।
- आयोजनामा कार्यरत कामदार, सुपरभाइजर तथा स्थानीय व्यक्तिहरूलाई वन्यजन्तु सम्बन्धी सचेतना तालिम दिइनेछ ।

७.२.२.२ जलीय वातावरण

- माछाको ओहोर दोहोर निर्वाध रुपमा गर्नका फिसपास को निर्माण तथा संचालन प्रस्ताव गरिएको छ ।
- माछामा पर्ने प्रभावलाई कम गर्न पानी कम हुने ६.८७ कि.मी. नदी खण्डमा ७ महिना सुख्खा याममा माछा मार्न रोक लगाइनेछ ।
- पानीको बहाव कम हुने समयमा (वर्षको ५ महिना) न्यूनतम ०.९९ घन मीटर प्रति सेकेण्ड पानी र वर्षको २ महिना (March & April) असलाको प्रजनन समयमा १.२ घन मीटर प्रति सेकेण्ड पानी बाँधवाट छोडिनेछ ।
- पानीको बहाव कम हुने क्षेत्र अर्दोली र बुढीगंगाको दोभानदेखी जलविद्युत गृहवाट पानी छाडीने ठाँउसम्म २०मी. x ५ मी. का १-१.५ मी. गहिरा ३ वटा पोखरीजस्ता वासस्थानहरु निर्माण गर्ने ।

७.२.२.३ सामाजिक आर्थिक तथा सांस्कृतिक वातावरण

- प्रस्तावकबाट आयोजना निर्माणको लागि स्थायी रुपमा आवश्यक पर्ने जग्गा र घर तथा गोठहरुको नियमानुसार अधिकरण प्रक्रिया शुरु भईसकेको छ ।
- अस्थायी रुपमा आवश्यक पर्ने जग्गा सम्बन्धित जग्गा धनीसंग कबुलियतमा लिईनेछ र प्रत्येक वर्षको कबुलियत रकम अग्रिम रुपमा भुक्तानी गरिने छ ।
- आयोजनालाई आवश्यक पर्ने घर र गोठको क्षतिपूर्ति दिइने छ ।
- आयोजनाबाट हानी नोक्सानी हुने निजी विरुवाहरुको उचित क्षतिपूर्ति दिइने छ ।
- आयोजनाबाट हुने वालीनालीको क्षतिपूर्ति वापत बजार मूल्य बराबर रकम उपलब्ध गराईने छ ।
- आयोजना सम्बन्धि आधिकारिक सार्वजनिक सुचना प्रवाह गर्न आयोजनामा एक सार्वजनिक सुचना केन्द्रको स्थापना गरिने छ ।
- स्थानीय गैरसरकारी संस्था, क्लव तथा सांस्कृतिक समूहहरु र महिला समूहहरु लाई उनिहरुको संस्कृति संरक्षण र विकास गर्न सांस्कृतिक कार्यक्रमक संचालनका लागि आवश्यक सहयोग गरिने छ ।



- आयोजनावाट प्रभावित ५ महिला घरमुल/परिवारका सदस्यलाई ३ महिने सिलाई वुनाई तालिम र सहयोग दिईनेछ, तथा ४ वटा दलित परिवारका सदस्यलाई रुचि अनुसारको ३९० घण्टाको सीपमूलक तालिमहरु दिईनेछ ।
- निर्माण क्षेत्रमा एक मेडिकल डाक्टर, हे.अ.र नर्स सहितको क्लिनिकको स्थापना गरिनेछ ।
- निर्माण कार्यमा संलग्न कामदारहरुका लागि कम्तिमा प्रत्येक ३/३ महिनामा स्वास्थ्य तथा निर्माण सुरक्षा सम्बन्धी सुरक्षा तालिम संचालन गरिने छ । यस बाहेक कामदारहरुको लागि प्रत्येक ६ महिनामा आकस्मिक तयारी वारे तालिम र स्थलगत अभ्यास गराइने छ ।
- आयोजना वाट १०%-२५% सम्म जग्गा पर्ने प्रभावित २५ परिवारका लागि कृषी सहयोग कार्यक्रम संचालन गरिनेछ ।
- आयोजनाले ७५% देखि १००% सम्म जग्गा पर्ने १० घर परिवारलाई एकपटकलाई आय आर्जनको नयाँ/थप कार्य शुरु गर्न प्रतिघरधुरी रु २,००,०००/- सहयोग उपलब्ध गराउने छ ।
- आयोजनावाट प्रभावित परिवारहरुलाई वाली ह्यास वापत रु ३५,४७३/- का दरले २ वर्षको रकम उपलब्ध गराईनेछ ।
- आयोजनावाट प्रभावित ६ परिवारहरुलाई एक पटकलाई घर भत्काउन र ती सामाग्री ढुवानि गर्न यातायात खर्च रु १०००० र प्रतिस्थापन भत्ता रु १५००० गरि रु २५००० उपलब्ध गराईनेछ ।

७.२.३ सामुदायिक सहयोग कार्यक्रम

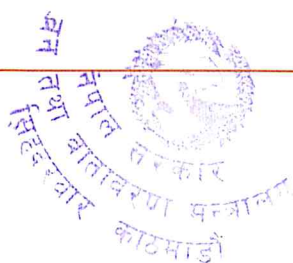
- आयोजनावाट प्रभावित नगरपालिका तथा गाउँपालिकाका सम्बन्धित वडा वाट ५ जना प्रतिनिधित्व हुने गरी कुल ३० जना विपन्न परिवारका व्यक्तिहरुलाई धारा/पाइप जडान, विजुली जडान, सवारीचालक आदि सीपमूलक तालिम प्रदान गर्ने ।
- आयोजनाले सामाजिक सहयोग कार्यक्रम अन्तर्गत खानेपानी, सिंचाई, विद्यालय, स्वास्थ्य तथा सरसफाई जस्ता आधारभूत क्षेत्रमा सहयोगका कार्यक्रमहरु संचालन गर्नेछ । आयोजनाले सांस्कृतिक समूहहरुलाई स्थानिय संस्कृति संरक्षण र विकास गर्न सहयोग गर्नेछ ।

८. वातावरणीय व्यवस्थापन योजना

आयोजनाको वातावरणिय व्यवस्थापन योजना लागु गर्ने प्रमुख जिम्मेवारी प्रस्तावकको हुनेछ ।

८.१ वातावरणीय व्यवस्थापन कार्ययोजना

वातावरणिय व्यवस्थापनको अंगका रूपमा परमिट र स्विकृति योजना, पुर्नवास र पुर्नउत्थान योजना, निर्माण क्याम र ट्राफिक व्यवस्थापन योजना, प्रदुषण व्यवस्थापन योजना, फोहोर मैला व्यवस्थापन योजना, स्थलिय परिस्थितिकीय व्यवस्थापन योजना, जलचर परिस्थितिकीय व्यवस्थापन योजना, भूस्खलन एवं ढुङ्गा माटो व्यवस्थापन योजना, जन स्वास्थ्य एवं पेशागत सुरक्षा व्यवस्थापन योजना, आकस्मिक व्यवस्थापन योजना, गुनासो सम्बोधन योजना आदि रहेका



छन् । यी योजनाहरूमा योजनाका कृयाकलापहरू गर्ने समय, जिम्मेवारी, ठाउँ र सम्पर्क गर्ने निकायहरू खुलाईएका छन् ।

८.२ सँगठनात्मक व्यवस्था तथा उत्तरदायित्व

प्रस्तावित आयोजनाको वातावरणीय व्यवस्थापन कार्यको लागि आयोजना प्रमुखको कार्यालय, वातावरण अनुगमन इकाई, वातावरण तथा सामाजिक व्यवस्थापन इकाई, ठेकेदार, निर्माण व्यवस्थापन निरीक्षण परामर्शदाता, स्थानीय सम्पर्क मञ्च, संयुक्त अनुगमन समिति जस्ता संस्थाहरू प्रस्ताव गरिएका छन् । प्रस्तावित संस्थाहरूको वातावरणीय प्रभाव न्यूनीकरणका उपायहरू कार्यन्वयन र अनुगमन गर्न निश्चित जिम्मेवारी रहने छ ।

८.३ वातावरणीय अनुगमन:

आधारभूत, पालनात्मक तथा प्रभाव मूल्याङ्कन सम्बन्धी अनुगमन कार्यहरू प्रस्ताव गरिएका छन्। अनुगमन कार्य भौतिक, जैविक तथा सामाजिक आर्थिक र सांस्कृतिक पक्षको निर्माण पूर्व, निर्माण अवधि तथा संचालन चरणमा गरिनेछ ।

८.४ वातावरणीय परीक्षण:

वातावरण संरक्षण नियमावली २०५४ अनुसार प्रस्तावित आयोजनाको वातावरणीय परीक्षण कार्य वन तथा वातावरण मन्त्रालयले आयोजना सम्पन्न भएको २ वर्ष पछि गर्नेछ । वातावरणीय परीक्षण अन्तर्गत भौतिक, जैविक (स्थलीय, जलीय) तथा सामाजिक, आर्थिक र सांस्कृतिक वातावरणका विभिन्न पक्षहरू समावेश गरिनेछन् ।

८.५ वातावरणीय व्यवस्थापन लागत:

यस आयोजनाको वातावरणीय व्यवस्थापन कार्यको लागत रु. १४२.६२ मिलियन अनुमान गरिएको छ जुन आयोजनाको कुल लागतको २.६२% हुन आउँछ । यस बाहेक वातावरणीय परीक्षण कार्यको लागि रु. १.१७ मिलियन प्रस्ताव गरिएको छ ।

९. सान्दर्भिक नीति, ऐन, नियम, निर्देशिका तथा सन्धीहरूको पुनरावलोकन

आयोजनासँग सम्बन्धित नीति, ऐन, नियम, निर्देशिका तथा सन्धीहरूको पालनागर्ने पूर्ण दायित्व प्रस्तावकको हुनेछ । नीति तथा योजनाहरूमा १५ औं आवधिक योजनाको अवधारणा पत्र, २०१९, भू उपयोग निति २०१५, राष्ट्रिय जग्गा निति २०१९, वन निति २०१९, राष्ट्रिय वातावरण नीति २०१९, राष्ट्रिय जलवायु परिवर्तन निति २०१९, तथा विद्युत विकास निति २००१ लाई प्रतिवेदन तयारीको क्रममा पुनरावलोकन गरिएको छ । यसै गरि वातावरण संरक्षण ऐन २०१९, भू उपयोग ऐन २०१९, उपभोक्ता संरक्षण ऐन २०१८, संकटापन्न वन्यजन्तु तथा वनस्पतिको अन्तर्राष्ट्रिय वयापार नियमन तथा नियन्त्रण ऐन २०१७, विद्युत ऐन १९९२ श्रम ऐन २०१७ तथा जग्गा अधिग्रहण ऐन १९७७ लाई पुनरावलोकन गरिएको छ । वातावरणीय अध्ययनको क्रममा वातावरण संरक्षण नियमावली १९९७, विद्युत नियमावली १९९३ तथा वन नियमावली १९९५ लाई पुनरावलोकन गरिएको छ ।

नेपाल सरकार
वातावरण मन्त्रालय
सिंहदरबार काठमाडौं

१० जनसम्पर्क

आयोजनाको जनसम्पर्क कार्य आयोजनाको क्षेत्र निर्धारण तथा कार्यसूची तैयारीको समयमा ई.सं. २०१६ देखि शुरु गरिएको थियो । वातावरणीय प्रभाव मूल्याङ्कनका समयमा ११ वटा वडास्तरीय द्रुत लेखाजोखा, ५ वटा समुहगत छलफल, १४ जना मुख्य व्यक्तिहरु संग अन्तरवाता, १२ ठाउँमा बजार सर्भेक्षण र आयोजना बाट प्रत्यक्ष प्रभावित ८० परिवारहरुको सामाजिक र आर्थिक सर्वेक्षण April २०१८ मा गरिएको थियो ।

वातावरणीय प्रभाव मुल्याङ्कन मस्यौदा प्रतिवेदन उपर स्थानीय व्यक्तिहरुको राय सुभाब लिने उद्देश्यले साँफेबगर नगरपालिका वडानं. १० ठाँटीवजारमा सार्वजनिक सुनुवाई कार्यक्रम भाद्र २१, २०७५ मा गरिएको थियो । उक्तकार्यक्रममा विभिन्न जातजाति, पेशा र व्यवसायका कूल १६४ जना व्यक्तिहरु सहभागी भएका थिए । कार्यक्रममा सहभागी सरोकावालाहरुको रायसुभाब सङ्कलन गरि प्राप्त रायसुभाबहरुलाई वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदनको सान्दर्भिक ठाउँमा समावेश गरिएको छ ।

११. उपसंहार

वातावरणीय प्रभाव मूल्याकन प्रतिवेदनले देखाए बमोजिम आयोजनाबाट वातावरणमा पर्न सक्ने प्रभावहरु न्यून देखि मध्यम खालका छन् जसलाई उचित व्यवस्थापन गर्न सकिन्छ र प्रस्तावित आयोजना वातावरणीय हिसाबले सम्भाव्य छ ।



EXECUTIVE SUMMARY

1. Introduction

Budhi Ganga Hydropower Project is proposed by Ministry of Energy, Water Resources and Irrigation (MoEWRI), Department of Electricity Development (DoED) on Budhi Ganga River. The Environmental Impact Assessment (EIA) of the proposed project was carried out as per the Environment Protection Rules, 1997. This EIA includes only the generation aspects of the project including project components road and facilities. The transmission line component is beyond the scope of the present study.

2. Project Description

The proposed Budhi Ganga Hydropower Project (BHP) is in Achham and Bajura districts of Sudurpaschim Pradesh of Nepal. The project covers ward number 4, 10 and 13 of Sanfebagar Municipality and ward no. 4 and 8 of Mellekh Rural Municipality of Achham district, and ward number 10 of Budhiganga Municipality of Bajura district. The proposed project does not lie in protected areas such as national parks, conservation areas, wildlife sanctuaries, buffer zones or any other environmentally sensitive and fragile areas. The project site is connected with the Sanfe-Martadi Road.

The proposed Dam site is about 200m downstream of the confluence of river Budhi Ganga and Ikri Gad. The dam is 44m high from the foundation level and 86m long concrete gravity structure with gated spillways and a fish ladder. The reservoir will extend up to 2.06 km upstream of the dam and will have a surface area of about 13.43ha. The water conveyance system, comprising a 5.58 km long headrace tunnel, underground surge shaft, 185.15m long penstock which transports water to surface powerhouse located close to Thapagaun. Water exiting the powerhouse rejoins Budhi Ganga River through a box culvert type tailrace.

The proposed project is Pondage Run of River (PRoR) scheme. The project has an installed capacity of 20 MW. The design discharge of 26 m³/s. The estimated cost of the project is NRs. 5,450.32 million, and its estimated construction period is four years.

3. Data Requirement and Study Methodology

A multidisciplinary team of experts which comprised of Environmental Expert, Environmental Engineer, Botanist, Wildlife Biologist, Fisheries Expert, Socio-economist and Sociologist conducted the EIA of the project. The fieldwork for EIA was conducted in 2016 and 2018. The various methodologies applied for study included literature review, field survey by the team of experts, sampling, household survey, group meetings with stakeholders and public consultation on preliminary findings of the EIA.

4. Description of the Existing Environment

4.1 Physical Environment

The project area lies in the Lesser Himalayan zone, with elevations ranging from 600 masl to 800 masl. The mean monthly flow of the Budhi Ganga River is 53.04m³/s. The minimum and maximum monthly flow recorded at the headworks is 9.90 m³/s in the month of January and 197.02 m³/s in the month of August. The project components like reservoir, diversion, inlet portal, headrace tunnel, adit and powerhouse lie on Budhi Ganga Gneiss.

The noise pressure level of the site recorded in different time zone (8.30 to 19:00 hours) shows that average noise level of L10 and L90 is 61dBA and 57 dBA at Dam area and 52 dBA and 42 dBA in Powerhouse area. The maximum temperature recorded at powerhouse site is 38.18°C in March 30, 2017 whereas minimum temperature recorded at same site is 3.05°C.

4.2 Biological Environment

4.2.1 Terrestrial Environment

The vegetation in this area is dominated by mixed forests predominantly composed of Sal (*Shorea robusta*) forests. The major vegetation of this area include Sal (*Shorea robusta*), Khair (*Acacia catechu*), Haldu (*Haldina cordifolia*), Seto Siris (*Albizzia procera*), Kalo Siris (*A. lebbek*), Botdhairo (*Lagerstroemia parviflora*), Bhorla (*Bauhinia vahlii*), Badkaulo (*Casearia sp*), Guelo (*Callicarpa arborea*), Khanayo (*Ficus cunia*), Sindure (*Mallotus philippinensis*), Bhimal (*Grewia oppositifolia*) and Amala (*Phyllanthus emblica*). All the forest resources of the project sites are managed by community forest user groups.

Thirteen species of mammals are found in project area. The major mammal species found in project area are Rhesus Monkey (*Macaca mulatta*), Langur (*Semnopithecus hector*), Jackal (*Canis aureus*), Eurasian Wild Boar (*Sus scrofa*) and barking deer (*Muntiacus muntjak*).

Forty-seven species of birds are reported from the project area. Bird migration route is not found in project area. The common bird species found in project area are Rose Ringed Parakeet (*Psittacula krameri*), Common Myna (*Acridotheres tristis*), Jungle Crow (*Corvus macrorhynchos*) and House Crow (*Corvus splendens*). Six species of reptiles are found in project area.

Of the 13 mammal species found in the project area six species fall in CITES category whereas 12 species are listed in IUCN red list. Thirty two bird species falls in IUCN red list and one species is categorized in CITES category.

4.2.2 Aquatic Environment

Fish sampling along the Budhi Ganga River and local information collected in the field reveal the presence of 25 species of fish. Chuche Asala, Asala, Katle, Gardi, Thed, Kalach and Mahseer are the main fish species recorded from Budhi Ganga River. Out of 25 species reported from Budhi Ganga River 21 species are listed in IUCN red list.

4.3 Socio-economic and Cultural Environment

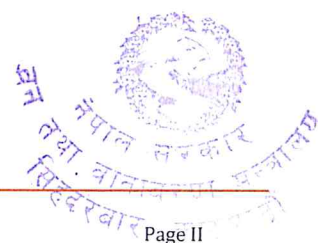
The total population of the project area is 18,926 consisting of 45.7% male and 54.3% female. The total number of households in the project area is 3,563 and the average household size is 5.30 persons. There are more than 10 different caste/ethnic groups dominated by Chhetri caste/ethnic groups (62.9%) followed by Dalits (29.2%). The literacy rate of the project area is 60.0%. The major sources of drinking water for the households of the project area are tap/piped water (69.7%) followed by spout water (18.5%), well (9.4%) and river/stream.

5. Environmental Impact

5.1 Positive Impacts

Construction Phase

- Employment to 400 persons (skilled, semi-skilled and un-skilled).



- Increase in enterprises development such as teashops, house rental, groceries, hotels, lodges and restaurants.
- Enhancement of technical skill in the areas of tunnel construction, heavy equipment operation, masonry, construction of dry walls, gabion walls and bio-engineering.
- Growth in economic activities in the project area due to increase in cash inflow, opening of commercial banks, government and non-government offices, development of market/growth centers, health and educational institutions etc.

Operation Phase

- Employment opportunity to 30 persons for the operation of the power plant. In addition, some people will get employment opportunity during periodic maintenance of the power plant.
- Revenue generation and contribution in national development by providing 109.61GWh of renewable energy.
- Contribute in tourism development and increase in land value of the area by providing better facilities and infrastructure

5.2 Adverse Impacts

5.2.1 Physical Environment

Pre-construction

- Relocation of foot trails found both bank of river below the dam site

Construction Phase

- Changes in land use pattern of 51.74 ha area which consist 20.84 ha cultivated land (Khet), 12.15 ha forest area, 5 ha barren land and 13.75 ha river and flood plain.
- Likely increase in noise and dust levels due to operation of equipment's, movement of vehicles and blasting activities.
- Likely increase in river turbidity, sedimentation and pollution by petrochemicals, cement washed out and disposal of 318,150 m³ spoil material.
- Impact on air, water and soil quality due to inadequate disposal of waste material.

Operation Phase

- Changes in river morphology and sedimentation pattern due to diversion of water and fluctuation of the water level may trigger the erosion and landslides.
- Indirect activities due to increase in road side settlement, construction of infrastructures and facilities may affect the land use of the area.

5.2.2 Biological Environment

5.2.2.1 Terrestrial Environment

Pre-Construction Phase

- Acquisition of 18.20 ha forest land consisting 12.15 ha forest area belonging to 5 community forests and 6.05 ha river and flood plain connected with forest.



- Loss of 4809 standing trees (4481 poles and 328 trees) of 16 species belong to community forest.
- Loss of seedlings of the non-timber forest species Asuro, Amala, Jamun, Aiselu and Sisno.

Construction Phase

- Likely increase in pressure on local forest resources due to increase in demand of firewood and timber.
- Construction disturbances and likely impact on feeding and normal movement of mammals.

Operation Phase

- Increase in illegal harvest of Sal and other important wood.

5.2.2.2 Aquatic Environment

Construction Phase

- Disturbance to aquatic habitat due to construction activities, spoil disposal and impact on spawning and rearing ground found in Budhi Ganga River.

Operation Phase

- Obstruction in upstream migration of long distance migrant and midrange migrant species found in lower reaches of Budhi Ganga River.
- Reduction in the flow of Budhi Ganga River particularly in 6.87 km section between the dam to powerhouse site will affect the fish found in this stretch.

5.2.3 Socioeconomic and Cultural Environment

Pre-Construction Phase

- Permanent acquisition of 17.34 ha of private land (Khet) owned by 80 households. In addition 8 ha private land will be taken on lease for the temporary facilities of the project.
- Acquisition of 6 houses (Kachi) and 5 cowsheds owned by 10 households.

Construction Phase

- Construction works in river, tunnel and slopes, blasting activities and use of heavy equipment may cause accidents and injuries.
- Increase pressure on drinking water sources and local market.
- Possibilities of conflict of interest between the workers and project management, and among the workers and local community.

Operation Phase

- The withdrawal or decrease in economic activities after construction may affect the life style of the local people since they will become reliant on more earnings from project construction.
- Possibilities of accidents to livestock and humans beings if water is suddenly released.
- Permanent reduction of 41.06 MT of cereal crops and 5.96 MT of cash crops may affect the livelihood of PAFs.



5.3 Cumulative Impacts

Department of Electricity Development proposed Budhi Ganga Khola Small Hydropower Project (10.85 MW) and Budhi Ganga Hydropower Project (20MW) in Budhi Ganga River. The cumulative impact assessment is done considering the impacts caused by both the projects.

6. Alternative Analysis

Four options of installed capacities, ranging 18 to 22 MW, were considered during the feasibility study conducted by METCON Consultant P. Ltd in 1998 and option 1 was selected based on the energy output, environmental consequences and economic analysis of the project. The current Detailed Engineering Design has been carried out on the recommended best alternative from the feasibility study.

Construction methodology will be based on intensive technologies of construction equipment and maximum utilization of local resources to the extent possible. The surface construction works will be carried out in dry season.

7. Mitigation and Enhancement Measures

The project proponent will have prime responsibility for implementation of the proposed mitigation and enhancement measures. The mitigation program will be implemented in coordination with line agencies.

7.1 Enhancement Measures for Positive Impacts

Priority will be given to employ local people in construction and other project activities as per their skill and qualification. Hiring preference will be given as per the magnitude of impact.

7.2 Mitigation and Enhancement Measures for the Adverse Impacts

7.2.1 Preventive and Avoidance Measures

Control blasting, surface excavation works in dry period, selection of lower value of agriculture land for temporary structures, selection of site for crusher plant far from the settlement and sensitive areas, and flushing and opening of gates in high flow periods are the main preventive and avoidance measures proposed for the physical environment.

Provision of central dining facility, prohibition of roaming outside workforce in forest area, placement of information and warning sign, manual clearance of trees, banned for hunting and poaching as per law are the main preventive and avoidance measures proposed for the biological environment.

Provision of health and safety plan, guideline for the operation of project vehicles, siren warning prior and after blasting, provision of fair price shop, use of drinking water source without disturbing the water requirement of local people and no discrimination based on gender, caste, colour or place of origin while hiring the workforce for the project are the main preventive and avoidance measures proposed for the socio-economic and cultural environment.



7.2.2 Mitigation and Enhancement Measures

7.2.2.1 Physical Environment

Slope of the cutting areas will be treated by applying proper bio-engineering measures. Land affected by the temporary facilities will be reclaimed and existing land slopes will be properly maintained.

- Water will be sprayed on the roads and construction sites, during hot and dry periods at least twice a day. All vehicles operating in the construction area will be maintained regularly as per the manufacturer's specifications. Noise barrier such as bund, thick plywood fence will be constructed at noise prone construction sites.
- The waste generated from batching plants and truck wash down will be diverted to settling tanks before disposal.
- Toilets with septic tanks will be provided in all camps.
- The muck disposal areas will be managed properly

The contractor will be responsible for the implementation of above mentioned programs and it will be ensured through contract clauses.

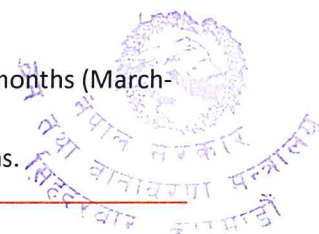
7.2.2.2 Biological Environment

7.2.2.2.1 Terrestrial Environment

- The proponent will purchase 18.20 ha land for replacement of permanently acquired forest land and handed to concerned forest office or deposit equivalent amount in forest development fund.
- The proponent will plant 48,090 saplings for the loss of tress at 1:10 tree. In addition, 29,120 saplings will be planted at 1,600 saplings/ha for the acquisition of permanently acquired 18.20 ha forest land.
- The proponent will plant and manage the planted site for 5 years or necessary cost for the plantation and management will be deposited in forest development fund as per the Guidelines for the Allocation of Forest Land for National Priority Project 2076.
- In order to increase the income level of the community forest users group of the project area 30,000 saplings of non-timber forest species will be planted in the area.
- Forest conservation awareness program will be conducted at 2 sites in project area covering the project workers, supervisors, representative of CFUGs and local people.
- Information board consisting of slogan related to forest conservation and warning sign will be develop and displayed at public places and construction sites.
- The representative of community forest users group will be trained for the record keeping, community forest management and income generation activities within the forest area.
- Wildlife conservation awareness training will be given to project labors, supervisors and local people.

7.2.2.2.2 Aquatic Environment

- Construction and operation of fish pass.
- Riparian release of 0.99 m³/s. for 5 dry months and release of 1.2 m³/s. for 2 months (March-April) during the breeding season of the Snow trout.
- Fishing will be prohibited in 6.87 km reduced flow zone for about 7 dry months.



- Construction of 3 pools of 20 m × 5 m size and depth ranges to 1 – 1.5 m is proposed in reduced flow zone (Ardoli Gad- Budhi Ganga River confluence to Powerhouse tailrace).

7.2.2.3 Socio-economic and Cultural Environment

- The proponent has started acquisition of private land and private property (house, cowshed etc.) required for the placement of project structures and facilities as per the land acquisition act.
- The land required for temporary facilities will be leased by negotiation and payment will be given in advance for each calendar year.
- Compensation for the house and cowshed to be acquired by the project will be paid.
- Compensation will be provided to the owners of trees to be felled by the project in farmland (Bari land).
- Compensation will be paid for the loss of standing crops at the prevailing market price.
- A project information center will be established to disseminate information related to project activities from one authentic place.
- Assistance will be given to local NGOs, clubs/cultural groups, women's group for the implementation of cultural program to preserve and promote their culture.
- Five women headed households affected by the project will receive 3 months weaving training and assistance and 4 Dalit households will receive 390 hours skill training in the area of their interest.
- A dispensary with one medical doctor, health assistant and staff nurse will be established at the construction site. Regular training (at least once in three months) to the construction workers regarding health and safety issues of the construction works will be conducted. In addition emergency preparedness training and on site exercise every 6 months will be conducted.
- Agricultural assistance program will be implemented for the 25 project affected families losing 10 – 25% of their total land. Ten households losing 75%-100% of their land will be given as one time livelihood assistance of NRs. 200000/HH to start new business or to purchase necessary equipment/inputs.
- The project will provide cash compensation as a part of livelihood assistance of NRs. 35,473 to each affected household covering 2 years of crop loss.
- A onetime dislocation and transportation allowance NRs. 25,000 including NRs.15, 000 as dislocation allowance and NRs. 10,000 as transportation allowance will be provided to the 6 affected HHs for demolition of the house and transportation of goods and materials.

7.2.3 Community Support Program

- Skill development training as per the CTEVT course in the areas of plumbing, house wiring, driving, etc. will be given to 30 deprived people of the area including 5 persons from each affected ward of the two project affected municipalities and one rural municipality.
- The project will provide small scale assistance for operation and maintenance of existing drinking water and irrigation schemes, support to local schools for improvement in physical facility and improvement in health and sanitation of the local people. The project will also support cultural group to promote local socio-cultural activities in the area.



8. Environmental Management Plan

The proponent will have prime responsibility for the implementation of the Environmental Management Plan.

8.1 Environment Management Activities

As part of the Environmental Management Plan, a Permits and Approval Plan; Resettlement and Rehabilitation Plan; Construction Camps and Traffic Management Plan, Pollution Abatement Plan; Waste Management Plan, Terrestrial Ecology Management Plan, Aquatic Ecology Management Plan, Erosion Abatement and Muck/Spoil Management Plan, Public Health and Occupational Safety Management Plan, Emergency Management Plan, Grievance Redress Plan and Public Disclosure Plan have been developed. These plans specify the timing of action and responsibility, location and agencies to be consulted.

8.2 Institutional Arrangement and Responsibility

Project Manager's Office, Budhi Ganga Environment Monitoring Unit, Environment and Social Management Unit, Construction Contractor, Construction Management/Supervision Consultant, Local Consultative Forum and Joint Monitoring Committee are the institutions proposed for implementation of the Environmental Management Plan of the project. These institutions have specific responsibility regarding the implementation of mitigation measures and monitoring works.

8.3 Environmental Monitoring

Baseline, compliance and impact monitoring for physical, biological (terrestrial, aquatic) and socio-economic and cultural environment will be conducted during the pre-construction, construction and operation phases of the project.

8.4 Environmental Audit

As per Environmental Protection Rule 1997, the Ministry of Forests and Environment, will conduct the environmental audit of the proposed project two years after construction. The environmental audit will include parameters of physical, biological (terrestrial, aquatic), and socio-economic and cultural environment.

8.5 Environmental Management Cost

The total estimated environmental management cost for the proposed project is 142.62 million NRs. which is 2.62% the total project cost excluding the environmental cost allocated under civil works. In addition, NRs. 1.17million is proposed for environmental auditing of the project.

9. Review of Relevant Plans, Policies, Acts, Rules, Guidelines and Conventions

The proponent will be solely responsible for fulfilling provisions of all relevant policies, acts, rules, guidelines and conventions while implementing the project. Among the plan and policies Concept Paper of 15th Periodic Plan 2019, Land Use Policy 2015, National Land Policy 2019, Forest Policy 2019, National Environment Policy 2019, National Climate Change Policy 2019 and Hydropower Development Policy 2001 were reviewed during the preparation of EIA. Likewise Environment Protection Act 2019, Forest Act 2019, Land Use Act 2019, Consumer Protection Act 2018, International Trade Monitoring and Control Act for CITES Animal and Plant Species 2017, Electricity Act 1992, Labour Act 2017 and Land Acquisition Act 1977 were reviewed during the the



preparation of EIA report. Among the rules and regulation Environment Protection Rules 1997, Electricity Regulation 1993, and Forest Regulation 1995 were reviewed.

10. Public Consultation

Public consultation commenced during the scoping of issues and preparation of the EIA terms of reference (ToR) in 2016. During EIA ward level PRA (11), consultation meetings (5), KIIs (14), Market Surveys (12) and a comprehensive socio-economic survey of 80 households affected by the project were conducted.

A Public hearing was conducted on August 21, 2018 at Thanti Bazar of Sanfebagar Municipality ward number 10 to discuss the findings of the EIA and to collect the issues/concerns of local people. Altogether 164 people from different caste/ethnic groups and professions participated in the meeting. The pertinent issues raised by the participants have been incorporated in the relevant sections of the EIA report.

11. Conclusion

The EIA study indicates that the project has low to moderate impacts on the environmental parameters and the construction of the proposed project is environmentally feasible and impacts of the project could be managed to acceptable level.



1. INTRODUCTION

1.1 Background

The Budhi Ganga Hydropower Project (BHP) is proposed on the Budhi Ganga River in Sudurpashchim Pradesh of Achham and Bajura Districts of Nepal. The project was identified and selected under a Screening and Ranking process carried out by the study team of Medium Hydropower Study Project (MHSP) of Nepal Electricity Authority (NEA) in 1996-1997 as a candidate project for medium term power supply in Nepal. In the Feasibility Study Report the BHP is proposed to be a peaking run-of-the-river scheme with daily peaking of 6 hours and an installed capacity of 20 MW utilizing a design discharge of 27.63 m³/s and a gross head of 90m. The Feasibility Study and previous Environmental Impact Assessment (EIA) of the project as per National EIA Guideline 1993 was conducted by METCON Consultants Pvt. Ltd on behalf of Canadian International Water and Energy Consultants (CIWEC) and Nepal Electricity Authority (NEA). The current Detailed Engineering Design study of the project recommends a peaking run-of-the-river scheme with installed capacity at 20MW (SMEC-UDAYA JV2018).

1.2 The Proponent

The Proponent of the project is Department of Electricity Development (DoED), Budhi Ganga Hydropower Project. This department, established in accordance with the Hydropower Development Policy 1992, is the central agency under the Ministry of Energy, Water Resources and Irrigation (MoEWRI), Government of Nepal (GoN), for promoting and regulating hydropower development in Nepal. DoED is responsible for processing license applications issued by MoEWRI, monitoring electricity generation, transmission and distribution projects, promoting and developing multipurpose and bi-national power projects and developing guidelines for project construction, power generation, transmission and distribution. DoED also provides advisory assistance to MoEWRI in updating and refining the legal and institutional framework required for the efficient and effective development of the power sector. In addition, DoED also carry out studies of different scales of hydropower projects. Budhi Ganga Hydropower Project (BHP) Office has been established under the umbrella of DoED for promotion of the study and construction work of the proposed project.

The address of the Proponent is:

*Department of Electricity Development
Budhi Ganga Hydropower Project
Sanogaucharan, Kathmandu, Nepal
Phone No.: +977-1-44823206
Fax: +977-1-4423207
E-mail: info@bhp.gov.np*

1.3 Rationale for Conducting EIA Study

As per Schedule 2 of the Environment Protection Rule (EPR) 1997 and its amendments, an EIA of hydropower projects with installed capacities over 50 MW is mandatory. Schedule 2A (12) of the EPR also states that an EIA is required if the project results in the felling of more than 5 ha forest



area. The project will acquire 18.20 ha forest land for the implementation of the proposed project which consist 12.15 ha area covered with trees and bushes and 6.05 ha river and flood plain connected with forest. Since 18.20 ha forest land will be acquired for this project, an EIA is required to fulfil the requirement of the EPR. Furthermore, the ESIA is required to fulfil the requirement of the funding agency, the Kuwait Fund for Arab Economic Development (KFAED) and Saudi Fund for Development (SFD). The Consultant is conducting an EIA of BHP, with an installed capacity of 20 MW, in accordance with the above mentioned requirements. The breakdown of land requirement for each project component and facilities is given in Table 2-2, Table 5-2 and Table 5-3 of the chapters 2 and chapter 5 respectively.

The project area does not lie within a national park, wildlife reserve, buffer Zone, conservation Area, wetlands, historically and archaeologically important sites and or environmentally sensitive/fragile areas. Khaptad National park is the nearest national park found in the project district. The closest aerial distance of the Khaptad National Park from the Project area is about 5.25 km.

1.4 Organization Responsible for Conducting EIA

As the project proponent, DoED, BHP, is responsible for the EIA of the proposed project. On behalf of DoED, BHP, the EIA is being conducted by a joint venture between SMEC International Pty Ltd., Australia and UDAYA Consultancy Pvt. Ltd. Nepal (hereinafter referred to as the Consultant) under the contract agreement with DoED.

SMEC International Pty Ltd is one of the leading International consulting firms that provides specialized services in the fields of hydropower development. Udaya Consultancy Pvt. Ltd is one of the leading consulting firms of Nepal having extensive experience in the engineering and environmental studies, detailed design of hydropower, road and other infrastructure projects.

The address of the Consultant is:

JV of SMEC International Pty Ltd and UDAYA Consultancy Pvt. Ltd.

MidBaneshwor, Kathmandu, Nepal

Phone no.: +977-1-4471884; Fax: +977- 1-4470361

E-mail: 5064035@smec.com, udayaconsultancypvtltd@gmail.com

1.5 Objectives of EIA

The principal objective of the proposed EIA is to ensure that BHP is executed in an environmentally sound manner. Its specific objectives are to

- establish the physical, biological, socio-economic and cultural baseline conditions of the project area;
- identify the positive and adverse environmental impacts of the project;
- analyze the critical impacts of the project;
- examine and select the environmentally optimal alternatives from the various relevant options available for the project components;
- suggest mitigation measures for adverse impacts;
- prepare environmental management, monitoring and auditing plans;



- involve stakeholders including the public in the decision-making process related to the environment; and
- advise decision makers on the likely social and environmental implications of implementation of the project.

1.6 Scope of the EIA

The scope of the EIA as per the terms of reference approved by the then Ministry of Population and Environment. The copy of Approved Terms of Reference is given in Volume II, Appendix:A of the EIA report. The EIA covers the generation component of the project including project structures, project component road, the ancillary project components and project facilities such as construction yard, construction camps, muck disposal area, crusher plant quarry area and diesel generators for backup construction power etc. The transmission line component is beyond the scope of the study.

1.7 Contents of EIA Report

This EIA report is prepared in accordance with Schedule 6 of the EPR 1997. The study also follows other relevant acts, policies, guidelines published by the related government agencies including MoFE, MoEWRI and DoED.

The EIA Report contains two volumes. Volume I is the main EIA Report prepared in accordance with the Schedule 6 of EPR 1997 and contains 11 chapters.

Chapter one provides brief introduction of the project, proponent and rational and objectives of the EIA. Chapter 9 presents review of policies, legal provision, guidelines and convention as relevant to present EIA. Chapter 2 contains project description followed by a description of a study methodology that is described in Chapter 4. Chapter 4 highlights description of the baseline information of the project area. The impacts due to project implementation during construction and operation phase on biophysical, socio-economic and cultural environment are presented in Chapter 5. Chapter 6 highlights the possible alternatives considered for the project in terms of layout, design, location, methods of implementation etc. Chapter 7 provides mitigation and enhancement measures proposed to minimize the adverse impacts and enhance the positive impacts. Chapter 8 deals with Environmental Management Plan including plan for, Environmental Monitoring and Environmental Auditing. Chapter 10 highlights the public consultation made during the study period. Chapter 11 of this report presents conclusion of the study.

Volume II contains Appendices. These include approved ToR and survey tools (household questionnaire, Focus Group Discussion checklists, in-depth interview guidelines, the market price survey checklist, and the checklists for forest resources and wildlife and birds). The documents related to the Public Consultation process carried out during the preparation of the EIA, including exhibits associated with the Public Hearing and letters of recommendation from the project-affected municipalities and rural municipalities. The detail data table of physical, biological and socio-economic and cultural environment is also given in Volume II: Appendices.

2. PROJECT DESCRIPTION

2.1 The Project

BHP is proposed on the Budhi Ganga River in Achham and Bajura districts of Sudurpashchim Pradesh of Nepal Figure 2-1. The project area lies between longitudes 81°13'47" to 81°17'50" east and latitudes 29°15'30" to 29°18'35" north.

BHP is planned as a Pondage Run of River (PRoR) scheme with a six hour daily peaking capacity. The project has an installed capacity of 20 MW generated through a gross head of 94.83 m and a design discharge of 26 m³/s. Its average annual energy (net) production is estimated at 109.61 GWh.

The major components of BHP are arranged on the left bank of Budhi Ganga River (Figure 2-2). Its headworks, located in Juke Lamkana and Rakshe community forest area close to Budhabagar settlement, divert water to the above ground powerhouse proposed near Thapagaun through a hydraulic conveyance system comprising of power Intake, Headrace tunnel, Surge shaft, and Penstock. Water exiting the Powerhouse rejoins the Budhi Ganga River through a tailrace.

2.2 Major Project Components

2.2.1 Headworks

The Headworks consist of a diversion Dam, a river intake and a surface Desanding Basin. The Dam site is located downstream of confluence of Budhi Ganga River with Ikri Gad at an elevation of 694.5 masl in a narrow gorge with near vertical cliffs on both the banks. The Dam is 44 m high from the foundation level and 86 m long concrete gravity structure with gated spillways and a fish ladder. Present Dam site is located at about 200 m downstream of the confluence of Budhi Ganga River and Ikri Gad.

The headworks is located between ward no. 13 of Sanfebagar Municipality (then Babala VDC) of Achham district on the right bank and ward no. 4 of Mellekh Rural Municipality (then Kushkot VDC) of the same district on the left bank. Both banks of the river at this location is covered with forests on the lower reaches and upper reach patches of terrace farming are found (Photo 2-1). Settling basin is located on the left bank covered with bushes and will be 12m wide and 92m long.



Photo-2-1: Headworks Site and Reservoir Area

Photo 2-2: Landuse along the Tunnel Alignment



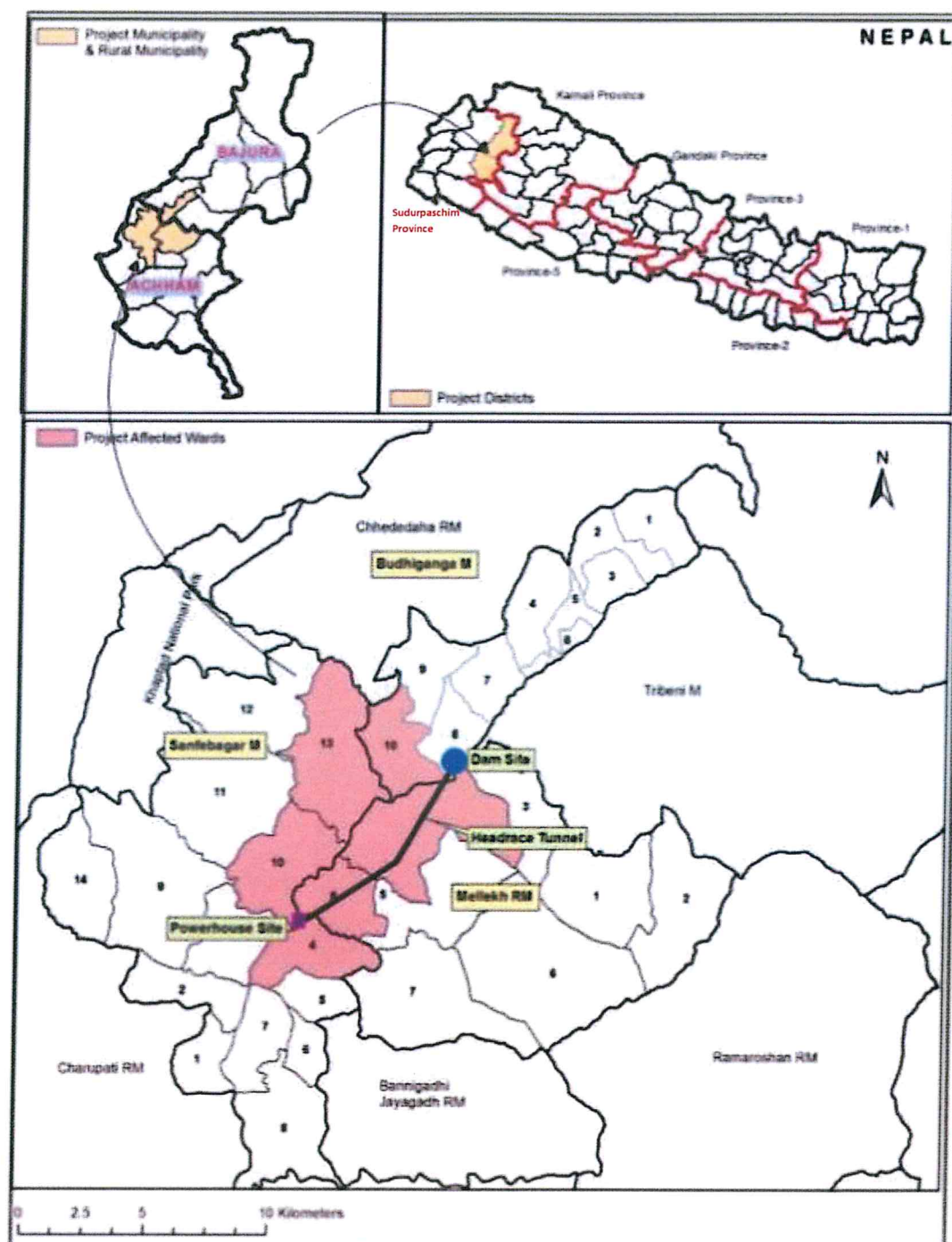


Figure 2-1: Site location map

Source: Topographical Map issued by Department of Survey, 1992





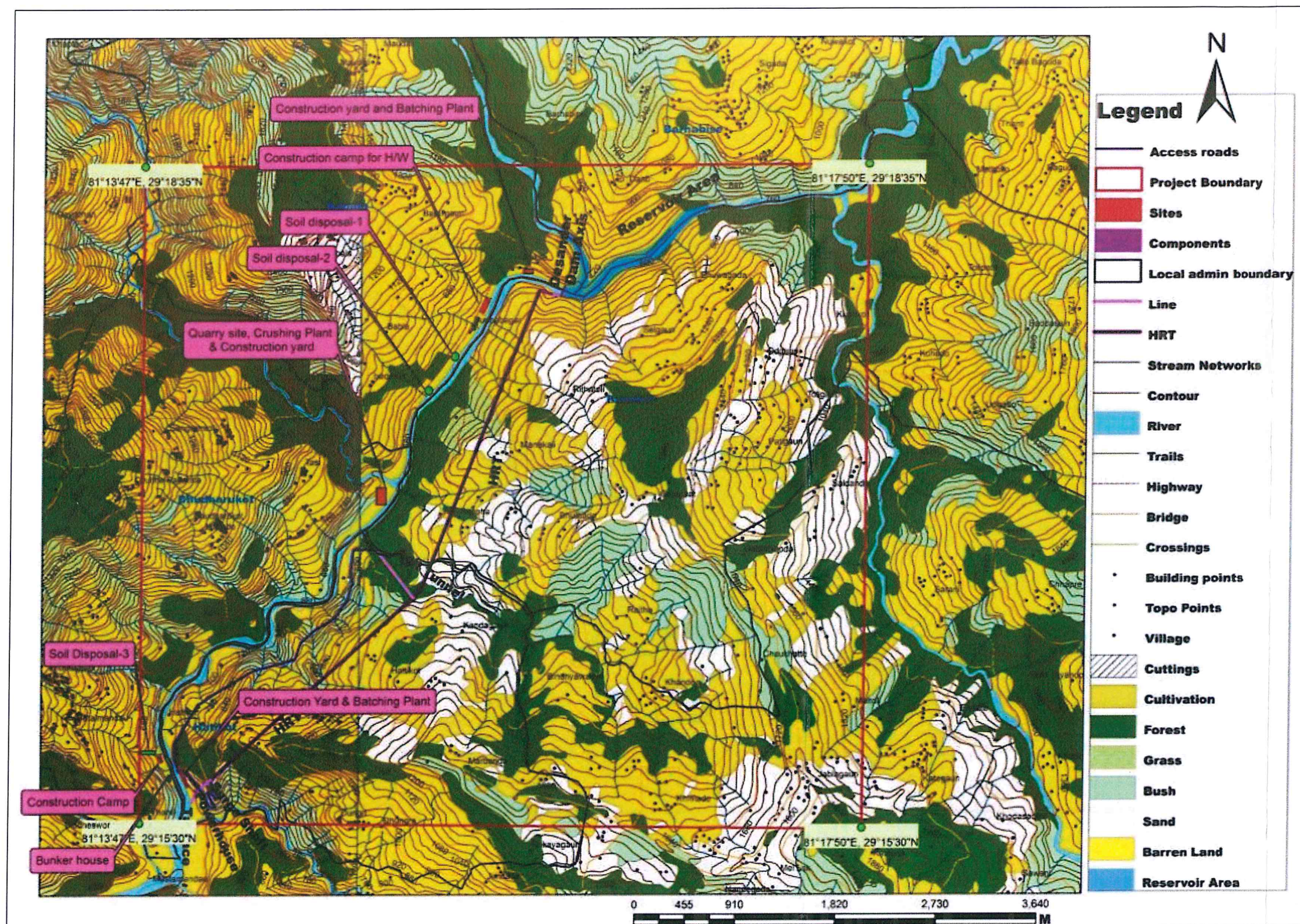


Figure 2-2: Layout map

(Source: Topographical Map issued by Department of Survey, 1992)

संघीय लोकतान्त्रिक गणतन्त्र नेपाल
संस्थागत विकास तथा योजना विभाग
सिंहदरबार काठमाडौं

संघीय लोकतान्त्रिक गणतन्त्र नेपाल
संस्थागत विकास तथा योजना विभाग
सिंहदरबार काठमाडौं

2.2.2 Reservoir

The impounding of the Budhi Ganga River for creating the required pondage will form a reservoir that will extend up to 2.06 km upstream of the Dam and will have a surface area of about 13.43 ha and a pondage volume of 1.05 million cubic meters at FSL of 718 masl. The minimum operating level of the Dam is 712 masl (Fig. 2-3).

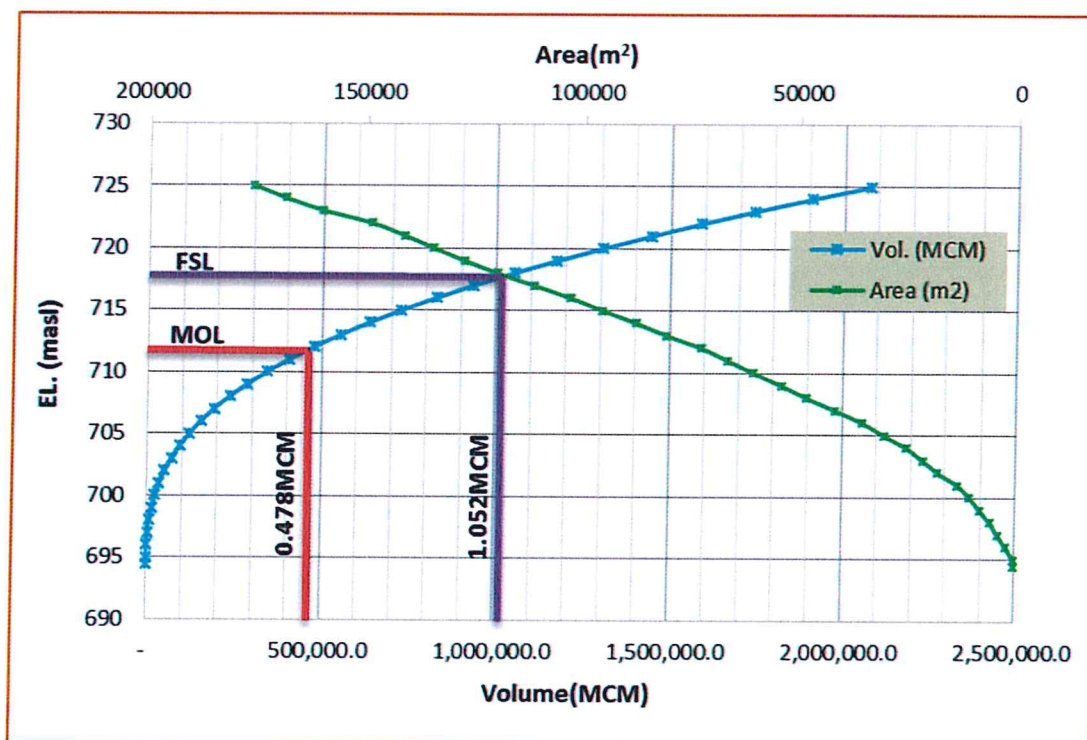


Figure 2-3: Reservoir elevation-area-volume curve

Source: DED, BHP, 2018

The reservoir is flanked on its left by ward no. 4 of Mellekh Rural Municipality (Kushkot VDC) of Achham district and on the right by ward no. 13. of Sanfebagar Municipality (Babala VDC) of the same district and wards 4 and 10 of Budhiganga Municipality (Barhabis VDC) of Bajura district. The reservoir area is covered by forest at lower reaches along both banks. Most of the cultivated land is confined to upper terraces of the reservoir area. Only a small patch of cultivated land is found along both river banks in the reservoir area.



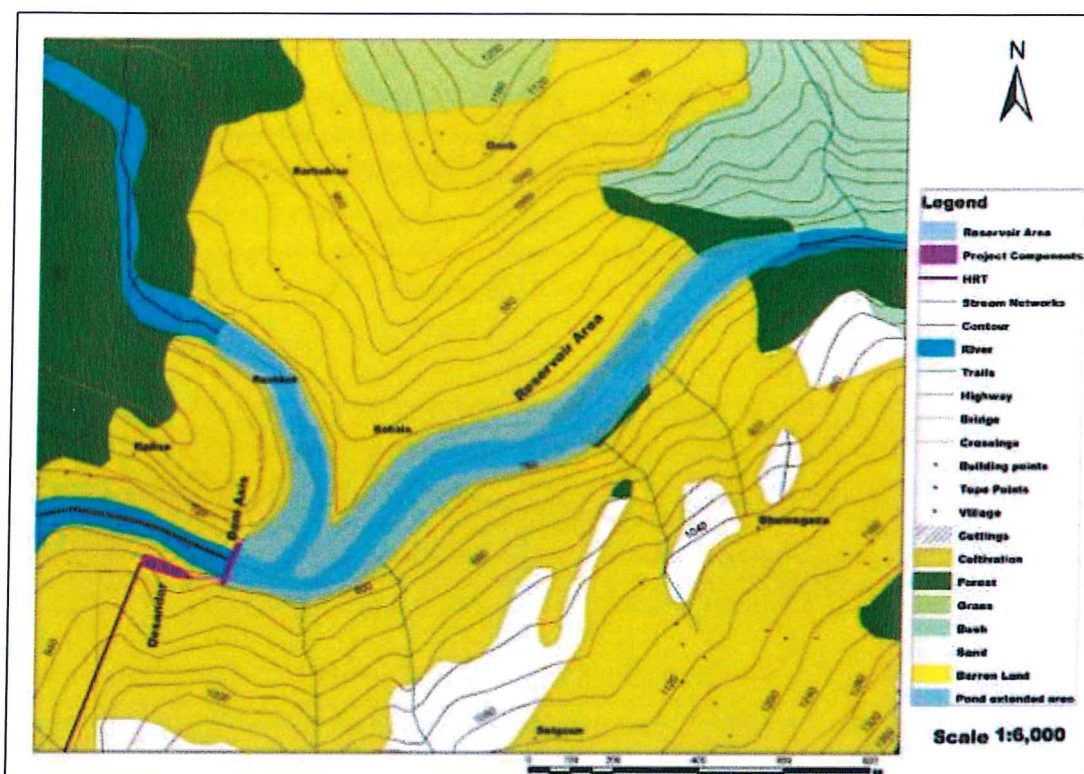


Figure 2-4: Reservoir area delineation map

Source: DED, BHP, 2018

2.2.2.1 Reservoir Operation

The reservoir is planned to operate at least for the peak hours (6 hours). Out of these 6 hours the reservoir will be operated three hours in the morning and three hours in the evening. The minimum operation hours throughout the year is given in table below.

Table 2-1: Minimum reservoir operation hours

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Minimum Operation Hrs.	9.5	6.5	10	8	9.5	16.5	24	24	24	24	14.5	9.5

The reservoir operation is so planned that the reservoir sediment deposit flushing will be carried out during monsoon in the month of July to September for two to three weeks depending on the reservoir flushing efficiency. Enough facilities have been provided in the design and the reservoir live storage volume shall not be threatened by the sedimentation as it generally happens in hydro projects.

The environmental flow of 0.99 m³/s will be released through the fish pass.



The reservoir operation pattern is as given below:

Months	Days	Morning			Evening			Months	Days	Morning			Evening		
		From	TO	Hours	From	TO				From	TO	Hours	From	TO	
JAN	0-3 days	6.00	11.42	10.83	18.00	23.42		FEB	0-3 days	6.00	10.00	8.00	18.00	22	
JAN	3-6 days	6.00	10.75	9.50	18.00	22.75		FEB	3-6 days	6.00	9.33	6.67	18.00	21.33	
JAN	6-9 days	6.00	9.58	7.17	18.00	21.58		FEB	6-9 days	6.00	9.85	7.70	18.00	21.85	
JAN	9-12 days	6.00	9.55	7.10	18.00	21.55		FEB	9-12 days	6.00	10.97	9.93	18.00	22.97	
JAN	12-15 days	6.00	9.45	6.90	18.00	21.45		FEB	12-15 days	6.00	10.50	9.00	18.00	22.50	
JAN	15-18 days	6.00	9.58	7.17	18.00	21.58		FEB	15-18 days	6.00	10.92	9.83	18.00	22.92	
JAN	18-21 days	6.00	9.75	7.50	18.00	21.75		FEB	18-21 days	6.00	10.92	9.83	18.00	22.92	
JAN	21-24 days	6.00	9.75	7.50	18.00	21.75		FEB	21-24 days	6.00	10.08	8.17	18.00	22.08	
JAN	24-27 days	6.00	9.52	7.03	18.00	21.52		FEB	24-27 days	6.00	10.33	8.67	18.00	22.33	
JAN	27-31 days	6.00	10.42	8.83	18.00	22.42		FEB	27-28 days	6.00	10.33	8.67	18.00	22.33	
Months	Days	Morning			Evening			Months	Days	Morning			Evening		
		From	TO	Hours	From	TO				From	TO	Hours	From	TO	
MAR	0-3 days	6.00	10.92	9.83	18.00	22.92		APR	0-3 days	6.00	10.08	8.17	18.00	22.08	
MAR	3-6 days	6.00	9.97	7.93	18.00	21.97		APR	3-6 days	6.00	10.30	8.60	18.00	22.30	
MAR	6-9 days	6.00	9.92	7.83	18.00	21.92		APR	6-9 days	6.00	10.92	9.83	18.00	22.92	
MAR	9-12 days	5.92	11.97	12.10	17.92	23.97		APR	9-12 days	6.00	10.67	9.33	18.00	22.67	
MAR	12-15 days	5.75	11.97	12.43	17.75	23.97		APR	12-15 days	6.00	10.42	8.83	18.00	22.42	
MAR	15-18 days	6.00	11.42	10.83	18.00	23.42		APR	15-18 days	6.00	10.30	8.60	18.00	22.30	
MAR	18-21 days	6.00	11.12	10.23	18.00	23.12		APR	18-21 days	6.00	10.25	8.50	18.00	22.25	
MAR	21-24 days	6.00	10.53	9.07	18.00	22.53		APR	21-24 days	6.00	10.70	9.40	18.00	22.70	
MAR	24-27 days	6.00	10.17	8.33	18.00	22.17		APR	24-27 days	6.00	10.40	8.80	18.00	22.40	
MAR	27-31 days	6.00	10.42	8.83	18.00	22.42		APR	27-31 days	6.00	11.00	10.00	18.00	23.00	



Months	Days	Morning From	TO	Hours	Evening From	TO	Months	Days	Morning From	TO	Hours	Evening From	TO
MAY	0-3 days	6.00	10.92	9.83	18.00	22.92	JUN	0-3 days	3.17	11.50	16.67	15.17	23.50
MAY	3-6 days	6.00	11.37	10.73	18.00	23.37	JUN	3-6 days	3.17	11.50	16.67	15.17	23.50
MAY	6-9 days	6.00	11.67	11.33	18.00	23.67	JUN	6-9 days	1.17	11.50	20.67	13.17	23.50
MAY	9-12 days	6.00	10.83	9.67	18.00	22.83	JUN	9-12 days	1.17	11.50	20.67	13.17	23.50
MAY	12-15 days	6.00	11.98	11.97	18.00	23.98	JUN/Jul/AUG/SEP				FULL TIME		
MAY	15-18 days	5.25	11.75	13.00	17.25	23.75	JUN/Jul/AUG/SEP				FULL TIME		
MAY	18-21 days	4.75	11.75	14.00	16.75	23.75	JUN/Jul/AUG/SEP				FULL TIME		
MAY	21-24 days	4.67	11.75	14.17	16.67	23.75	JUN/Jul/AUG/SEP				FULL TIME		
MAY	24-27 days	5.00	11.58	13.17	17.00	23.58	JUN/Jul/AUG/SEP				FULL TIME		
MAY	27-31 days	5.83	11.50	11.33	17.83	23.50	JUN/Jul/AUG/SEP				FULL TIME		
Months	Days	Morning From	TO	Hours	Evening From	TO	Months	Days	Morning From	TO	Hours	Evening From	TO
OCT	0-3 days			FULL TIME			NOV	0-3 days			FULL TIME		
OCT	3-6 days			FULL TIME			NOV	3-6 days	1.58	11.75	20.33	13.58	23.75
OCT	6-9 days			FULL TIME			NOV	6-9 days	1.75	11.75	20.00	13.75	23.75
OCT	9-12 days			FULL TIME			NOV	9-12 days	2.42	11.75	18.67	14.42	23.75
OCT	12-15 days			FULL TIME			NOV	12-15 days	2.70	11.75	18.10	14.70	23.75
OCT	15-18 days			FULL TIME			NOV	15-18 days	3.00	11.75	17.50	15.00	23.75
OCT	18-21 days			FULL TIME			NOV	18-21 days	3.40	11.75	16.70	15.40	23.75
OCT	21-24 days			FULL TIME			NOV	21-24 days	3.83	11.75	15.83	15.83	23.75
OCT	24-27 days			FULL TIME			NOV	24-27 days	4.08	11.75	15.33	16.08	23.75
OCT	27-31 days			FULL TIME			NOV	27-31 days	4.50	11.75	14.50	16.50	23.75
Months	Days	Morning From	TO	Hours	Evening From	TO							
DEC	0-3 days	4.17	11.00	13.67	16.17	23							
DEC	3-6 days	4.37	11.00	13.27	16.37	23.00							
DEC	6-9 days	4.73	11.00	12.53	16.73	23.00							
DEC	9-12 days	4.75	11.00	12.50	16.75	23.00							
DEC	12-15 days	5.23	11.00	11.53	17.23	23.00							
DEC	15-18 days	5.40	11.00	11.20	17.40	23.00							
DEC	18-21 days	5.67	11.00	10.67	17.67	23.00							
DEC	21-24 days	5.75	11.00	10.50	17.75	23.00							
DEC	24-27 days	6.08	11.00	9.83	18.08	23.00							
DEC	27-31 days	6.25	11.00	9.50	18.25	23.00							



2.2.3 Settling Basin

The Settling Basin is proposed on a raised terrace towards hill side on the left bank of Budhi Ganga River 60 m downstream of the main Dam at an elevation of 703.80 masl. The layout of Settling Basin comprises of 92m (L) x 12m (W) x 13m (H) double chambered closed surface Dufour Basin with conventional flushing system. The design discharge of Settling Basin is taken same as that of approach Tunnel (14.95 m³/s for each) with two separate feeder Tunnels coming from Intake. 15% of design discharge is used to flush accumulated silt down to the river. The Settling basin is designed to remove the particles larger than 0.2 mm at 95% efficiency. For the discharge of 29.90 m³/s, two bays Settling basin has been designed with effective length of 92 m and 12 m wide and effective depth of 6.331 m. Each bay is further divided into two bays so as to reduce the overall height of the structure.

2.2.4 Headrace Tunnel

The 5.582 km long Headrace Tunnel conveys the design discharge from the Collection chamber to the Surge shaft. The Tunnel will be inverted D-shaped with 4.0m diameter with the invert at an elevation of 702.55 at inlet portal. The Headrace Tunnel passes along the left bank of Budhi Ganga River through ward no. 4 (then Kushkot VDC) and ward No.8 (then Hatikot VDC) of Mellekh Rural Municipality of Achham. The terrain along its alignment is terraced cultivated land, patches of vegetation and rocky areas (Photo 2-2). The settlements are located at higher elevation than the proposed tunnel alignment and far from the alignment. The adit site is in forest area (Photo 2-3).

2.2.5 Surge Shaft

The Surge shaft is a 53.35 m high underground structure housed in a cliff above the Powerhouse. The Surge shaft is restricted orifice type with 7.5 m diameter. The invert of the surge shaft is at an elevation of 680.15 masl.

The Surge shaft is in ward no.8 of Mellekh Rural Municipality (then Hatikot VDC). The terrain in this area is mild slope with grasses and patches of trees in upper part (Photo 2-4).

2.2.6 Penstock

The Penstock will be covered and exposed structure. The Penstock will be 185.15m long with internal diameter 2.8m. The terrain at proposed penstock site is rocky with grass.

2.2.7 Powerhouse

The Powerhouse is proposed on the left bank of the Budhi Ganga River at an elevation of 629 masl at Thapagaun near hill toe. It is in ward no. 8 of Mellekh Rural Municipality (then Hatikot VDC), just upstream of the confluence of Budhi Ganga River with Bhimkoti Khola. The Powerhouse is 39.7 m long and 14.8 m wide with a maximum height of 26.25 m. The Powerhouse consists of two Francis Turbine units 10 MW each.

2.2.8 Tailrace

The Tailrace will be a box culvert type one 69.9 m long channel that discharges water from the Powerhouse to the Budhi Ganga River at an elevation of 623.57 masl. The channel will be concrete lined.





Photo 2-3: Adit site

Photo 2-4: Location of Surge shaft and Powerhouse

2.2.8.1 Outdoor Switchyard

The outdoor switchyard will house three-phase main transformers and a station transformer on the left bank of Budhi Ganga River at Thapagaun at an elevation of 630 masl. The transformers will be placed in separate transformer cells. The switchyard is in private flat cultivated land and about 60mx39m area will be required for this.

2.2.9 Access

Presently, the Project site is connected with the Sanfe-Martadi National road (Fig.2-5). The road is of 3.5m width with an Asphalt pavement. Therefore, construction of access road is not required for this project. The condition of road especially in Sanfebagar to Budhabagar section might be changed due to frequent movement of project vehicles and equipment. The proponent will maintain the road to its original condition or in better condition as required. The project component road is under construction to provide access to different project sites. The existing road condition is suitable for the transportation of construction materials and equipment.

The project site is 940 km west from Kathmandu. There is an airport at Sanfebagar which is not in service and is being upgraded to bring back in service. The nearest operating airport to the project site at present is at Dhangadhi of Kailali District. The nearest border from the project site is Gaurifanta via Dhangadhi of Kailali. From Gaurifanta, a 271 km road with asphalt pavement leads to Sanfebagar of Achham via Syaule of Dadeldhura and Dipayal of Doti. It takes an average 9 hours to drive from Attariya of Kailali through hill roads up to the Sanfebagar. Sanfebagar is the nearest market to the project site. The project Dam site and Powerhouse site are 13 km and 6 km respectively from Sanfebagar which can be accessed by Sanfe-Martadi road on the right bank of Budhi Ganga River which is in good condition and has asphalt pavement. The Powerhouse site is accessible by an access road of 1.3 km from Thanti Bazar via a motorable bridge on Budhi Ganga River near Powerhouse. The width of this road is 5.5 m including the shoulder of 0.75 m on each side.

The project will construct 700 m of new road for headworks site, 1.5 km road for surge shaft and 3.7 km road for adit site. The road for headworks will start from the Safe-Martadi road at Babala on the right bank of Budhi Ganga River whereas the road for adit and surge shaft will start from the powerhouse area. The width of this road will be 5.5 m including the shoulder of 0.75 m on each side.



The salient features of BHP, including the features described in the preceding sections, are summarized in table 2-2.

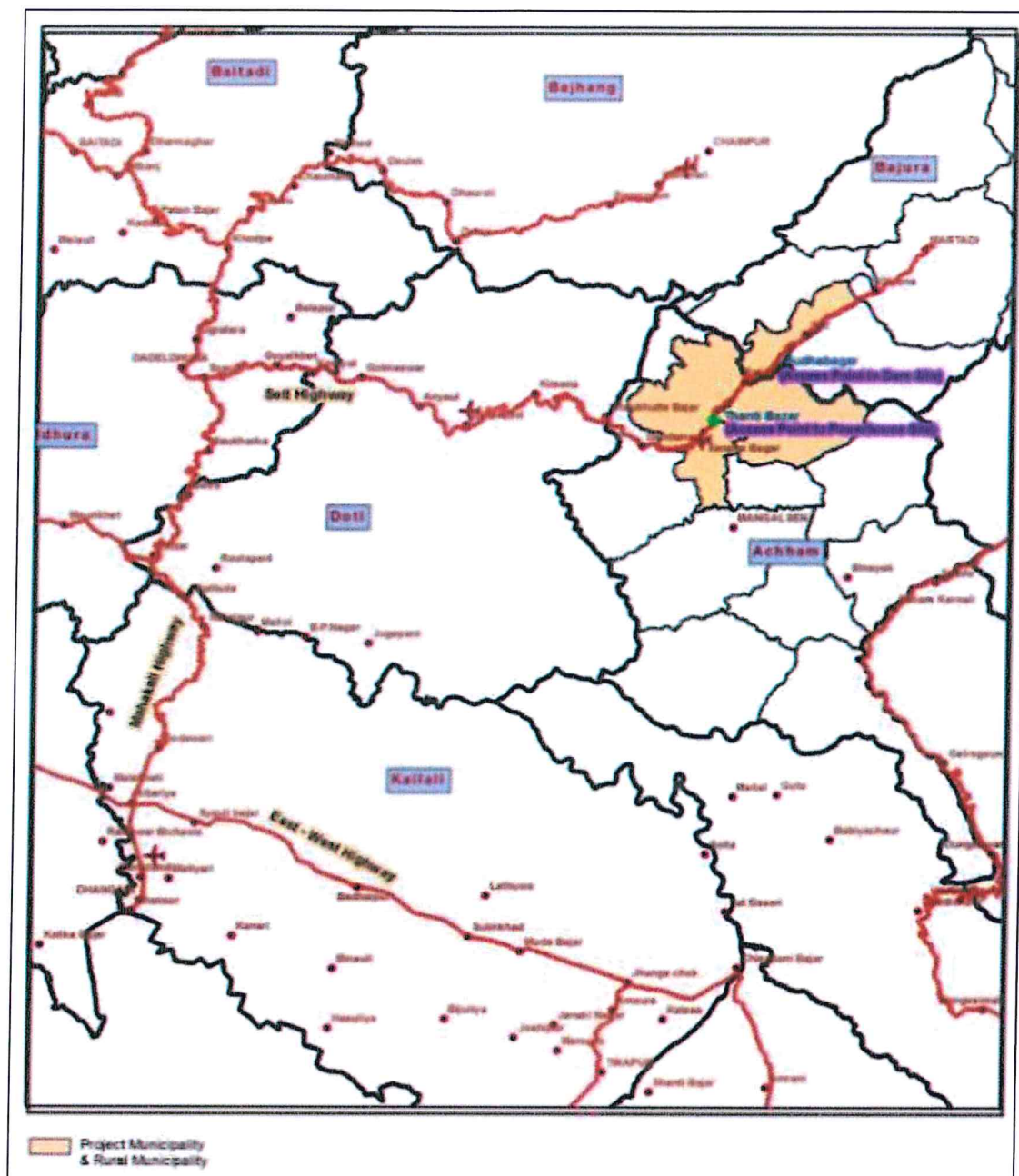
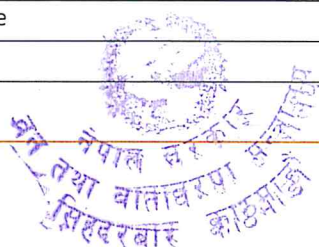


Figure 2-5: Project access map

Table 2-2: Salient features of BHP

S.N.	Features	Description
1	Name of Project	Budhi Ganga Hydropower Project
2	Project Municipality/Rural Municipality	Sudurpashchim Pradesh Bajura district: Budhiganga Municipality (a'9Lu+uf gu/kflnsf), ward no. 10 Achham district: Sanfebagar Municipality (साँफेबगर नगरपालिका) ward no. 4,10 and 13 and Mellekh Rural Municipality (मेल्लेख गाउँपालिका) ward no. 4 and 8

3	Dam Location	At the foot hills of Sanfebagar Municipality (Babala VDC) and Mellekh Rural Municipality (Kushkot VDC) Achham
4	Powerhouse Location	Thapagaun of Mellekh Rural Municipality (then Hatikot VDC), Achham
5	Type of Project	Peaking Run-of-River
6	Hydrology	
	Catchment area (Dam axis)	1075 km ²
	90% dependable flow	0.9m ³ /s
	Average annual flow	53.04 m ³ /s
	Design flow	26 m ³ /s
	Design Flood for Spillway (1000 years)	3900 m ³ /s
	Design flood (100 years) for Stilling basin	2700 m ³ /s
	PMF	5100 m ³ /s
7	Geology	Mostly dominated by Augen Gneiss
8	Head	
	Gross	94.83 m
	Net	86.95 m
9	Dam	
	Height	44m from foundation
	Crest Length	86m
	Dam Type and Size	Conventional Concrete Gravity
	Spillway	3x 12.50 m (H) x 8m(W)
	Under sluice Size	Single Bay,
	Intake Type, Nos. and Size	Side Intake, 2 no. 4.8 m (W) X 6.4 m (H)
	Flood Level at 100 Year (Gates open)	El.715 masl (Gates opening 6.5m)
	Dam crest Elevation	720 masl
10	Settling Basin	
	Type	Closed, Surface, Dufour Type, Double Chamber
	No. of Chambers	2
	Size	92 m (L) x 12 m (W) x 13 m (H)
	Flushing system	Conventional type
11	Peaking Pond	
	Full Supply Level (FSL)	718
	Minimum Operating Level (MOL)	712
	Storage at FSL	1.05 MCM
	Length of reservoir	2.06km
	Storage area at FSL	0.1343km ²
12	Headrace Tunnel	
	Length	5.582 km
	Size	4.75 m excavated diameter, D-shape
		4.0 m finished diameter



	Lining	Concrete lining throughout the length
13	Surge Shaft	
	Type	Restricted Orifice type, underground
	Size	53.35m (H) x 7.5 m (Φ)
	Maximum Upsurge (Zmax)	734.500 masl
	Minimum Down surge (Zmin)	694.310 masl
14	Penstock	
	Type	Covered and exposed
	Size	185.153 m (L), 2.8 m (Φ)
	thickness	10 to 20 mm
15	Powerhouse	
	Type	Surface
	Size	39.7 m (L) x 14.8 m (B) x 26.25 m (H)
16	Tailrace Channel	Box culvert type 69.9m (L) x 4.45 m (B) x 3.00 m (H) with free board and cover
17	Turbine	
	Type, Orientation	Francis, Horizontal Axis
	No. of Units	2Nos.
	Unit Capacity	10 MW
18	Generator	
	Type and Number	3 Phase Synchronous AC, 2 Nos.
	Unit Capacity	12.93 MVA
19	Installed Capacity	20 MW
20	Annual Energy Generation	109.61 GWh
	Dry Energy	33.54 GWh
	Wet Energy	76.07 GWh
21	Transmission Line	
	Length	80.29km
	Voltage/circuit	132 kV/double circuit
22	Substations	
	Number	3
	Locations	One at Thapagaun (near Powerhouse)
		One at Chapartola
		One at Pahalmanpur (bay extension)
23	Project Component Road	
	Road to dam	700 m
	Road to adit	3.7 km
	Road to surge shaft	1.5 km
24	Total Project cost (excluding transmission line)	5450.32 million (NRs)
	Internal Rate of Return	3.06%
	EIRR	7.20%
	BCR	1.46
25	Others	

Land Requirement	51.74 ha
Permanent acquisition	35.54 ha
Temporary acquisition /lease	16.20 ha
Forest Land	18.20 ha (12.15 ha forest cover + 6.05 ha river and flood plain connected with forest)
Private land (Permanent)	17.34 ha

2.2.10 Power Evacuation

The Power evacuation of Budhi Ganga Hydropower Plant will be made through an 80.29 km Long 132 KV Transmission line from Budhi Ganga substation (Sanfebagar Municipality, Achham) to Pahalmanpur (Pahalmanpur of Kailali district) substation via Chapartola substation of Simchaur of Doti district. The EIA/IEE of the transmission line is not in the scope of the present study.

2.3 Project Planning and Cost

2.3.1 Construction Phase: Construction Activities and Implementation Schedule

The project components include dam, reservoir, settling basin, headrace tunnel, adit, surge shaft, penstock, powerhouse, tailrace and project component road. The construction yards, owner's engineer's camps, contractors and labor camps, disposal sites, quarry area, crushing plant area are also included in project component as the project facilities. The major activities conducted under the project are acquisition of private land and government land, clearance of site including removal of vegetation, excavation and earth work, diversion of river, blasting and tunnelling and construction of project structures and facilities. Removal of quarry, crushing, concreting, storage of construction material, disposal of the spoil, movement of vehicles and construction equipment are the other activities conducted under this project. The estimated construction period (contract to commissioning) is 48 months (Figure 2-6).

2.3.2 Operation Phase

The camps and office building located in powerhouse area will be mainly used for the operation and maintenance of the power plant. Similarly, the office building and camps at headwork will be used for operation and maintenance of headworks. The project will require 100 staff for operation and maintenance.

2.4 Project Requirements

2.4.1 Land Requirement

The project will require acquisition of about 51.74 ha of land for the placement of project structures and facilities including the inundation area. Out of this, 35.54 ha will be permanently acquired for placement of different structures including reservoir area (13.43 ha). The project will take 16.2 ha land for temporarily facilities on lease. The land to be acquired is cultivated land, forest land, grass land, river and flood plain. Of the total permanently acquired land 18.20 ha is forest land consisting 12.15 ha forest cover managed by community forest users group and 6.05 ha river and flood plain connected with forest and 17.34 ha private cultivated and Kharbari land owned by local people. The required land has been/will be acquired through designated processes and procedures.



Table 2-3: Land to be acquired for the project

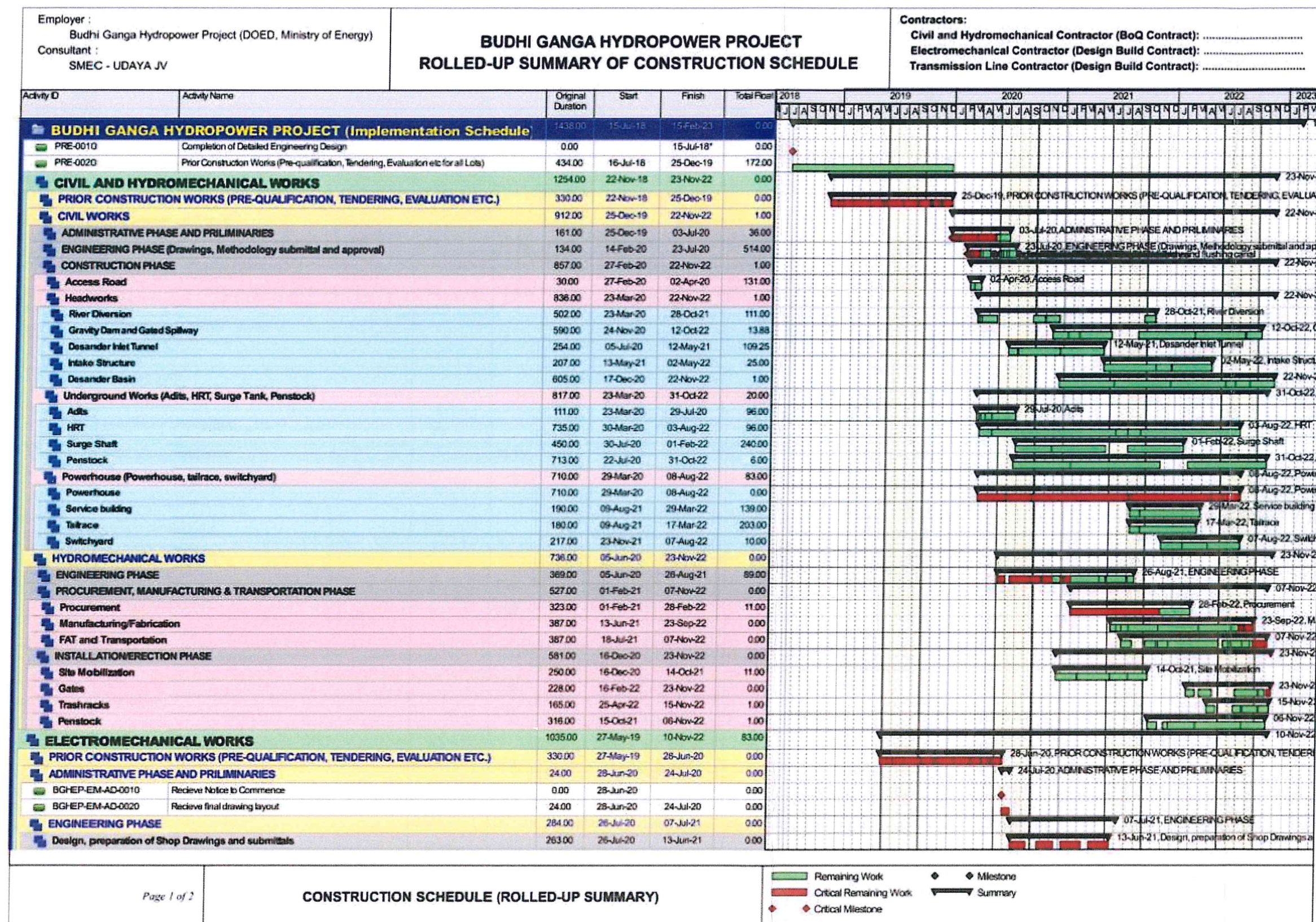
S.N.	Project Components.	Land type (In hectare)												
		Forest					Cultivated		Barren		River and Flood Plain (Gov.land)	Built up/ Residential		Total area
		Gvt.	CF	LHF	Rel.	Pvt.	Govt.	Pvt.	Gvt	Pvt.		Public	Pvt.	
	Permanent Acquisition						ऐलाती							
1	Reservoir		6.51					1.57			5.35			13.43
2	Dam		0.07								0.43			0.5
	Stilling basin										0.265			0.265
	Settling basin		1.25											1.25
3	Adit		2.47											2.47
4	Powerhouse and tailrace area							3.15						3.15
5	Project component road													0
5.1	Road to headworks		0.35					0.73						1.08
5.2	Road to adit		1.5					4.05						5.55
5.3	Road to powerhouse							2.015						2.015
5.4	Road to surge shaft							2.325						2.325
6	Owners/engineers camp							2.82						2.82
7	Office and camp							0.68						0.68
	Total Permanent Area		12.15					17.34			*6.045			35.54
	Temporary Acquisition													
1	Construction yard							1.5		0.5				2
2	Disposal area								0.5	2	5.5			8
3	Quarry area										2.2			2.2
4	Contractor and labor camps							2						2
5	Crushing plant									2				2
	Total Temporary Area		0					3.5	0.5	4.5	7.7			16.2
	Total Permanent and Temporary Area		12.15					20.84	0.5	4.5	13.75			51.74

Source: Field Survey, 2018

Note: The area of bunker house (0.0025 ha) is included in the area acquired for the Powerhouse

* River and flood plain connected with forest (Forest land)





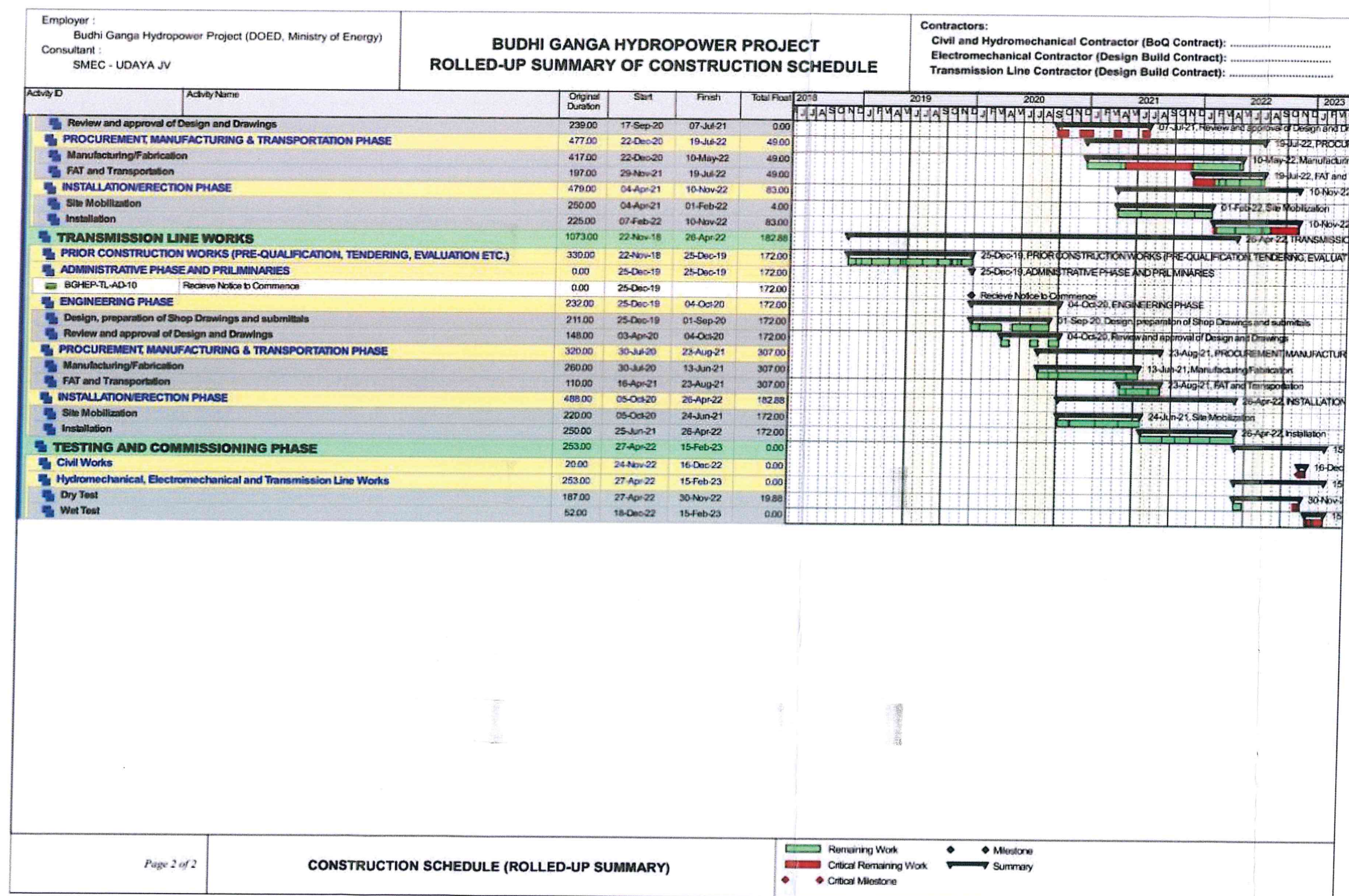


Figure 2-6: Construction schedule of the project

2.4.2 Construction Materials

The project will require construction materials including cement, sand, aggregates, reinforcing steel etc. (Table 2-4). Coarse aggregates and sand will be produced locally from designated quarries and borrow areas. Cement and steel will be procured from Nepal or India.

Table 2-4: Details of construction materials

SN	Materials	Quantities
1	Concrete Volume	200,000 m ³
2	Cement	65000 tons (Concrete + Shotcrete)
3	Total Aggregate Volume	190,000 m ³ (Concrete)
4	Sand Material 0 - 5mm	70,000 m ³ (Concrete + Shotcrete)
5	Coarse Material 6 - 75 mm	120,000 m ³ (Concrete)
6	Clay Material	2800 m ³
7	Rock-fill Material	17000 m ³ (U/S and D/S cofferdams)
8	Rocks for Rip-rap	3450 m ³
9	Stone filling	6000 m ³
10	Steel Reinforcement	7250 ton
11	Fly-ash (if accessible)	10,000 tons
12	Emulsion Explosive	350 tons
13	Short delay detonators No.8 strength 5m	50,000 pieces
14	Cordex Detonating Fuse 10g/m	50,000 m

2.4.3 Quarry Sites

Potential quarry sites that are close to the project site have been identified and are summarized in Table 2-4. These sites have massive deposition of rock and are located nearly flat surface and or gentle stable slopes. The sites are sufficiently far from forests and settlements as well. Following table summarizes an initial detail of these potential quarry sites.

Table 2-4: Details of quarry sites

SN	Potential Quarry site	Location	Types material	Approximate Quantity	Remarks
1	Budhabagar	Below the proposed Construction camp (29°17'37.98"N, 81°15'20.14"E)	Coarse aggregate	35x10 ³ m ³	River deposits
2	Ardoli Gad (Photo 2-5)	Confluence of Budhi Ganga River and Ardoli Gad (29°16'52.47"N, 81°14'46.74"E)	Boulders	100x10 ³ m ³	Debris brought down by Ardoli Gad
3	Budhi Ganga River Bank	Thanti Bazar (29°15'27.52"N, 81°13'51.61"E)	Boulder and coarse aggregates	90x10 ³ m ³	River deposits
4	Bhimkoti Khola	Downstream of tailrace (29°15'31.88"N, 81°14'8.68"E)	Boulders and coarse aggregates	80x10 ³ m ³	River deposit
5	Ikdi Gad	Confluence of Ikdi Gad and Budhi Ganga (29°18'26.39"N, 81°15'55.80"E)	Boulders and coarse aggregates	150x10 ³ m ³	Old river deposits Especially useful for works on reservoir area due to its accessibility

2.4.4 Explosive Handelling

Bunker house is proposed on the right bank near bridge connecting the Powerhouse (Figure 2-2). Explosive materials will be procured through designed process of government of Nepal and stored in bunker house. The explosive materials will be handled as per Explosive Materials Regulations, 2020.

2.4.5 Electro-mechanical and Hydro-mechanical Equipment

The electro-mechanical and hydro-mechanical equipment, such as generators, turbines, gates, etc. will be imported. Imported goods will be brought to the project site via Calcutta, the nearest seaport to Rupaidia of the India-Nepal border.

2.4.6 Construction Methods

The latest construction technologies using modern equipment and facilities will be adopted to ensure quality in works, timely completion and minimum cost. For economy, local resources will be utilized to the maximum extent possible. Due priority will be given to the recruitment of local people to minimize the requirement of temporary camps, reduce fuel wood and timber requirements, enhance local skills and economy and develop better relationship between the project and local people.

Two construction yards one each at headworks and powerhouse area is proposed. The construction yard at headworks site includes storage area of construction material like cement sand, aggregate and fuel whereas at Powerhouse area cement, sand, aggregate reinforcement steel along with other construction material will be stored. Crushing plant will be placed on private land at Ardoli Gad area (Photo 2-5). The capacity of the crusher plan will be 150 ton/hour.



Photo 2-5: Proposed Quarry Site and Crushing Plant Area Photo 2-6 Spoil disposal site-2

Similarly, the essential and the major efficient Construction Vehicles/equipment to be used are as follows:

1. Head-work Civil works:

Tower crane, concrete batching plants, sand crushing system (crushing machines, sand sorting system, sand washing machine), concrete pumps, drilling machines, drilling hammers,

compressors, bulldozer, excavators, loaders, grader, water pumps, concrete vibrators, concrete truck mixers, water tankers, rollers, scraper, powergeneration machines, etc. will be used.

2. Headwork Mechanical Works:

Gantry crane, mobile crane (25 to 100 tons), welding machines, etc. will be used.

3. Surface Excavation:

Drilling machines, excavator, loader, bulldozer, shotcrete machine/pumps, jumbo-drilling machine for excavation and rock support installation, grouting machine, concrete truck mixer, and power generation machines, etc. will be used.

4. Underground Excavation:

Jumbo-drilling machine, loaders, trucks, ventilation machines, concrete pumps, shotcrete pumps, excavators, drill machines for bench excavation, formworks and related hydraulic machines, hammers for drilling, compressors, grouting machines, concrete truck mixer, trucks with agitators, etc. will be used.

5. Surge Shaft:

Drilling machines, jumbo-drilling machines, excavators, bulldozer, Loader, lifting system of muck material, concrete pumps, shotcrete machine, slip-forms system, winches, concrete truck-mixer/trucks with agitators, etc. will be used.

6. Penstock:

Concrete pumps, bulldozer, excavator, loader, drilling machines, shotcrete machine, trucks, etc. will be used.

7. Powerhouse:

Bulldozer, excavator, drilling machines, shotcrete machine, jumbo-drilling machine, water pumps, concrete pumps, gantry crane, tower crane(optional), mobile crane, etc. will be used.

2.4.7 Construction Personnel

The project will require approximately 400 persons (75 skilled, 150 semi-skilled and 175 unskilled) during construction and 45 persons during operation phase. The skilled personnel will be hired from Nepal or abroad; however, unskilled and semi-skilled construction workers will mostly be hired locally.

2.4.8 Construction Power

For construction power, extension of 11 kV line from the national grid at Thanti Bazar will be undertaken. The length of the proposed line from Thanti Bazar to headworks site is 6.5km. The project will require 2 MW electricity for construction. For this, two diesel generators each having capacity of 1 MW will also be used as backup power for construction at headworks and powerhouse area.



2.4.9 Spoil Disposal

Excavation work for dam, desender, headrace tunnel, surge shaft, vertical shaft and underground powerhouse would generate spoil material 454,500 m³ spoil material. The details of spoil produced from different project component is as follows:

• Dam and Intake and Diversion Scheme (alluvium and rock)	140,000 m ³
• De-sander (colluvium and rock)	200,000 m ³
• Headrace tunnel work front tunnel intake	26,000 m ³
• Headrace tunnel work front from adit mid	52,000 m ³
• Headrace tunnel + surge shaft work front from adit end	30,000 m ³
• Powerhouse including tailrace	6,500 m ³

Out of this 30% (136,350 m³) will be used as aggregate and remaining 318,150 m³ spoil material will be disposed off at pre-identified, designated three muck disposal areas located at right bank of Budhi Ganga River.

Abandoned river terraces 100 m downstream of the Sanfebagar settlement, private barren land and river terrace at about 1km from the Sanfebagar (Photo 2-6), area near Kholsa are potential sites for spoil disposal (Figure 2-2). These sites are located on the right bank of Budhi Ganga River within the project area. They are relatively stable, and no apparent landslides are observed at or around them. Sensitive areas like forests, agricultural lands, natural water courses and areas prone to landslides and mass wasting will not be used for spoil disposal.

2.4.10 Construction Camps

The project will construct two contractors' camp and one owner camp. Contractor camps are proposed near Budhabagar for headworks area and Thanti Bazar area for powerhouse site. Both sites are located on private land. The Budhabagar site is used for cultivation (Photo 2-8) whereas at Thanti Bazar site is private barren land (Photo 2-7). Labor camp is proposed just upstream of Budhabagar settlement at right bank of river partly in private land and partly in barren land for headworks site and in private barren land for Powerhouse site. The owners/engineers camp will be constructed at Thapagaun at left bank of river near powerhouse site. This is private cultivated land.



Photo 2-7: Construction Camp at Powerhouse Site Photo 2-8: Construction Camp at Headworks Site



2.5 Project Area Delineation

The project covers ward numbers 4, 13 and 10 of Sanfebagar Municipality and ward numbers 4 and 8 of Mellekh Rural Municipality of Achham district, and ward number 10 of Budhiganga Municipality of Bajura district (Fig. 2-7). For the purposes of the EIA, the study area, or the impact zone, was delineated into two components: (a) the core project area, or the direct impact zone, and (b) the surrounding areas likely to be affected by the construction and operation of the project, i.e. the indirect impact zone. These areas were defined based on the proximity and magnitude of impacts.

2.5.1 Core Project Area

The core project area was taken as the areas fenced off for safeguarding various structures and facilities as well as the areas permanently acquired by the project and reduced flow zone (Table 2-5).

Table 2-5: Project area and location of the project structures and facilities

SN	Affected Rural Municipality /Municipality	Core project area	Surrounding Area	Project structures
1.	Sanfebagar Municipality (then Ghughurkot and Babala VDC and Sanfebagar Municipality) of Achham district	Area fenced off for safeguarding various structures and facilities as well as the areas permanently acquired by the project including reduced flow section of river	Ward 4, 10 and 13	Dam, reservoir, reduced flow zone, office of DoED, road to powerhouse site and immediately downstream of tailrace
2	Mellekh Rural Municipality (then Kushkot and Hatikot VDCs) of Achham district		Ward 4 and 8	Dam, reservoir tunnel reduced flow zone, powerhouse and surge shaft
3	Budhiganga Municipality of Bajura district (then Barabish VDC)		Ward 10	Reservoir

2.5.2 Surrounding Area

The surrounding area was taken as the “zone of influence” of the project - a greater area, which could be directly or indirectly affected by the construction and operation of the project.



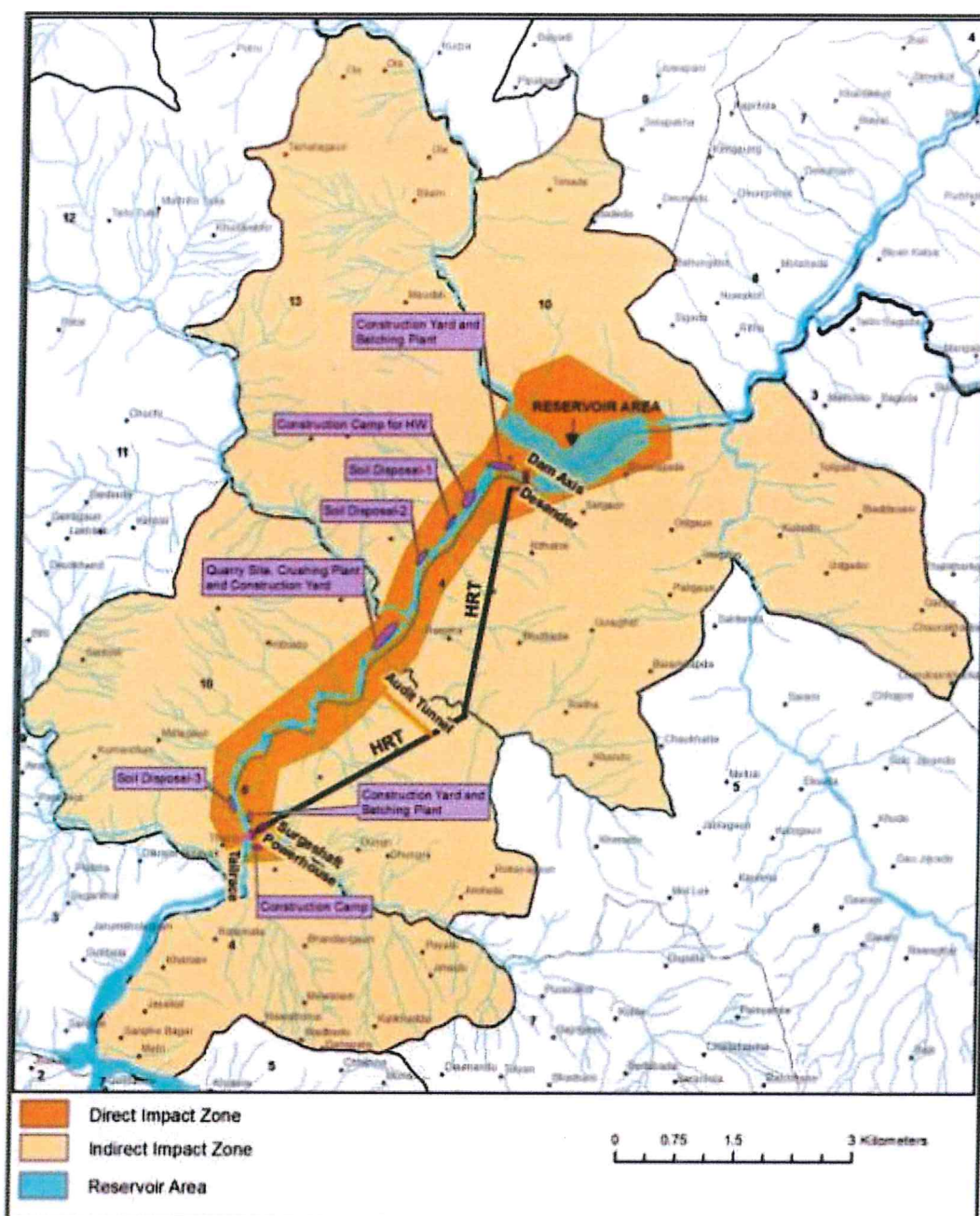


Figure 2-7: Project area delineation map

Source: DED, BHP, 2018

2.6 Power and Energy Production

With the available net head of 86.95 m, an overall efficiency of 87.35 % and a design discharge of 26 m³/s the installed capacity of the project calculated is 20 MW. Similarly the energy has been calculated with the concept of 6 hours of peaking (3 hours in the morning and 3 hours in the evening). The environment release considered is 0.99 m³/s (10% of driest month flow). The project will generate 109.61 GWh energy (net) annually. The % of dry and wet energy generated is 30.67 % and 69.33 % respectively. The project will generate maximum energy from May-November and minimum energy in the month of February (Table 2-6).

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Table 2-6: Power and energy production

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Flow (m ³ /sec)	9.90	10.75	11.89	10.89	14.83	38	187.54	197.02	124.78	46.06	21.09	13.77	53.04
Total d/s release including env. flow and others (m ³ /s)	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Flow Diversion for Power (m ³ /sec)	26	26	26	26	26	26	26	26	26	26	26	26	
Max. Power (MW)	19.64	19.66	19.64	19.64	19.64	19.65	20.01	20.01	19.98	19.70	19.67	19.64	
Energy (GWh)	Peak	3.53	3.18	3.52	3.40	3.50	-	-	-	-	-	3.40	20.53
	Off peak	1.16	1.40	2.17	1.71	3.45	12.23	13.89	13.90	12.34	13.77	9.93	89.08
Total	4.69	4.58	5.69	5.11	6.95	12.23	13.89	13.90	12.34	13.77	9.93	6.53	109.61
% Dry Energy	30.67												
% Wet Energy	69.33												

The project will generate 4.69 GWh energy in driest month January deducting an outage of 2%.

The detail of power and energy generation is presented in tables below.

Table 2-7: Power and energy production in January

Days	0-3 days	3-6 days	6-9 days	9-12 days	12-15 days	15-18 days	18-21 days	21-24 days	24-27 days	27-31 days
Minimum Flow [m ³ /s]	11.27	9.93	9.06	8.67	8.44	8.37	9.08	8.69	8.65	9.68
Average Flow [m ³ /s]	12.80	11.87	9.38	8.86	8.78	9.14	9.28	9.23	8.91	10.44
Maximum Flow [m ³ /s]	14.14	14.14	9.93	9.06	9.96	10.06	10.06	10.05	9.69	11.01
Total d/s release including env. flow and others (m ³ /s)	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Reservoir Elevation Start	715.80	715.74	715.03	716.39	716.46	716.80	716.72	716.32	716.35	716.70
Reservoir Elevation End	715.74	715.03	716.39	716.46	716.80	716.72	716.32	716.35	716.70	716.15
Reservoir Max Elevation	717.96	718.01	717.87	718.01	718.01	718.01	718.01	718.01	718.01	718.01
Reservoir Min Elevation	715.12	714.62	714.66	715.81	715.83	715.72	715.70	715.37	715.65	715.18
Maximum Power [MW]	19.62	19.64	19.60	19.63	19.63	19.63	19.63	19.63	19.63	19.63
Turbine Flow [m ³ /s]	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00
Peaking time [hr.]	10.83	9.50	7.17	7.10	6.90	7.17	7.50	7.50	7.03	8.83
TWL	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17
Approx. HL	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70
Crest El.	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00
Energy [GWh]	0.63	0.56	0.42	0.42	0.41	0.42	0.44	0.44	0.41	0.69
Peak Energy [GWh]	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.47
Non-Peak Energy [GWh]	0.28	0.20	0.07	0.06	0.05	0.07	0.09	0.09	0.06	0.22
Drawdown Level from Crest [m]	2.88	3.38	3.34	2.19	2.17	2.28	2.30	2.63	2.35	2.82
Drawdown within month	0.06	0.72	(1.36)	(0.07)	(0.34)	0.08	0.40	(0.03)	(0.35)	0.56

Fluctuation in Reservoir	2.84	3.39	3.21	2.20	2.18	2.29	2.31	2.64	2.36	2.83
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Table 2-5: Power and energy production in February

Days	0-3 days	3-6 days	6-9 days	9-12 days	12-15 days	15-18 days	18-21 days	21-24 days	24-27 days	27-28 days
Minimum Flow [m3/s]	8.87	8.62	8.97	9.95	10.47	10.37	10.32	10.06	10.18	10.18
Average Flow [m3/s]	9.91	8.80	9.38	12.34	10.88	11.84	12.64	10.44	10.53	10.18
Maximum Flow [m3/s]	11.50	9.13	9.95	15.41	11.51	16.94	16.94	10.80	10.86	10.18
Reservoir Elevation Start [-]	716.15	715.68	716.75	716.31	715.85	715.99	716.20	714.84	716.16	716.03
Reservoir Elevation End [-]	715.68	716.75	716.31	715.85	715.99	716.20	714.84	716.16	716.03	715.73
Reservoir Max Elevation [-]	718.01	718.01	718.01	718.01	717.90	718.00	718.01	717.75	718.15	717.80
Reservoir Min Elevation [-]	715.13	715.12	715.60	714.75	715.28	714.14	714.48	714.29	715.50	715.18
Maximum Power [MW]	19.63	19.63	19.63	19.64	19.61	19.63	19.64	19.57	19.66	19.59
Turbine Flow [m3/s]	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00
Peaking time [hr]	8.00	6.70	7.70	9.97	9.00	9.83	9.83	8.17	8.63	8.63
TWL	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17
Approx HL	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70
Crest Elv	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00
Energy [GWh]	0.47	0.39	0.45	0.58	0.53	0.57	0.58	0.47	0.51	0.17
Peak Energy [Ghr]	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.12
Non Peak Energy [GWh]	0.12	0.04	0.10	0.23	0.18	0.22	0.22	0.13	0.16	0.05
Drawdown Level from Crest [m]	2.87	2.88	2.40	3.25	2.72	3.86	3.52	3.71	2.50	2.82
Drawdown within month	0.47	(1.07)	0.44	0.46	(0.14)	(0.21)	1.36	(1.32)	0.14	0.30
Fluctuation in Reservoir	2.88	2.89	2.41	3.26	2.62	3.86	3.53	3.46	2.65	2.62

Table 2-6: Power and energy production in March

Days	0-3 days	3-6 days	6-9 days	9-12 days	12-15 days	15-18 days	18-21 days	21-24 days	24-27 days	27-31 days
Minimum Flow [m3/s]	10.66	9.46	9.28	11.65	13.63	12.86	11.36	10.82	9.85	10.20
Average Flow [m3/s]	12.11	10.11	9.86	14.06	15.08	13.15	12.01	11.18	10.15	10.60
Maximum Flow [m3/s]	13.45	10.67	11.66	17.75	17.75	13.64	12.87	11.36	10.83	10.94
Reservoir Elevation Start [-]	715.73	715.02	716.17	716.72	715.63	714.76	715.64	715.23	715.92	716.04
Reservoir Elevation End [-]	715.02	716.17	716.72	715.63	714.76	715.64	715.23	715.92	716.04	715.81

Reservoir Max Elevation [-]	718.01	717.88	718.01	718.01	718.01	717.98	718.01	717.89	717.90	717.83
Reservoir Min Elevation [-]	714.65	714.68	715.30	714.15	714.76	714.78	714.93	714.84	715.42	715.22
Maximum Power [MW]	19.64	19.60	19.63	19.63	19.64	19.63	19.63	19.61	19.61	19.59
Turbine Flow [m ³ /s]	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00
Peaking time [hr]	9.83	7.93	7.83	12.03	12.43	10.83	10.23	9.10	8.37	8.83
TWL	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17
Approx HL	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70
Crest Elv	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00
Energy [GWh]	0.57	0.46	0.46	0.70	0.72	0.63	0.60	0.53	0.49	0.69
Peak Energy [Ghr]	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.47
Non Peak Energy [GWh]	0.22	0.11	0.11	0.35	0.37	0.28	0.25	0.18	0.14	0.22
Drawdown Level from Crest [m]	3.35	3.32	2.70	3.85	3.24	3.22	3.07	3.16	2.58	2.78
Drawdown within month	0.71	(1.15)	(0.55)	1.09	0.87	(0.89)	0.41	(0.69)		0.24
Fluctuation in Reservoir	3.36	3.20	2.71	3.86	3.25	3.20	3.08	3.05	2.48	2.61

Table 2-7: Power and energy production in April

Days	0-3 days	3-6 days	6-9 days	9-12 days	12-15 days	15-18 days	18-21 days	21-24 days	24-27 days	27-30 days
Minimum Flow [m ³ /s]	9.92	9.92	11.20	10.45	10.22	10.23	9.77	10.08	9.39	9.40
Average Flow [m ³ /s]	10.03	10.43	11.87	11.10	10.78	10.49	10.21	11.57	10.98	12.73
Maximum Flow [m ³ /s]	10.09	330.00	12.90	11.51	11.47	10.95	10.68	13.80	13.80	14.68
Reservoir Elevation Start [-]	715.81	716.06	716.14	715.84	715.57	715.90	716.07	715.81	716.46	715.72
Reservoir Elevation End [-]	716.06	716.14	715.84	715.57	715.90	716.07	715.81	716.46	715.72	716.42
Reservoir Max Elevation [-]	717.81	717.79	718.01	717.97	717.75	718.01	718.01	718.01	718.01	718.01
Reservoir Min Elevation [-]	715.23	715.01	715.27	715.10	715.09	715.50	715.27	715.01	715.25	713.89
Maximum Power [MW]	19.59	19.58	19.63	19.62	19.58	19.63	19.63	19.63	19.63	19.64
Turbine Flow [m ³ /s]	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00
Peaking time [hr]	8.20	8.60	9.87	9.40	8.83	8.57	8.50	9.37	8.83	10.00
TWL	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17
Approx HL	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70

Crest Elv	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00
Energy [GWh]	0.48	0.50	0.58	0.55	0.52	0.50	0.50	0.55	0.52	0.58
Peak Energy [Ghr]	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Non Peak Energy [GWh]	0.13	0.15	0.23	0.20	0.17	0.15	0.15	0.20	0.17	0.23
Drawdown Level from Crest [m]	2.77	2.99	2.73	2.90	2.91	2.50	2.73	2.99	2.75	4.11
Drawdown within month	(0.25)	(0.08)	0.30	0.27	(0.33)	(0.17)	0.26	(0.65)	0.74	(0.70)
Fluctuation in Reservoir	2.58	2.78	2.74	2.87	2.66	2.51	2.74	3.00	2.76	4.12

Table 2-8: Power and energy production in May

Days	0-3 days	3-6 days	6-9 days	9-12 days	12-15 days	15-18 days	18-21 days	21-24 days	24-27 days	27-31 days
Minimum Flow [m3/s]	10.81	10.96	13.05	11.05	11.05	14.74	14.62	14.63	14.45	14.54
Average Flow [m3/s]	11.74	13.45	13.96	11.78	19.06	15.48	16.45	16.87	15.47	15.06
Maximum Flow [m3/s]	12.80	17.30	17.30	13.35	31.94	16.27	18.15	18.42	18.38	15.59
Reservoir Elevation Start [-]	716.42	715.82	716.60	715.35	715.54	716.31	715.52	714.91	716.05	715.02
Reservoir Elevation End [-]	715.82	716.60	715.35	715.54	716.31	715.52	714.91	716.05	715.02	714.15
Reservoir Max Elevation [-]	718.01	718.01	718.01	718.01	718.01	718.01	718.01	717.93	718.01	718.01
Reservoir Min Elevation [-]	715.05	713.70	715.24	715.13	712.91	715.32	714.81	713.49	714.85	713.98
Maximum Power [MW]	19.63	19.64	19.64	19.63	19.64	19.64	19.64	19.62	19.64	19.64
Turbine Flow [m3/s]	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00
Peaking time [hr]	9.87	10.73	11.37	9.67	11.97	12.97	13.97	14.13	13.17	11.37
TWL	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17
Approx HL	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70
Crest Elv	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00
Energy [GWh]	0.57	0.62	0.66	0.56	0.70	0.76	0.82	0.82	0.77	0.88
Peak Energy [Ghr]	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.46
Non Peak Energy [GWh]	0.23	0.27	0.31	0.21	0.35	0.41	0.47	0.47	0.42	0.42
Drawdown Level from Crest [m]	2.95	4.30	2.76	2.87	5.09	2.68	3.19	4.51	3.15	4.02
Drawdown within month	0.60	(0.78)	1.25	(0.19)	(0.77)	0.79	0.61	(1.14)	1.03	0.86
Fluctuation in Reservoir	2.96	4.31	2.77	2.88	5.10	2.69	3.20	4.44	3.16	4.03

Table 2-9: Power and energy production in June

Days	0-3 days	3-6 days	6-9 days	9-12 days	12-15 days	15-18 days	18-21 days	21-24 days	24-27 days	27-30 days
Minimum Flow [m3/s]	14.23	17.31	19.47	25.77	34.19	29.05	44.65	49.74	53.53	62.47
Average Flow [m3/s]	21.17	19.33	24.69	36.39	45.69	36.11	46.53	54.36	56.22	73.21
Maximum Flow [m3/s]	22.85	22.12	38.65	43.83	51.20	45.42	53.65	59.34	62.50	79.93
Reservoir Elevation Start [-]	714.15	717.08	715.94	717.99	718.01	718.01	718.01	718.00	718.00	717.99
Reservoir Elevation End [-]	717.08	715.94	717.99	718.01	718.01	718.01	718.00	718.00	717.99	717.98
Reservoir Max Elevation [-]	718.01	718.01	718.01	718.02	718.04	718.03	718.05	718.06	718.06	718.07
Reservoir Min Elevation [-]	712.30	715.08	712.74	717.94	718.00	718.01	717.99	717.96	717.96	717.93
Maximum Power [MW]	19.64	19.64	19.64	19.64	19.65	19.64	19.65	19.65	19.65	19.65
Turbine Flow [m3/s]	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00
Peaking time [hr]	16.70	16.70	20.63	24.00	24.00	24.00	24.00	24.00	24.00	24.00
TWL	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17
Approx HL	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70
Crest Elv	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00
Energy [GWh]	0.96	0.97	1.18	1.41	1.41	1.41	1.41	1.41	1.41	1.41
Peak Energy [Ghr]	-	-	-	-	-	-	-	-	-	-
Non Peak Energy [GWh]	-	-	-	-	-	-	-	-	-	-
Drawdown Level from Crest [m]	5.70	2.92	5.26	0.06	-	(0.01)	0.01	0.04	0.04	0.07
Drawdown within month	(2.93)	1.14	(2.05)	(0.02)	(0.00)	0.00	0.00	0.00	0.01	0.01
Fluctuation in Reservoir	5.71	2.93	5.27	0.08	0.04	0.02	0.06	0.10	0.10	0.14

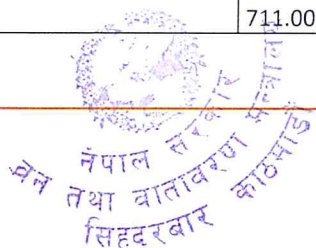
Table 2-10: Power and energy production in July

Days	0-3 days	3-6 days	6-9 days	9-12 days	12-15 days	15-18 days	18-21 days	21-24 days	24-27 days	27-31 days
Minimum Flow [m3/s]	73.69	83.94	107.58	117.05	117.12	147.11	143.12	139.71	171.93	169.84
Average Flow [m3/s]	86.49	96.71	122.49	125.40	139.54	161.40	150.01	150.68	192.16	188.29
Maximum Flow [m3/s]	100.70	330.00	131.58	129.47	176.53	176.53	153.58	194.31	203.02	214.28
Reservoir Elevation Start [-]	717.93	711.23	711.26	711.26	711.25	711.27	711.27	711.26	711.27	711.27
Reservoir Elevation End [-]	711.23	711.26	711.26	711.25	711.27	711.27	711.26	711.27	711.27	711.27
Reservoir Max Elevation [-]	718.04	711.48	711.60	711.61	711.56	711.78	711.70	711.66	711.85	711.77

Reservoir Min Elevation [-]	703.84	711.22	711.25	711.25	711.25	711.25	711.26	711.27	711.23	711.25
Maximum Power [MW]	19.86	19.92	19.94	19.95	19.93	19.99	19.97	19.96	20.01	19.99
Turbine Flow [m ³ /s]	28.50	28.50	28.50	28.50	28.50	28.50	28.50	28.50	28.50	28.50
Peaking time [hr]	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
TWL	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17
Approx HL	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70
Crest Elv.	711.00	711.00	711.00	711.00	711.00	711.00	711.00	711.00	711.00	711.00
Energy [GWh]	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.91
Peak Energy [Ghr]	-	-	-	-	-	-	-	-	-	-
Non Peak Energy [GWh]	-	-	-	-	-	-	-	-	-	-
Drawdown Level from Crest [m]	7.16	(0.22)	(0.25)	(0.25)	(0.25)	(0.25)	(0.26)	(0.27)	(0.23)	(0.25)
Drawdown within month	6.70	(0.02)	(0.00)	0.01	(0.02)	0.00	0.00	(0.01)	0.00	(0.00)
Fluctuation in Reservoir	14.20	0.26	0.35	0.36	0.31	0.53	0.44	0.39	0.62	0.52

Table 2-11: Power and energy production in August

Days	0-3 days	3-6 days	6-9 days	9-12 days	12-15 days	15-18 days	18-21 days	21-24 days	24-27 days	27-31 days
Minimum Flow [m ³ /s]	163.84	175.87	178.41	178.50	192.21	206.58	193.37	176.16	183.35	175.21
Average Flow [m ³ /s]	183.04	179.85	185.97	212.14	200.18	222.13	210.64	194.52	210.98	184.52
Maximum Flow [m ³ /s]	198.52	187.49	197.29	235.19	208.32	238.24	234.54	219.14	235.55	193.88
Reservoir Elevation Start [-]	711.27	711.27	711.27	711.27	711.27	711.27	711.27	711.27	711.27	711.27
Reservoir Elevation End [-]	711.27	711.27	711.27	711.27	711.27	711.27	711.27	711.27	711.27	711.27
Reservoir Max Elevation [-]	711.74	711.82	711.81	711.79	711.86	711.88	711.96	711.83	711.79	711.83
Reservoir Min Elevation [-]	711.26	711.24	711.24	711.25	711.22	711.22	711.17	711.24	711.25	711.23
Maximum Power [MW]	19.98	20.00	20.00	19.99	20.01	20.01	20.03	20.00	19.99	20.00
Turbine Flow [m ³ /s]	28.50	28.50	28.50	28.50	28.50	28.50	28.50	28.50	28.50	28.50
Peaking time [hr]	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
TWL	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17
Approx HL	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70
Crest Elv	711.00	711.00	711.00	711.00	711.00	711.00	711.00	711.00	711.00	711.00



Energy [GWh]	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.91
Peak Energy [Ghr]	-	-	-	-	-	-	-	-	-	-
Non Peak Energy [GWh]	-	-	-	-	-	-	-	-	-	-
Drawdown Level from Crest [m]	(0.26)	(0.24)	(0.24)	(0.25)	(0.22)	(0.22)	(0.17)	(0.24)	(0.25)	(0.23)
Drawdown within month	(0.00)	0.00	0.00	(0.00)	(0.00)	0.00	(0.00)	0.00	(0.00)	0.00
Fluctuation in Reservoir	0.48	0.58	0.57	0.54	0.64	0.66	0.79	0.59	0.54	0.60

Table 2-12: Power and energy production in September

Days	0-3 days	3-6 days	6-9 days	9-12 days	12-15 days	15-18 days	18-21 days	21-24 days	24-27 days	27-30 days
Minimum Flow [m3/s]	150.16	133.04	122.43	108.89	106.15	97.78	106.08	99.71	91.62	72.96
Average Flow [m3/s]	155.63	147.99	130.67	116.49	108.89	107.62	126.37	116.52	111.93	78.90
Maximum Flow [m3/s]	166.94	159.17	134.02	123.44	111.93	142.26	144.67	134.49	134.49	91.70
Reservoir Elevation Start [-]	711.27	711.27	711.26	711.25	711.24	711.24	711.26	711.23	711.26	711.25
Reservoir Elevation End [-]	711.27	711.26	711.25	711.24	711.24	711.26	711.23	711.26	711.25	711.23
Reservoir Max Elevation [-]	711.73	711.70	711.60	711.56	711.51	711.49	711.64	711.50	711.73	711.57
Reservoir Min Elevation [-]	711.26	711.26	711.25	711.24	711.24	711.23	711.24	711.24	711.23	711.20
Maximum Power [MW]	19.98	19.97	19.95	19.93	19.92	19.92	19.95	19.92	19.86	19.85
Turbine Flow [m3/s]	28.50	28.50	28.50	28.50	28.50	28.50	28.50	28.50	28.50	28.50
Peaking time [hr]	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	13.97	13.97
TWL	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17	623.17
Approx HL	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70
Crest Elv	711.00	711.00	711.00	711.00	711.00	711.00	711.00	711.00	711.00	711.00
Energy [GWh]	1.43	1.43	1.43	1.43	1.43	1.43	1.43	1.43	0.84	0.84
Peak Energy [Ghr]	-	-	-	-	-	-	-	-	-	-
Non Peak Energy [GWh]	-	-	-	-	-	-	-	-	-	-
Drawdown Level from Crest [m]	(0.26)	(0.26)	(0.25)	(0.24)	(0.24)	(0.23)	(0.24)	(0.24)	(0.23)	(0.20)
Drawdown within month	0.00	0.01	0.01	0.01	0.01	(0.03)	0.03	(0.02)	0.01	0.02
Fluctuation in Reservoir	0.47	0.44	0.35	0.32	0.27	0.26	0.40	0.26	0.50	0.37

Table 2-13: Power and energy production in October

Days	0-3 days	3-6 days	6-9 days	9-12 days	12-15 days	15-18 days	18-21 days	21-24 days	24-27 days	27-31 days
Minimum Flow [m3/s]	63.41	55.67	51.52	46.71	43.29	39.91	35.25	31.72	29.34	26.76
Average Flow [m3/s]	67.58	59.31	53.59	48.65	44.40	41.42	37.52	33.53	30.13	27.88
Maximum Flow [m3/s]	72.13	330.00	55.68	51.54	46.73	44.01	39.93	35.26	31.73	29.35
Reservoir Elevation Start [-]	711.23	718.03	718.21	718.19	718.17	718.15	718.13	718.10	718.07	718.04
Reservoir Elevation End [-]	718.03	718.21	718.19	718.17	718.15	718.13	718.10	718.07	718.04	717.80
Reservoir Max Elevation [-]	718.04	718.24	718.27	718.24	718.21	718.19	718.16	718.12	718.08	718.05
Reservoir Min Elevation [-]	711.40	718.11	718.19	718.17	718.15	718.13	718.10	718.07	718.05	717.81
Maximum Power [MW]	19.65	19.70	19.70	19.70	19.69	19.69	19.68	19.67	19.66	19.66
Turbine Flow [m3/s]	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00
Peaking time [hr]	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00	24.00
TWL	623.15	623.15	623.15	623.15	623.15	623.15	623.15	623.15	623.15	623.15
Approx HL	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70
Crest Elv	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00
Energy [GWh]	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.42	1.41	1.89
Peak Energy [Ghr]	-	-	-	-	-	-	-	-	-	-
Non Peak Energy [GWh]	-	-	-	-	-	-	-	-	-	-
Drawdown Level from Crest [m]	6.60	(0.11)	(0.19)	(0.17)	(0.15)	(0.13)	(0.10)	(0.07)	(0.05)	0.19
Drawdown within month	(6.80)	(0.17)	0.02	0.02	0.01	0.02	0.03	0.03	0.02	0.24
Fluctuation in Reservoir	6.64	0.13	0.08	0.07	0.06	0.06	0.06	0.05	0.03	0.24

Table 2-14: Power and energy production in November

Days	0-3 days	3-6 days	6-9 days	9-12 days	12-15 days	15-18 days	18-21 days	21-24 days	24-27 days	27-30 days
Minimum Flow [m3/s]	24.86	23.32	21.74	21.09	20.26	19.49	18.70	17.63	17.23	16.91
Average Flow [m3/s]	25.60	24.06	22.54	21.41	20.69	19.95	19.14	18.14	17.60	17.07
Maximum Flow [m3/s]	26.27	24.87	23.33	21.74	21.09	20.26	19.49	18.70	17.85	17.24
Reservoir Elevation Start [-]	717.80	714.30	716.82	716.13	716.42	716.14	715.86	715.75	715.47	715.27
Reservoir Elevation End [-]	714.30	716.82	716.13	716.42	716.14	715.86	715.75	715.47	715.27	715.67
Reservoir Max Elevation [-]	717.81	717.83	718.12	718.03	718.13	718.08	718.05	718.10	717.70	717.91

Reservoir Min Elevation [-]	714.29	714.37	716.00	716.09	716.02	715.73	715.62	715.35	715.16	715.30
Maximum Power [MW]	19.60	19.60	19.66	19.65	19.67	19.66	19.65	19.66	19.57	19.62
Turbine Flow [m ³ /s]	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00
Peaking time [hr]	24.00	20.33	20.00	18.67	18.07	17.53	16.67	15.83	15.33	14.53
TWL	623.15	623.15	623.15	623.15	623.15	623.15	623.15	623.15	623.15	623.15
Approx HL	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70
Crest Elv	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00
Energy [GWh]	1.39	1.18	1.17	1.09	1.06	1.02	0.98	0.92	0.89	0.84
Peak Energy [Ghr]	-	-	-	-	-	-	-	-	-	-
Non Peak Energy [GWh]	-	-	-	-	-	-	-	-	-	-
Drawdown Level from Crest [m]	3.71	3.63	2.00	1.91	1.98	2.27	2.38	2.65	2.84	2.70
Drawdown within month	3.50	(2.52)	0.69	(0.29)	0.28	0.28	0.11	0.28	0.20	(0.40)
Fluctuation in Reservoir	3.52	3.46	2.12	1.94	2.11	2.35	2.43	2.75	2.54	2.61

Table 2-15: Power and energy production in December

Days	0-3 days	3-6 days	6-9 days	9-12 days	12-15 days	15-18 days	18-21 days	21-24 days	24-27 days	27-31 days
Minimum Flow [m ³ /s]	15.70	15.02	14.64	13.96	13.44	13.01	12.39	12.22	11.61	11.27
Average Flow [m ³ /s]	15.98	15.36	14.81	14.56	13.64	13.23	12.65	12.40	11.91	11.36
Maximum Flow [m ³ /s]	16.34	15.70	15.02	14.90	13.96	13.44	13.02	12.61	12.36	11.62
Reservoir Elevation Start [-]	715.67	715.89	715.63	715.94	715.56	715.77	715.71	715.63	715.48	715.84
Reservoir Elevation End [-]	715.89	715.63	715.94	715.56	715.77	715.71	715.63	715.48	715.84	715.80
Reservoir Max Elevation [-]	718.01	718.01	718.01	718.01	718.00	718.01	718.01	717.77	718.01	718.01
Reservoir Min Elevation [-]	715.30	715.15	715.23	715.13	715.25	715.31	715.25	715.02	715.30	715.46
Maximum Power [MW]	19.64	19.64	19.64	19.64	19.64	19.64	19.64	19.58	19.64	19.64
Turbine Flow [m ³ /s]	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00	26.00
Peaking time [hr]	13.70	13.30	12.50	12.50	11.57	11.17	10.70	10.50	9.83	9.50
TWL	623.15	623.15	623.15	623.15	623.15	623.15	623.15	623.15	623.15	623.15
Approx HL	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70	7.70
Crest Elv	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00	718.00

Energy [GWh]	0.80	0.77	0.73	0.73	0.67	0.66	0.62	0.61	0.58	0.56
Peak Energy [Ghr]	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Non Peak Energy [GWh]	0.45	0.42	0.38	0.38	0.32	0.30	0.27	0.26	0.22	0.20
Drawdown Level from Crest [m]	2.70	2.85	2.77	2.87	2.75	2.69	2.75	2.98	2.70	2.54
Drawdown within month	(0.22)	0.27	(0.31)	0.37	(0.20)	0.06	0.08	0.15	(0.36)	0.04
Fluctuation in Reservoir	2.71	2.86	2.78	2.88	2.75	2.70	2.76	2.75	2.71	2.55



3. STUDY METHODOLOGY

3.1 Introduction

This chapter outlines the methodology adopted for conducting the EIA for the proposed Budhi Ganga HPP. The methodology for conducting the EIA follows the Environment Protection Rules, 1997 and the recent amendment. This EIA was prepared in accordance with all the legal requirements of GoN, based on field studies and consultation with local people and government officials. In addition, the information presented in this Chapter has been presented through various primary as well as secondary sources.

The study has been carried out based on the Terms of Reference approved from the then Ministry of Population and Environment. The issues identified in the ToR were studied in detail and cost effective mitigation measures have been proposed for each identified adverse impact. Literature review, field survey by the team of experts (observation, sampling, checklist and questionnaire), meetings and discussions with line agencies, public meeting and impact assessment matrix were the main tools applied for the EIA. Sample sites have been selected based on the ground condition and study tools have been applied accordingly. The detail of methodology applied to conduct Environmental Impact Assessment of the proposed project is presented below.

3.2 EIA Scoping and Terms of Reference

SMEC-UDAYA JV carried out an EIA Scoping study in 2017. Based on field visits, consultations with local stakeholders of the project area and district level stakeholders, the Budhi Ganga HPP scoping document was prepared. The Scoping study led to the preparation of Terms of Reference (ToR) for this EIA as per Schedule 4 of the Environment Protection Rules, 1997. The Scoping and ToR documents were approved by the then Ministry of Population and Environment.

3.3 Data Requirement

For the physical environment, data on climate (air temperature, rainfall, humidity and precipitation), geology (rock type, slope stability), hydrology (flow and flood data), sedimentation (sediment load and patterns) and volume and type of spoil material was required. Likewise, topographical data, land use, air noise and water quality were also required for the study.

The biological environment data required for the study includes forest area, vegetation types, forest type, species, wood volume, biomass etc. Contiguous forest outside the project influence area, forest in different project component and facilities, NTFP and dependency on forest resources was the other information required for the study. The data regarding types of mammals, birds, reptiles including their habitat, fish diversity, composition and migration and information about the listed species was required.

Socio-economic and cultural data, required for the study includes project area's population, household size, male-female ratio, infrastructure, ethnicity, language, religion, food sufficiency, disease, occupation, migration, education and skill, energy, communication and information, cropping pattern and average annual income. The other



socio-economic data such as irrigation facilities, water mills/ghattas, water supply system and sanitation, educational and health institutions, infrastructures and their approximate distance from the project component sites was required. Household level data of the Project Affected Families was required for the study of project impact at household level.

3.4 Literature Review

Review of EIA report of Budhi Ganga HPP prepared by the METCON Consultants Pvt. Ltd as per National EIA guidelines, district level annual reports, and other pertinent literatures were done. Topographical and land use maps of the area including Google Earth maps and GIS maps were studied for field study. The major reports consulted included: District Profile of Achham and Bajura district published by the then District Development Committee; National Population and Housing Census 2012, published by Central Bureau of Statistics, GoN. Based on the reviewed information regarding the project areas, data gaps were identified and the methodology described in this chapter was developed to collect other relevant information required for the EIA. All the issues identified in TOR document were studied during the EIA.

Information on climate (air temperature, rainfall, humidity and precipitation), geology (rock type, slope stability), hydrology (flow and flood data), sedimentation (sediment load, pattern) and volume and type of spoil material was taken from the Detailed Engineering Design Report prepared for this project. Review of topographical map and land use map was done to identify the land use patterns of the area.

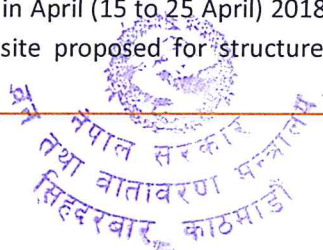
The general information of the forest area, types, community forest of the district was collected by review of publication of District Forest Office of Achham and Bajura district (DFO, 2071). The wildlife information was collected by review of existing literature on birds (Baral, H.S 2003) and mammals (Baral, H.S. and Shah, K.B. 2008).

Socio-economic and cultural data, such as population of project district and municipalities/rural municipalities, households size, male-female ratio, infrastructures, ethnicity, religion etc. was derived from National Population and Housing Census (CBS 2012), National Population and Housing Census, Village Development/ Municipalities, (CBS 2014).

Data related to infrastructure and development programs was derived from district profiles, development plans and program and achievement reports published by District Development Committee (DDC)/District Coordination Committee (DCC), district-level government offices, VDC, rural municipality, municipality and other organizations.

3.5 Field Investigation

A team of experts specialized in engineering, forestry, wildlife, fisheries and social science visited the project area to collect baseline information of the area and to identify the potential impacts of the proposed project during construction and operation phases. Field survey was conducted twice during the study period to cover the wet season and dry season data. The field investigation lasted for 9 days in August (12 to 20 August) 2016 and 11 days in April (15 to 25 April) 2018 respectively. During this visit, the team visited the project site proposed for structures and facilities as well as settlements of the



affected municipalities and rural municipalities and collected required data on physical, biological, and socio-economic and cultural resources of the area. Topographical maps were referred for site investigations. The disposal areas, permanent and temporary camp areas and construction yards were also visited on foot to verify and confirm the site conditions. The stability of slopes and the presence of landslides, fan deposits and rock slides within the project area were evaluated mainly by site observations and from maps.

The team also visited relevant government offices of project districts to interact with concerned officials and collect necessary information and their concerns. The study team has adopted a participatory approach with maximum involvement of different stakeholders of the project at the local and district levels to generate relevant information for the EIA. The study team has maintained a close contact with the district level government relevant line agencies, municipality/rural municipality level key stakeholders and community forest users group while conducting fieldwork for the EIA.

3.5.1 Physical Environment

i) Climate

The data relating to the temperature and precipitation was derived from the hydro-meteorological data sheet of the Department of Hydro-Meteorology (DHM). The available data of the nearest Meteorological station such as Dipayal, and Sanfebagar was obtained from the DHM office.

Site specific data of temperature was derived from the available one-year data from the meteorological equipment established at Thanti Bazar at DoED office.

ii) Hydrology

The hydrological data for the EIA has been derived from Hydrology Report of the project. Besides this, stream gauging was placed at 100m downstream of the proposed dam site to measure the discharge of Budhi Ganga River. The gage was electronically tied-up with the monitoring station in Kathmandu. The measurement included the monthly minimum and maximum flow of the River.

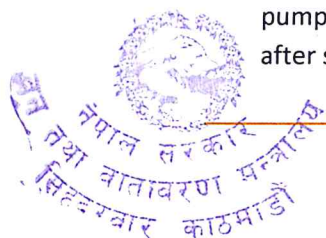
iii) Air Quality

The air quality data of the project area has been meticulously measured. The air sampling was done at the following sites (Table 3-1).

Table 3-1: Air sampling sites

Sample ID	Location	Coordinates		Elevation
		Longitude (N)	Latitude (E)	
AP-1	Dam, Budhabagar	N 29 18 11	E 81 15 53	700m
AP-2	Power House, Thapa gaun	N 29 15 40	E 81 13 57	600m
AP-3	Main quarry, Chepe Khola (Sanfebagar)	N 29 14 52	E 81 12 21	588m

Parameters such as TSP, PM₁₀, Sulfur dioxide and Nitrogen dioxide were measured using appropriate tools and methodology. The TSP and PM₁₀ was measured by SKC gravimetric pumps, model no Air Chek XR500 with cyclones. The pumps were calibrated before and after sampling using a soap bubble meter or a rotameter. The sampling period was eight



hours in each site. Two different cyclones were used for PM₁₀ and TSP and it was also cleaned before and after by using air pumps and cotton buds to minimize the false reading. The paper size of filter paper was 47mm diameter and Teflon filter at a flow rate of 2 l/min in 1.5m height from ground level was used for the study.

Nitrogen dioxide was measured by ToxiRAE II NOX sampler. QRAE II Continuous Multi-gas Detector Diffusion Monitor by RAE System has been calibrated in zip lock bag before and after each monitoring. The reading intervals were set up in ten-minute interval for eight straight hours in all locations. This full-featured single-gas monitor is compact and light enough. The ToxiRAE II continuously displays gas concentration; short-term exposure limits (STEL), time-weighted average (TWA), and peak values. Sulfur dioxide (SOX) was measured by ToxiRAE II NOX sampler. The reading intervals were set up in ten-minute interval for eight straight hours in all locations.

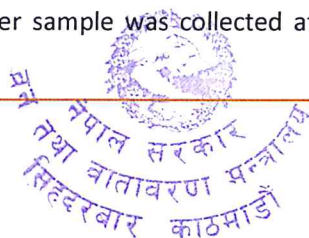
PM_{2.5}, ambient temperature and humidity was measured by UCB PATS plus a sophisticated device, manufactured by Berkeley Air Monitoring Network. The activation and download of PATS plus were done using PICA software in the closed rooms. Air is pumped in the boxes through High Efficiency Particulate Air (HEPA) filters for 50 -70 times. The data logging interval was set up for 10 minutes during activation and was deployed in locations for eight straight hours. After 10 minutes the PATS were transported to sampling location in air tight zip lock bags and are deployed with other devices for concurrent reading.

iv) Noise Quality

The noise quality parameters such as L_{eq} (Average sound pressure level), L_{90} (Ninety percentile sound pressure level), L_{10} (ten percentile sound pressure level) and L_d (Average day time sound pressure level) were measured for the three sites namely dam site, powerhouse area and Sanfebagar area using laboratory calibrated SPL meter manufactured by Lutron, Taiwan, model no SL 4010 and calibrated at 94_{dB(A)}. The sample sites were similar where air quality sampling was done (Fig. 3-1). The battery operated equipment was placed in 1.5-meter-high from ground level for ten-minute duration continuous SPL record for each two hours' representation. The method applied for sampling, monitoring and calculation was equi-partitioned energy distribution reference: JIS C 1502 (1990), Sound Level Meters. The instrument was held in hand and the microphone pointed at measured noise source and the sound level was displayed in "dBA" (decibel) unit. The noise descriptors were calculated based on recorded continuous sound pressure level for ten minute intervals of each time zone.

v) Water Quality

Water samples were collected from the dam, powerhouse and Sanfebagar area (downstream of powerhouse tailrace) of Budhi Ganga River (Fig. 3-1). One litre sample was filtered through membrane filter paper followed by rinsing with ten drops of saturated magnesium carbonate to fix the collected chlorophyll on the filter paper. The filter papers were then kept inside petri plates, sealed and transported in ice box to the laboratory without exposure to the light maintained at four degree for analysis. One liter water sample was collected at each sampling site and ISO 5667-6:2005 method was



applied for sample collection. The collected sample was transported in ice box for analysis in the NESS laboratory in Kathmandu.

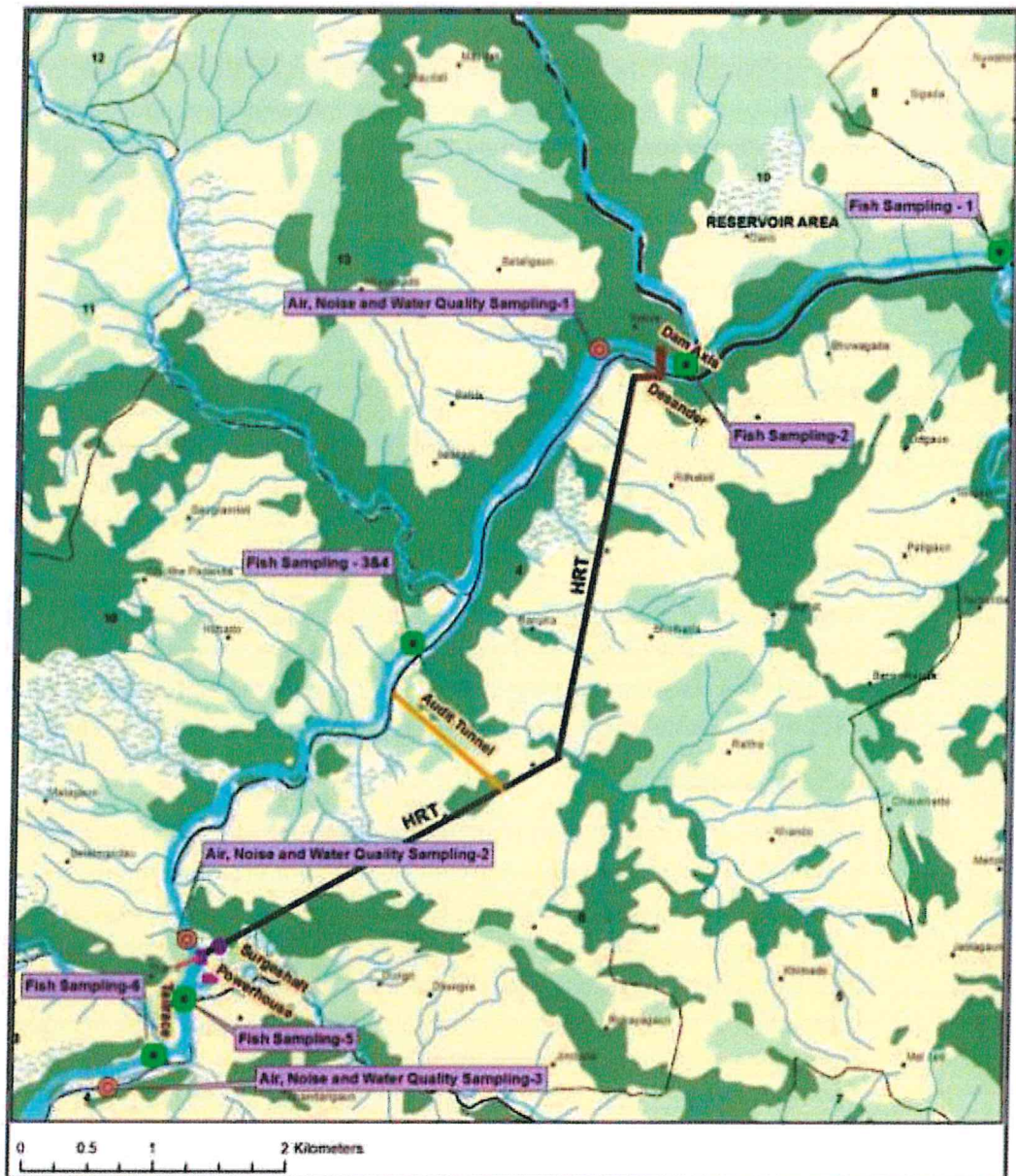


Figure 3-1: Sampling sites

vi) Geology

The regional geology and geology of the project sites has been covered in the EIA Report, as per the available information in the Detailed Engineering Design Study (DEDS). The regional seismo-tectonics around the project area highlighting seismicity has been covered in the EIA report, as per the available information in the Geology and Geotechnical Report of the project.

The stability of slopes and the presence of landslides, fan deposits and rock fall within the project area were evaluated mainly by site observations and from topographical maps.



The local people were enquired about the occurrence of major landslides and soil erosion in the project area.

vii) Land Use

Land-use pattern of the study area as well as the project site was carried out by standard methods of analysis of remotely sensed data followed by ground truth collection and interpretation of topographical and GIS data.

3.5.2 Biological Environment

3.5.2.1 Terrestrial Environment

A. Vegetation/Forest Resources

i) Walkthrough Survey

Walkthrough survey was conducted at each project site to make general observation of the vegetation type and forest area delineation in different project components. Based on the field observation sample plots were fixed covering different type of vegetation and project sites.

Forest inventory survey was conducted to collect data on vegetation, estimate of forest products that will be lost as a part of site clearance. Commonly employed standard methods like: random sampling at site, questionnaire and interviews with local people and other concerned agency have been conducted using appropriate tools.

ii) Forest Sampling

Thirty four forest sample plots (Volume II, Appendix: B) were chosen to assess the status of the natural vegetation and biodiversity in different project component sites. As far as practicable, representative units of the major forest types or vegetative areas were selected for the assessment. Some additional sample plots were also laid in surrounding area and immediate vicinity of the project site to monitor changes during and after the completion of the project. Quadrats of 25m x 25m plots were made in most of the cases and in adverse topography 10m x 10m plots were taken to cover the representative area of forest growth (Photo 3-2). Circumference at breast height (dbh) was measured at 1.3 m from the ground level and later converted to diameter at breast height (dbh) for volume and basal area estimation (Photo 3-1).

Ground conditions such as gregariousness of the herbaceous vegetation, rock-outcrops, richness of the ground flora, etc. were also noted. Height of the few tallest trees (3 to 4) was measured by using clinometers and compass, and height of rest of the trees was measured by ocular estimation based on the previous measurement. Ecological parameters such as crown coverage, aspect, slope of inclination, etc. were also recorded for ecological analysis and further study. Crown coverage was estimated from ocular estimation. Ground flora was identified in the field as far as possible and the trees and other species that could not be identified in the field were later identified in the National Herbarium by tallying with the specimens and with the help of standard literatures (DPR, 2001; Polunin and Stainton, 1984; Press et al., 2000; Regmi, 1982; Stainton, 1988). Along



with this, general floral diversity survey covering the project area and vicinities were also conducted.

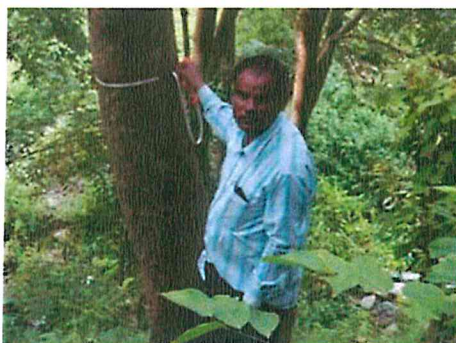


Photo 3-1: Measuring treediameter



Photo 3-2: Quadrat sampling

iii) Group Meetings

Group meetings were conducted in all affected community forest users group (Photo 3-3 and Photo 3-4) to discuss forest management pattern, vegetation in their forest resource use pattern of the plants within the forest environment (general plant diversity) and village settlements (mostly agro-diversity). Ethno-botanical information was also gathered through consultation to explore the specific use of plants found in and around the project area.



Photo 3-3: Meeting with Imildugra CFUGs Photo 3-4: Meeting with Sukethana CFUGs

B. Wildlife

Data on wildlife was collected by direct observation at different project sites and adjacent areas with various land use types (e.g. forest areas, grassland, agriculture land). Different signs (e.g. scats/droppings, scratches, calls, pugmarks, carcasses and scales) were also used for identification of mammals, birds and reptiles. Other indirect indicators such as cliffs were also observed in the area.

i) Transect Survey

Three transects, each measuring 150 m in length, were established at the right bank of Dam site, adit area and powerhouse area, to collect site specific information of wild animals. These transects were checked each consecutive morning for wildlife signs such as droppings and footprints for 3 days. Since the area is disturbed due to human activities no such signs were observed.



The area surrounding the transect sites was also investigated for habitat condition and adjacent cultivated areas were examined using binoculars. The potential presence of some wildlife species was assumed based on observation of vegetation types.

In addition, mammals and aquatic birds found in project area was studied by walking along the bank of Budhi Ganga River from Budhabagar to Thanti Bazar.

Birds were observed with the help of binoculars and identified using standard keys developed by Baral (2003) and Salim Ali (1997). Many birds were identified by their sounds. The status of endangered, threatened, rare and vulnerable species was identified using the list of protected animals (Shrestha, 1997) published by IUCN, Nepal and website www.iucnredlist.org. The data sheet prepared and used for the wildlife data collection is presented in Volume II, Appendix: B.

ii) Group Discussion

Meetings were conducted with forest users group of Rakshe, Juke and Imiltukra community forest to discuss the wild animals found in their forest and immediate vicinity. Likewise, the meeting conducted for socioeconomic data collection was also used for wildlife information collection (Photo 3-5 and Photo 3-6). Colored photographs of different species of mammals, birds, amphibians and reptiles were shown to the groups to confirm the species' presence. Information regarding the raiding of crops and depredation of domestic animals were also collected through group discussion. The information provided by local people was verified through the available literatures (Baral and Shah 2008 and Baral 2003).

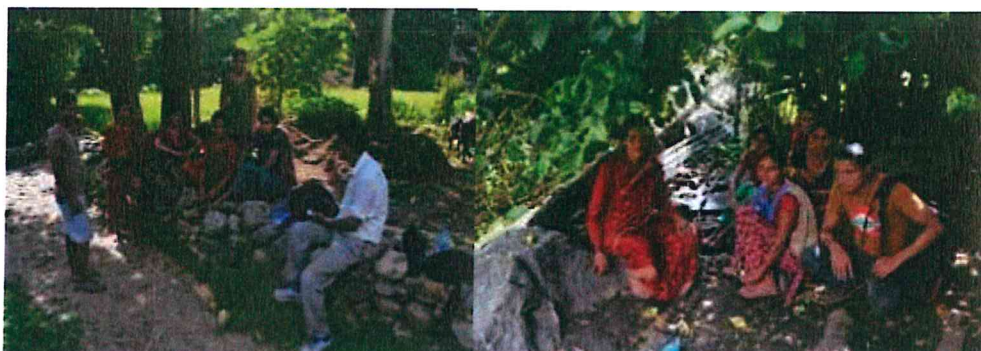


Photo 3-5: Group discussion with women group

Photo 3-6: Group discussion with women group

iii) Interviews with Local Residents

Local villagers from Budhabagar, Tansi Bazar and Thanti Bazar were interviewed using a structured questionnaire to document their knowledge and sighting experience regarding local fauna. Color photographs of different mammals, birds and reptiles were shown to the local people to ascertain their occurrence.

3.5.2.2 Aquatic Environment

i) Habitat Characterization

The river habitat was studied by using visual method (observation). Topographical map of 1:25,000 scale was used for river habitat characterization. Possible spawning habitat conditions were recorded by walking along the bank of river. The riverine habitat such as

run, riffle and pool habitat, river bifurcation and meandering, and tributaries joining in different stretches of Budhi Ganga River was recorded by visual observation during the field visit. Attempt has been made to collect information about the river condition (site observation method), depth (measurement through scale) and flow (floating method) at sampling areas. The habitats were marked in GIS and Google map.

ii) Sampling Locations

Fish samples were collected from Budhi Ganga River and its feeder streams to collect detailed information about fish distribution and composition. Among the tributaries Sarane Gad, Ikri Gad, Bhimkoti Gad and Jijadi Gad were sampled for the study of fish diversity and composition. The sampling stations were set along the stretch of Budhi Ganga River from upstream of reservoir to below powerhouse. Approximately 500m² area was covered at each sampling site.

The following sampling stations were set along the different stretch of Budhi Ganga River (Figure 3-1) for 2016 August and 2018 April sample. The planktons and aquatic insects were collected from stations 2 and 4 of the Budhi Ganga River whereas fish sampling was done from five sampling sites given below (Table 3-2).

Table 3-2: Sampling locations/stations

Sampling Stations	Sampling Locations	Sampling Time	Sampling Item			
			Zooplankton	Phyto-plankton	Aquatic Insects	Fish
1	Budhi Ganga River with Sarane Gad Confluence area	Morning				✓
2	Budhi Ganga River with Ikri Gad Confluence area	Evening	✓	✓	✓	✓
3	Budhi Ganga River with Ardole Gad Confluence area	Morning				✓
4	Budhi Ganga River with Bhimkoti Gad Confluence area	Morning	✓	✓	✓	✓
5	Budhi Ganga River with Jijadi Gad Confluence area	Morning				✓

iii) Sampling of Planktons and Aquatic Insects

✓ Zooplanktons

One hundred liters of River water was filtered through 50 mm plankton net to collect 50 ml sample. The filtered water along with zooplankton was transferred in to the sample bottle. Few drops of 3% formaldehyde solution were added in to the plankton sample for preservation.

✓ Phytoplankton

One liter of water sample was collected in a glass jar and Lugal's solution was added in the glass jar till light tea color appeared. The collected water was allowed to settle for 24 hours and after that water was siphoned out with the help of plastic tube. The sample

solution was siphoned till it reached 50 ml mark on the glass jar. Then the remaining solution of phytoplankton was transferred into the sample bottle.

✓ Aquatic Insects

Aquatic insects were collected by D-net (Drift net) and forceps and preserved in 10% formalin solution.

iv) Sampling of Fish

✓ Hiring of local fishermen

The Fisheries Expert selected 2 supervisors and 4 local fishermen for fish and aquatic life sampling. One-day training for the fishermen and supervisors was conducted at project site in August 2016 and April 2018 to familiarize with them about the sampling procedures for this study, counting of level of efforts, catch collection and other technical details.

✓ Cast net

Cast net was used for fish study at different sampling sites (Photos 3-7 and 3-8). This is the commonest fishing gear used in mountain fisheries in Nepal and India. This gear is widely used in Budhi Ganga River and other hill streams of Nepal.

Two cast nets were used for fish sampling and 200 efforts were made at each sampling site. The cast nets were made up of nylon thread with mesh size of 1.5 cm × 1.5 cm and diameter was 225 cm.

Fish species caught at each station were identified (Shrestha 1994), measured and weighted. The types of species present per catch, composition of each species and level of effort were recorded (Murphy and Wills 1996). Standard data sheet was used for data collection.



Photo 3-7: Fish sampling at Budhi Ganga River Ardoli Gad confluence Photo 3-8 Fish sampling through gill net D/S of tailrace

✓ Gill net

Gill net was used for collection of fish at the sampling sites (Photo 3-8). Data collected through gill net was documented separately for each site. Two gill nets were used at each site for different time interval. Normally it was placed for the entire night starting from evening to early morning. The river habitat like run, riffle, rapid and pool areas were considered for the sampling and the average depth of the sampling sites ranges 0.75m to 1.5m. Gill net is very popular gear for collection of fish diversity data. Since mesh size of

different layer of mesh is different it is useful gear for the collection of different size and type of fish.

v) Observation in Market Centers

The fish caught by local people were sold in hotels of Budhabagar, Thanti Bazar and Sanfebagar. The fish expert visited in early morning and evening time to these market centers to collect information about fish diversity of Budhi Ganga River. Fish species available at local market and fish caught by local fishermen were also purchased to document information regarding local fisheries resources.

vi) Interaction with Local People

Interaction was conducted with the local people of Budhabagar, Tansi Bazar, Thanti Bazar and Sanfebagarto collect information about the fish diversity, migration pattern and other relevant aspects. Colored photographs of different fishes were shown to fishermen/local people to confirm their presence. The information provided by the local people is used for baseline and impact prediction.

3.5.2.3 Socio-economic and Cultural Environment

The methodology adopted to collect data and information on social, economic and cultural environment included desk study, survey of affected households (HHs), key informant interviews (KIIs), Participatory Rapid Appraisal (PRA), market survey, informal meetings/discussions with local key stakeholders (government officials, municipality/rural municipality). Both qualitative and quantitative data were collected using different tools i.e. household questionnaire, PRA checklist, key informant interview guidelines and market survey checklist (Vol.II, Appendix: B).

1) Identification of Project Affected Households/Families

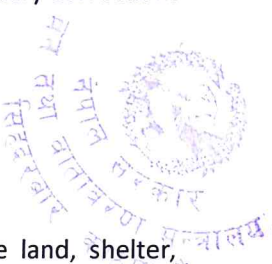
For the identification of project affected households/landowners and land area affected due to placement of project structures and facilities, cadastral maps prepared by the District Survey Office, land acquisitions notice of District Administration Office (Achham and Bajura) for the BHP and records of Site Office of BHP, Thanti Bazar were used. Based on the map and other information, a list of project affected households/families and their affected land and assets by municipality/rural municipality was prepared.

This list was further verified in the field with the local people and necessary corrections were made (Vol. II, Appendix: B).

Project Affected Families

Families residing in the core project area or surrounding area whose land, shelter, property, access to assets, and income sources or means of livelihood may be affected due to project construction or operation are considered as 'Project Affected Families' and the members of these families were referred to as 'Project Affected Persons'. The project affected families were ranked in two categories based on the magnitude of impacts.

Marginally Project Affected Households (MPAFs)



The households losing up to 10% of their total land were categorized under this category.

Severely Project Affected Families (SPAF)

In accordance with current practices and guidelines, families who were physically displaced from their residences or commercial establishments and those who were severely affected through loss of agricultural land are classified as SPAF. The households losing more than 10% of their total land and or losing residential structures were considered under this category.

Vulnerable Households

Women headed households, single women headed households, household heads with disabilities/old age, infected with chronic disease and HIV/AIDS, and Dalit households affected by the project were categorized under this category.

II) Sample Distribution

The distribution of sample includes socioeconomic survey of 80 project affected households/families, 11 ward level PRA, 5 consultation meetings with stakeholders, 14 KIIs and 12 market surveys in different locations of the project area (Table 3-3).

Table 3-3: Distribution of samples

Municipality/ Rural Municipality	Former VDC/Municipality/ Ward	Ward No.	Sample Distribution				
			Survey of Project Affected HHs	Ward Level PRA	Consultation Meeting with Stakeholders	KII	Market Survey
Sanfebagar Municipality (Achham)	Sanfebagar Municipality - 6	4	4	1			2
	Ghughurkot VDC	10	16	2	1	3	2
	Babala VDC	13	10	2	1	3	2
Mellekh Rural Municipality (Achham)	Kushkot VDC	4	8	2	1	2	2
	Hatikot VDC	8	37	2	1	3	2
Bhudhiganga Municipality (Bajura)	Barhabis VDC -7	10	5	2	1	3	2
Total	-	-	80	11	5	14	12

Source: Field Survey 2018

III) Household Survey

Altogether 80 families/households were identified as project affected families/households affected due to acquisition of land and assets for the placement of project structures and facilities. Census of affected households was conducted to collect socioeconomic and cultural data of the affected households.

A household survey questionnaire was used to collect household level socio-economic data. The household survey questionnaire (in Nepali language) covered key areas of inquiry such as demography (population distribution, gender composition, household size, caste/ethnicity, religion and festivals, education and skill level, health and sanitation, livelihood, income and expenditure, community infrastructures and services, agricultural practices and production (Vol. II, Appendix: B).

Qualified enumerators including one female and three males were hired locally to conduct the socio-economic survey. The field survey was conducted under direct supervision of social experts (socio-economist and sociologist). Use of local enumerators helped to ease the field work by their familiarity to the area, language and the local people. Two days extensive training was provided to the local enumerators in Sanfebagar Bazar focusing on EIA process, objective of the study, study tools, data collection and interview technique, rapport building, logistic management, data verification/editing.

IV) Consultation-Engagement of Stakeholders

a) Scoping and ToR Stage

Public involvement/consultation is one of the important components in the EIA process. The main objective of the public involvement/consultation was to discuss issues and concerns of the stakeholders regarding the project as well as inform them of the present status of the project.

Public consultation for the proposed project was initiated with the commencement of the EIA study. A public notice for EIA Scoping of Budhi Ganga Hydropower Project was published in the Annapurna Daily on August 14, 2016 (2073/04/30 BS) to inform concerned people and other stakeholders regarding the project.

The purpose of the public notice was to inform the public, local bodies, local communities of the project area about the proposed project and its activities. The notice sought opinions and suggestions from the project-affected municipalities and other stakeholders regarding potential environmental impacts of the project on the existing environmental conditions. The stakeholders were extensively consulted in the field during the scoping exercise in August 2016.

b) EIA Field Survey

In April 2018, as part of the EIA field work, extensive consultation was made with the stakeholders by the study team using different study methods.

Ward level PRA

Altogether 11 ward level PRAs were conducted in the project affected municipalities and rural municipality including two PRAs in each ward excluding in ward 4 of Sanfebagar Municipality where only one PRA was conducted to collect ward level data of the project area (Photo 3-9 and Photo 3-10).

The main objective of the ward level PRA was to collect data related to education, health, drinking water, gender, development activities and issues/concerns of local people regarding the project as well as to inform local people of the area about the proposed BHP. The participants of the ward level PRA were farmers, housewives, wage labors, teachers, students, political party leaders, businessman, jobholders and officials of local government. The PRA was conducted with the help of a checklist (Vol. II, Appendix: B).

Altogether 140 participants including 45 from Mellekh Rural Municipality, 63 from Sanfebagar Municipality and 32 of Budhiganga Municipality participated in the PRAs. Of the participants 83.6% were males and 16.4% were female. Their main occupations were agriculture and business (Table 3-4).

Table 3-4: Details of PRA conducted in project area

S.N.	Date	Sex			Municipality/Rural Municipality	Location	Main Occupation
		Male	Female	Total			
1	1/4/2075	8	5	13	Sanfebagar Municipality-10	Thanti Bazar	Agriculture, Business
2	1/8/2075	5	8	13	Sanfebagar Municipality-13	Budhabagar	Agriculture, Business
3	1/10/2075	9	1	10	Sanfebagar Municipality- 4	Samtada	Agriculture
4	1/11/2075	12	1	13	Sanfebagar Municipality-13	Bataligaun	Agriculture
5	1/10/2075	10	4	14	Sanfebagar Municipality-10	Tansi Bazar	Agriculture, Business
6	1/6/2075	8	0	8	Mellekh Rural Municipality-4	Kuskot	Agriculture
7	1/5/2075	14	1	15	Mellekh Rural Municipality-8	Pipal Chautara,	
8	1/12/2075	9	1	10	Mellekh Rural Municipality-8	Hatikot, Thapagaun	Agriculture
9	1/11/2075	11	1	12	Mellekh Rural Municipality-4	Saudtole, Kuskot	Agriculture
10	1/8/2075	12	0	12	Budhiganga Municipality-10	Malika Bazar,	Agriculture
11	2075-1-10	19	1	20	Budhiganga Municipality-10	Chautara, Malika Bazar	Agriculture
Total		117	23	140	-	-	-

Source: Field Survey



Photo 3-9: PRA with Stakeholders

Photo 3-10: PRA with Stakeholders

ii) Consultation meeting with stakeholders

Altogether 5 consultation meetings were conducted with women, vulnerable groups (Photo 3-11 and 3-12) and other stakeholders of the project area to know their views/concerns regarding the project and provide them information about the project and its activities (Vol. II, Appendix: B). A total of 90 participants including 84.4% male and 15.6% female had participated in the consultation meetings (Table 3-5).

Table 3-5: Details of consultation meetings

Date	Number of Participants			Municipality/ Rural Municipality/	Place /Location	Main Occupation
	Male	Female	Total			

				ward		
	17	0	17	Mellekh Rural Municipality-4	Kalamadu, Kuskot	Agriculture, Business
	11	6	17	Mellekh Rural Municipality-8	Hatikot, Pipalchaur	Agriculture
	14	2	16	Sanfebagar Municipality-10	Ghunghurkot, Thanti	Agriculture, Business, Salaried jobs
	14	6	20	Sanfebagar Municipality-13	Budhabagar, Babala	Agriculture, Business, Salaried jobs
	20	0	20			
Total	76	14	90			

Source: Field Survey 2018

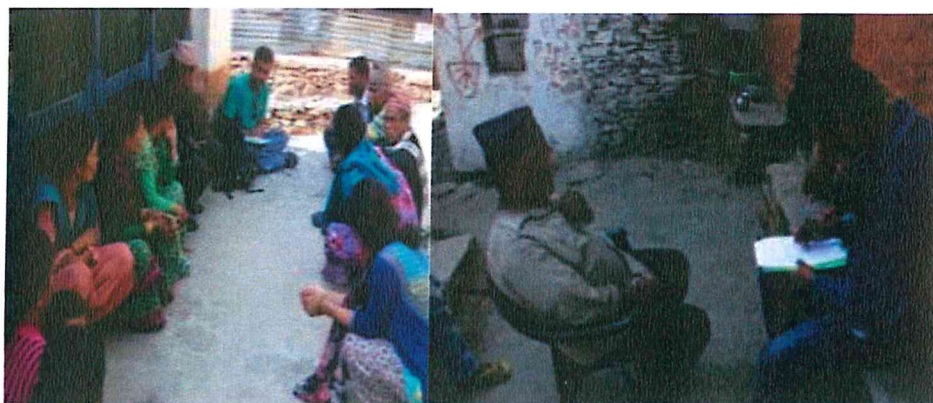


Photo 3-11: Consultation with Women/Vulnerable Group Photo 3-12: Consultation with Stakeholders

iii) Key informant interviews (KIIs)

Altogether 14 key informant interviews (KIIs) were conducted in the project affected wards of the municipalities and wards (Photo 3-13 and Photo 3-14). The respondents of the KIIs were purposively selected for interviews. The main objective of KIIs was to assess their views, concerns and expectation from the project and collect relevant information of the project area. The key informants included social workers, businessmen, teachers, representatives of political parties, former VDC Chairmen, local elected officials and intellectuals of the project area. The KII was conducted using an in-depth interview guideline (Vol. II, Appendix: B).



Figure 3-13: Respondent of key informant interview Figure 3-14: Respondent of key informant interview

During the consultation process consent/recommendation letters were also collected from concerned 5 CFUGs, Sanfebagar and Budhiganga Municipalities and Mellekh Rural Municipality (Vol. II, Appendix:B). The main issues and concerns of the stakeholders have been incorporated in the public involvement/consultation chapter of this report.

iv) Interaction/Consultation with Key Stakeholders

Informal interaction/consultation was conducted with relevant district level government officials at district headquarter, Mangalsen (Achham), and at local levels (municipal) with key stakeholders (elected local representative, teachers, representative of civil society organization, CFUGs, health workers, government officials, BHP field team and political party leaders). The purpose of the meetings/consultations was to inform them about the project, collect their concerns/expectations regarding the project and required information for the EIA.

V) Market Survey

Market surveys were conducted in 12 locations of the project area to get the prevailing price of agricultural commodities, major construction materials, and wage rates. Market surveys were conducted with the help of a checklist (Vol. II, Appendix: C).

VI) Crop Loss Calculation

The crop loss data was calculated based on the production data available from District Agriculture Development Office, household survey and consultation meeting in core settlements.

VII) Water Use Study

The use of river water in the project area was studied by walking along the bank of river and existing water uses were noted. Further consultation with river side villagers like Budhabagar, Tansi Bazar, Thanti Bazar and Thapagaun were made to collect the site specific information regarding water uses. The issue of water diversion for power generation and its implication on local water uses was discussed during the consultation.

3.6 Data Analysis

Both qualitative and quantitative data collected in the field were analysed accordingly. The air quality data was analysed for the parameters TSP, P.M₁₀, PM_{2.5}, Sulfur dioxide and Nitrogen dioxide in the laboratory of Leaders Nepal. Similarly, noise quality parameters L_{eq}, L₉₀, L₁₀ and L_d were analysed in the same laboratory. The water samples taken from the Budhi Ganga River were analysed in laboratory of Nepal Environment and Scientific Services Laboratory (NESS). Altogether 29 parameters for physical (pH, electrical conductivity), chemical (N-nitrate, N-ammonia, total phosphorous, total hardness), heavy metals (Fe, Mn, Hg, As, Pb, Cd, Na, K, Cr) and biological (Chlorophyll A, Total Coliform/ E. coli) were analysed.

Data Analysis of the forest was done by following standard rules prescribed by Ministry of Forests and Environment. [Listing of flora was done from the field visit by the botanist and citations from the publications of district forest office of the concerned project districts.](#) The classification of forests was based on Dobermez (1976), Stainton (1972) and Polunin and Stanton (1984), Storrs and Storrs (1984) and Jackson (1994). The correct

nomenclature of the collected specimens is the first requirements for the good results. So the accurate nomenclatures of collected plants were done with the help of literatures (Hara et. al 1978, 1979, Hara and Williams 1979, Polunin and Stainton, 1984). The data from forest sampling were quantitatively analysed for basal area, crown coverage and wood volume.

The inventory of the forest patches was carried out according to the Community Forestry Inventory Guidelines (2004). The volume of timber and fire wood were estimated according to the forest rules 1995 using the following formulae.

Tree class above 30 cm dbh

Pole class 10 – 30 cm dbh

Sapling 4 – 10 cm dbh

Seedling less than 4 cm dbh

Density and Frequency: Density and frequency of tree species were calculated as follows:

$$\text{Density (D) / hectare} = \frac{\text{No. of individuals of a species}}{\text{Size of the plot} \times \text{Total number of plots sampled}} \times 10,000$$

Standing Volume: Wood volume of standing tree was calculated by using the following formula:

Wood volume = $1/2 \times \text{Basal area} \times \text{Height}$

Gross Volume = $(\text{Girth}^2 / 16) \times \text{height} \times \text{form factor}$

Basal Area is the trunk cross-sectional area. The basal area of each of trees was calculated basis of based on diameter at breast height.

$$\text{Basal Area} = \pi r^2 = 3.142 \times (\text{DBH}/2)^2$$

Biomass was calculated by using Regression model $\ln \times W = a + b \times \ln \times \text{dbh}$

Fuel wood (Chatta) was calculated by using branch volume correlating with density of species.

The listing of wildlife including mammals, rodents and birds was done from the field visit by the zoologist, consultation with local people and citations from the published literature such as Wild Mammals of Nepal (Baral, H. S., & Shah, K. B. 2008) and Birds of Nepal (Grimate R, C. Inskip, T. Inskip and Baral H 2003). The information about reptiles and amphibians were presented based on the field visit, information collected through local consultation and citations from the published literature (H. Hermann Schleich & Kaluram Rai 2012).

Fish species caught from Budhi Ganga River were identified at site by using literature (Shrestha 1994). The information about the rare, endangered and protected flora and fauna was collected by review of the existing literatures, NPWCA, 1973 and website www.iucnredlist.org. The phytoplankton, zooplankton and aquatic insects were identified in the laboratory of Central Department of Botany, T.U. Kathmandu.

After completion of the fieldwork, all the collected primary and secondary data regarding socio-economic and cultural environment was encoded, processed and analysed in

Kathmandu. The household survey data was processed using computer software (Microsoft Excel) and output tables were produced. Similarly, the other data were processed and analysed manually. One Statistician was assigned to develop data entry program, data cleaning/editing, managing the data entry process and processing data in Kathmandu. The Statistician worked in close coordination with the Socio-economist. All the primary data collected from field and the secondary data from the literature review were tabulated and analysed.

3.7 Impact Identification and Prediction

The possible positive and adverse impacts due to implementation of the proposed project were identified. The impacts were predicted in terms of magnitude, extent and duration. The impacts were further rated as high medium and low in terms of magnitude, site specific, local and regional in terms of extent and short term, medium term and long-term in terms of duration. Impact assessment and mitigation measures matrix was developed for the construction and operation phases of the project. The impact ranking was done as per the National EIA Guidelines 1993.

3.7.1 Significance of Impacts

- i. Significant: If the impact is considerable and changes the baseline condition it is considered significant impact.
- ii. Insignificant: If the change is so minor that baseline condition is not affected considerably it is called insignificant.

The following scoring criteria were considered for significant analysis:

Table 3-6: Scoring criteria for significance analysis

Importance of Impacts	Importance of Impacts	Significance Value
High	3	200 and above
Moderate	2	100 to below 200
Low	1	Below 100

3.7.2 Nature of Impacts

- i. Direct: Refers to an alteration of the existing environmental condition as a direct consequence of the project activity.
- ii. Indirect: This impact results when the effect of the project activity on one component produces repercussions on other components.

3.7.3 Magnitude of Impacts

- i. Low Impact (L): If the value of the resources could be used with no or minimum inconvenience to the public.
- ii. Medium/Moderate Impact (M): If the value of the resources could be used with inconvenience to the public.
- iii. High Impact (H): If the value of the resources reduced far below publicly acceptable level.



3.7.4 Extent of Impacts

- i. Site Specific (S): If the impact is limited to the project area then it is a site specific one.
- ii. Local (L): If the impact of the work extends to the watershed then it is termed as local.
- iii. Regional (R): If the impact of the work extends beyond the watershed then it is termed as regional.
- iv. National (N): If the resources are affected at national scale, it is known as a national impact.

3.7.5 Duration of Impacts

- I. Short Term (ST): If the impacts last for 5 years after project initiation it is classified as short term. The construction phase impacts are mostly categorized under this category.
- II. Medium Term (MT): An impact that continues for more than 5 years but less than 20 years is considered as medium-term. The construction phase impacts which carry over 1-2 years of operation phase fall under this category.
- III. Long Term (LT): An impact that lasts beyond 20 years is considered to be long term. The operation phase impacts are mostly categorized under this category.

The following numerical scale as given in National EIA Guidelines 1993 was used for qualitative assessment of the various impacts.

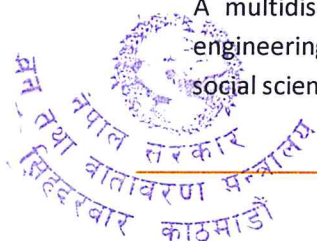
Table 3-7: Scoring criteria for prioritization of impacts

Impact Nature	Weighting
Magnitude	
Low	10
Moderate/Medium	20
High	60
Extent	
Site specific	10
Local	20
Regional	60
Duration	
Short term	5
Medium term	10
Long term	20

Source: National EIA Guidelines 1993

3.8 Study Team

A multidisciplinary team of professionals specialized in the field of environmental engineering, socioeconomic development, ecology/forestry, fishery and wildlife, and social science are involved in the study. The team was supported by local assistants in the



field (Table 4-8). The declaration sheet of the team members involved in the study is given in Appendix I.

Table 4-8: Composition of study team members

S N	Name	Position
1	Mr. Michael Holics	Team Leader
2	Mr. Nar Gopal Rai	Deputy Team leader/ Env. Engineer
3	Mr. Rishikeshab Raj Regmi	Sociologist/Anthropologist
4	Mr. Tej Bahadur Singh Mahat	Botanist/Forest Expert
5	Mr. Charles Pradhan	Zoologist & Aquaticlife Expert
6	Mr. Narayan Bahadur Shrestha	Environment Management Plan Expert



4. DESCRIPTION OF BASELINE ENVIRONMENT

The following chapter outlines the baseline conditions of the physical, biological, and socio-economic and cultural environment of the project area. The information presented is based on field study including observation by experts, sampling and laboratory analysis, household survey, stakeholder consultation and review and analysis of the available secondary data on bio-physical, socio-economic and cultural environment of the area. The technical information is drawn from the Detailed Engineering Design Report of the Project.

4.1 Physical Environment

4.1.1 Topography

The project area lies in the hills of the Lesser Himalayas. The elevation of the river bed at Dam site is 694masl whereas the Tailrace level is 621masl. The project area comprises of moderately to steeply sloping mountain, steep to very steep terrain, gently sloping alluvial fans and river terraces. The gently sloping lands are located downstream from the proposed headworks along the Budhi Ganga River. The upstream watershed area of Ikri Gad and Ardoli Gad lies in the high mountain region. Land in this area is composed of steeply to very steeply sloping terrain. The lower slopes near headworks are very steep and the upper slopes are moderate. The topography along the headrace tunnel up to the surge shaft area is characterized by moderate slopes with terrace cultivated land and bushes in upper reaches and forest on river slopes. The surge shaft is on moderate slope whereas the powerhouse is proposed in nearly flat cultivated land.

4.1.2 Climate

The altitude of the project area ranges from 630 m to 3,275 m with climatic condition varying from sub-tropical, sub-humid to cool temperate humid. River valleys and immediate hill slopes in the project area below 1,000 m have sub-tropical sub humid climate with mean annual temperature of 22°C. The upper slopes between 1,000 m and 2000 m have warm humid climate with mean annual temperature of 17°C. The temperature of the core project area exceeds 30°C in summer whereas in winter it ranges from 15-20°C.

The temperature data recorded in Dipayal meteorological station shows the average maximum temperature recorded is 30.9°C and minimum average temperature is 15.7°C. May and June are the warmest months and December and January the coolest months. During the past 5 years, the maximum temperature was recorded as 39.4°C in May 2015 and the minimum temperature recorded was 4.1°C in January 2016. The maximum temperature recorded at the powerhouse site is 38.18°C on March 30, 2017 whereas minimum temperature recorded at same site is 3.05°C (Metrological record of project 2018).

Table 4-1: Mean temperature of nearest station (Dipayal-Doti)

Year	Maximum Temperature(°C)	Minimum Temperature(°C)
2013	30.8	16
2014	31.2	15.9
2015	30.7	15.7
2016	31.1	15.6
2017	30.8	15.5
Average	30.9	15.7

Source: Department of Hydrology and Meteorology, 2018

Similarly, annual mean precipitation in Dipayal was 1,192 mm. The average minimum rainfall recorded in last 5 years (2013 to 2017) at Sanfebagar metrological station is 32.7 mm in April and 261.27 mm in July.

4.1.3 Air Quality

The measured values of the total suspended particulates (TSP), PM₁₀, PM_{2.5} and Nitrogen dioxide at three locations within the project area viz. Budhabagar (dam area), powerhouses area and Sanfebagar the major settlement in downstream of the powerhouse tailrace on different dates and subsequent laboratory analysis are presented in the Table 4-2.

Table 4-2: Ambient air quality in the project area

Sample ID	Sampling Date	Site	TSP (µgm/m ³)	PM10	PM2.5 (µgm/m ³)	Sulfurdioxide (µgm/m ³)	Nitrogen dioxide (µgm/m ³)	Av. Temp. °C	Av. Humidity
				(µgm/m ³)					%
AP-1	3/3/2018	Budhabagar (Dam area)	156	48	17.05	15	22	30	41
AP-2	3/4/2018	Thapagaun (Power house area)	151	70	25	30	33	25	41
AP-3	3/2/2018	Sanfebagar	164.4	73.6	10.85	17	20	31	41

Source: Measurement of Air Quality (NESS Laboratory), 2018

4.1.4 Noise Quality

The noise level data of the proposed dam site, powerhouse site and area below powerhouse tailrace was measured. The values of percentiles i.e. L_{eq}, L₁₀, L₉₀, and L_d for each time zone were calculated using appropriate formulae. The noise pressure level of the site recorded in different time zone (8:30 to 19:00 hours) shows that average noise level of L₁₀ and L₉₀ is 61_{dBA} and 57_{dBA} at dam area, 52_{dBA} and 42_{dBA} in powerhouse area and 50_{dBA} and 44_{dBA} in Sanfebagar area Table 4-3. The L_d ranges from 49_{dBA} to 60_{dBA} at different locations. Vehicle operated in Martadi Sanfebagar are the main source of noise pollution in the area.



Table 4-3: Noise level recorded at different sites

Sample ID	Location	Time	dBA			
			Leq	L10	L90	Ld
N-1	Budhabagar (Dam area)	8:30	58	60	55	
		11:00	60	61	61	
		14:40	59	61	56	
		16:30	60	62	58	60
		19:00	61	62	59	
		Average		61	57	
N-2	Thapagaun (Power house area)	8:40	46	49	41	
		11:45	52	54	43	
		14:00	52	54	43	
		17:10	46	49	41	50
		19:00	46	48	43	
		Average		52	42	
N-3	Sanfebagar	9:00	47	49	44	
		11:30	48	48	43	
		14:30	53	53	46	
		17:00	47	49	43	49
		19:00	45	47	41	
		Average		50	44	

Source: Measurement of Noise Level by Consultant, 2018

4.1.5 Catchment Characteristics

The Budhi Ganga River is perennial rain-fed River originated from Yugaldanda (5,475m) located at about 63 km from the proposed Dam site. It is a major tributary of the Seti River which is the westernmost sub-basin of Karnali River. The catchment area at intake site is 1,075 km² which encompasses both the Himalayan and Mahabharat mountains and almost entirely lies in Bajura district. The length of main channel from farthest point of the catchment up to Dam site is 63 km. Average slope of the main channel is 7.5%. The shape of the Budhi Ganga River catchment is fern leaf shaped.

The study of available maps, aerial photographs and Google Earth indicate the presence of permanent and temporary snow covering area of about 41 km² (4.3% of total area) within the upper portion of the catchment. Out of total catchment area 1,070 km² (99.5%) is below 5,000 m and 817.4 km² (76%) is below 3,000m. The total catchment area up to Powerhouse site of BHP is 1147.5 km².



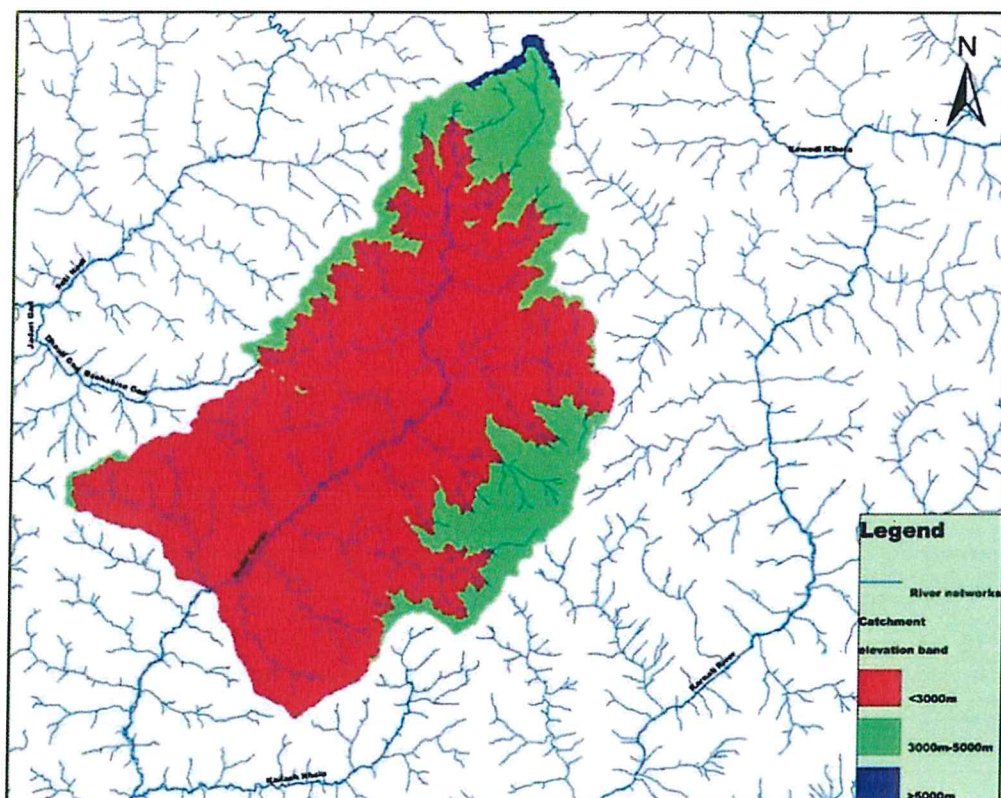


Figure 4-1: Catchment area at Budhi Ganga River intake

Source: Detailed Design Report of BHP, 2018

There are six major sub-water basins in the project area. They include Ikri Gad, Ardoli Gad and Jijadi Gad on the right bank and Sarane Gad, Agali Gad and Bhimkoti Khola from the left bank of Budhi Ganga River. There are also several small streams originating from the immediate hill slope. Two of these six major sub water basins, Ikri Gad and Sarane Gad are located upstream from the headworks, Ardoli Gad and Agali Gad are located between headworks to powerhouse and Bhimkoti Khola and Jijadi Gad are located downstream of the Powerhouse.

Observation of the springs in the mountain areas indicate that the groundwater in the surrounding mountains lie at shallow to moderate depths. Geological structures are expected to have control over the overall ground water mobility rates in some structurally complex sections in the area. Considering the low levels of human activities, the water quality is expected to be good and free from human contamination in the natural states.

4.1.6 Hydrology

4.1.6.1 Estimation of Long term Flow

Estimation of long term flow has been carried out based on various approaches like WECS/DHM, MHSP, Nepal upto 2006, catchment area ratio (CAR) with West Seti (station 260), including transposing of flow data from similar basin (Budhi Ganga, station No. 256.5 and watershed modeling based on rainfall in the catchment (Australian Water Balance Model). The monthly flows derived from these approaches are compared in the table and figure below. Based on these assessments, transposition of long term daily

flows from BG 256.5 station using CAR was found to be adequate for this project and hence the longterm flow for the project has been estimated from the transposed flows of Budhi Ganga at Chitregat (station No. 256.5) to Dam site using CAR.

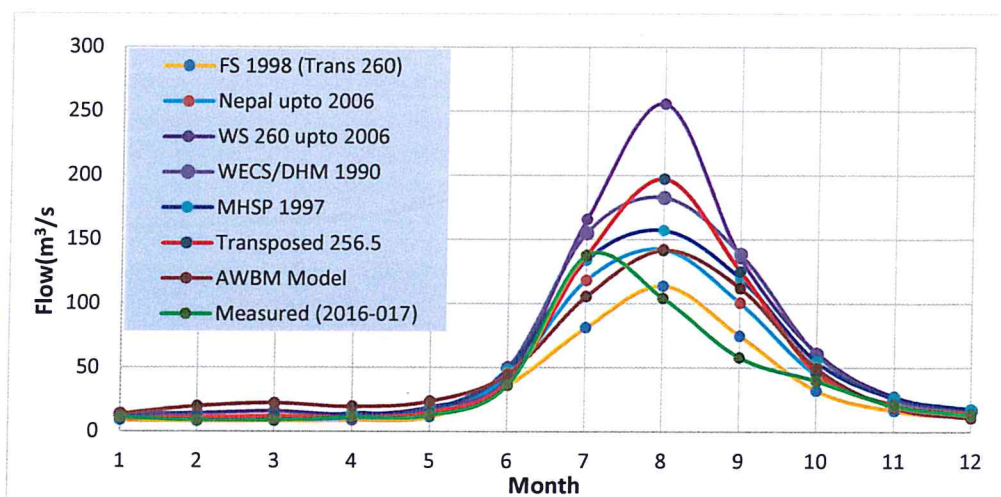


Figure 4-2: Comparison of flow estimation from different method

Table 4-4: Summary of monthly flow estimated from different method

Sources/Methods	Flow (m ³ /s)												
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
FS 1998 (Trans 260)	8.5	7.9	8.1	8.6	11.2	36.0	81.0	113.5	74.6	32.0	16.3	11.4	34.1
Nepal upto 2006	11.1	9.7	9.0	10.0	14.6	43.1	118.1	142.1	100.5	44.5	21.5	14.3	44.9
WS 260 upto 2006	13.8	14.2	15.7	13.1	19.2	42.2	165.6	255.5	135.3	61.6	27.3	17.2	65.1
WECS/DHM 1990	13.0	11.1	10.3	11.6	16.9	49.7	154.9	182.4	138.3	60.5	25.5	16.4	57.5
MHSP 1997	13.0	10.8	10.2	14.0	16.3	48.3	133.7	156.9	119.6	54.5	26.5	17.4	51.8
Transposed 256.5	9.9	10.8	11.9	10.8	14.8	38.0	137.5	197.0	124.8	46.1	21.1	13.8	53.0
AWBM Model	13.8	19.9	22.2	19.4	23.6	44.8	105.3	141.4	111.9	49.5	19.1	10.6	48.5
Measured (2016-017)	10.65	8.63	8.64	10.93	12.32	35.9	136.99	104.22	57.94	39.6	20.19	12.78	38.23

The minimum and maximum monthly flow at headworks is 9.90m³/s in the month of January and 197.02 m³/s in the month of August. The mean monthly flow of the River is 53.04m³/s (Table 4-5).

Table 4-5: Long term monthly flows of Budhi Ganga River at the dam site

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Avg
Mean monthly flow (m ³ /sec)	9.90	10.75	11.89	10.80	14.83	38.00	137.54	197.02	124.78	46.06	21.09	13.77	53.04

Source: DED, BHP

To develop the flow duration curve at the Dam site, the daily flows of nine years of BG 256.5 have been transposed using catchment area ratio (CAR) method. All the daily flows of nine years have been used to derive the flow duration curve for the project. Similarly, the estimated flow duration curve has been compared with that of measured flows. The estimated flow duration curve and its comparison with the flow duration curve of measured flow is given in the figure and table below.

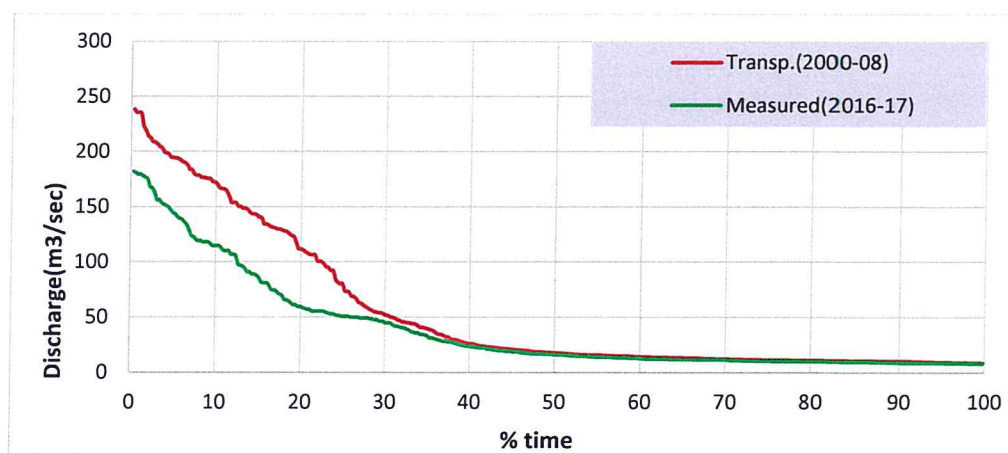


Figure 4-3: Comparison of FDC transposed and measured

Source: DED, BHP, 2018

Table 4-6: Comparison of the flow durations at dam site between generated transposed and measured

Time	1%	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%
Qtrans (2000-08)	234.75	194.18	170.68	140.55	111.22	76.81	51.76	39.3	25.71	20.64	17.54
Qmeas (2016)	178.95	143.87	114.23	85.75	58.97	50.33	44.65	32.65	23.29	18.57	15.66
Time	55%	60%	65%	70%	75%	80%	85%	90%	95%	99%	
Qtrans (2000-08)	15.49	13.99	13.07	11.93	11.24	10.86	10.3	10.01	9.12	8.6	
Qmeas(2016)	13.59	12.36	11.52	11.11	10.04	9.7	9.16	8.48	8.32	7.84	

The recommended method for estimating the design discharge is CAR method from station 256.56 at Budhi Ganga Chitregat. The design discharge for the project is 26 m³/sec which has been computed by reservoir simulation and is near to Q₄₀.

From GLoF point of view Nepal is one of the vulnerable country. There are around 1466 glacial lakes in Nepal. Among these glacial lakes 21 glacial lakes are potentially dangerous. Of these 21 glacial lakes 17 glacial lakes lie in the Koshi Basin whereas 4 lies in Gandaki basin. The figure below shows the glaciers in the high Himalayan region of Nepal. Historical data show that there had not been a single GLoF event in Budhi Ganga catchment.

4.1.7 Flood Calculation

4.1.7.1 Estimation of Flood from Different Methods

Flood estimation for Budhi Ganga at Dam site had been carried out using different method and approach. The different methods used for flood analysis are Regional methods, 7HSC, 1HSC, Gumbel EV, Log Pearson Type III, Log Normal and different empirical methods like Rational method, Snyder's method, BD Richard, Synthetic UH, PCJ 1996, WECS/DHM 1990, DHM 2004, Modified Dicken's and MHSP 1997.

4.1.7.2 Comparison of Floods by Different Methods and Approaches

The flood calculated from different methods and approaches gives more or less similar flood values. Methods which gave very high or very low flood values are not selected for comparison. The comparison of the results are presented in Table and Figure below.

Table 4-7: Comparison of Floods at BHP dam site by different methods and approaches

Methods and	Return Periods in Years
-------------	-------------------------

Approaches	50	100	500	1000	10000
Log Transposed 256.5	2345	2697	3513	3865	5033
GEV Transposed 256.5	2167	2445	3087	3363	4280
CF Weibull Transp 256.5	2068	2329	2915	3160	3953
Log Transposed 260	1994	2274	2925	3206	4136
GEV Transposed 260	2009	2235	2758	2983	3728
Rational	2417	2674	3295	3565	4457
PCJ 1996	1474	1830	2529	2858	3952
WECS/DHM 1990	1772	2013	2605	2876	3860
DHM 2004	2232	2587	3491	3917	5511
Modified Dicken's	1905	2140	2686	2922	3703
Snyder SUH	2032	2247	2770	2996	3746
BD Richard's	1976	2248	2937	3250	4326

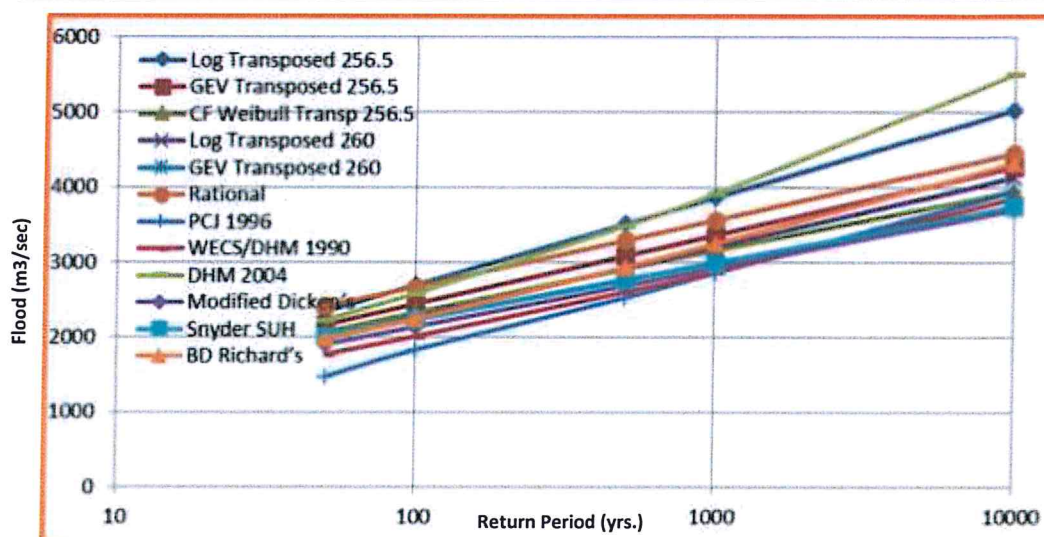


Figure 4-4: Comparison of floods at BHP dam site estimated by different methods

4.1.7.3 Selected Method/Approach for Design Flood

From Table 4-7 it is very clear that all methods make a band of floods from 2000 to 2700 m^3/s for 100 years frequency and from 3000 to 4000 m^3/s for 1000 years frequency. The flood values obtained from the transposition of the flood obtained from logarithmic equation generated at Budhi Ganga 256.5 are selected for the project.

Thus the design flood of 3900 m^3/s of 1000 years frequency is recommended for spillway and the design flood of 2700 m^3/s of 100 years frequency is recommended for Settling basin.

The design flood at Powerhouse has been estimated by transposing the 100 year flood of Dam site to Powerhouse. Hence the design flood of 2900 m^3/s of 100 years frequency is recommended for Powerhouse of BHP.

4.1.8 Sedimentation

The sediment samples at headworks site were collected at the gauging station established by the Consultant. The dip method of sampling was adopted for sampling. The sediment samples have been collected intensively during the monsoon period and brought to laboratory in Kathmandu for analysis. The maximum concentration of

sediment during the study period was 4408 PPM in July 2016 and minimum was 11 PPM in March 2016. The annual sediment yield using this equation is 8,786.36 PPM while the yield of monsoon alone is 6663.61 PPM. From the analysis it is seen that suspended sediment contained 59 % of fine particle as silt and clay.

4.1.9 Water Quality

The pH is slightly basic whereas the Total Suspended Solids (TSS), oil and grease, Ammonical-N, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Lead (Pb), Cd, As and Hg are lower than that specified for effluent standards discharged into inland surface water, prescribed by GoN 2001. E-coli at the Site-(W-2) are much higher than that recommended for drinking water by WHO. The concentration of E-coli at site(W-2) was found to be 460 colonies (Table 4-8). The micro-biological contamination is probably associated with both the existing villages in the upstream catchment and to the cattle and wildlife in the area.

Table 4-8: Water quality parameters of Budhi Ganga River

S.N.	Parameters	Observed Values			Generic Effluent Standards Discharged into inland surface water, GoN 2001
		Site (W-1)	Site (W-2)	Site (W-3)	
1	Temperature(°C)	15	15	17	-
2	pH at 20°C	8	8	8	5.5-9
3	Electrical Conductivity(μS/cm)	193	194	193	-
4	Total Dissolved Solids(mg/L)	132	124	142	-
5	Total Suspended Solids(mg/L)	16	6	6	30-200
6	Total Alkalinity as CaCO ₃ (mg/L)	113	120	110	-
7	Total Hardness as CaCO ₃ (mg/L)	104	106	102	-
8	Chloride(mg/L)	<0.5	<0.5	<0.5	-
9	Sulphate(mg/L)	<1	<1	<1	-
10	Free Carbon Dioxide(mg/L)	2.05	2.05	2.05	-
11	Oil and Grease(mg/L)	<0.2	<0.2	<0.2	10,max
12	Nitrate-N(mg/L)	0.28	0.22	0.2	-
13	Ammoniacal-N(mg/L)	0.07	<0.05	<0.05	50,max
14	Total Phosphorous as PO ₄ -P(mg/L)	0.28	2.27	0.21	-
15	Dissolved Oxygen(mg/L)	7	8	8	-
16	Biological Oxygen Demand(mg/L)	1	2	2	30-100
17	Chemical Oxygen Demand(mg/L)	2	3	4	250,max
18	Iron(mg/L)	0.19	0.23	0.21	-
19	Manganese(mg/L)	N.D.(<0.02)	N.D.(<0.02)	N.D.(<0.02)	-
20	Lead(mg/L)	N.D.(<0.01)	N.D.(<0.01)	N.D.(<0.01)	0.1,max
21	Cadmium(mg/L)	N.D.(<0.03)	N.D.(<0.003)	N.D.(<0.003)	2,max

S.N.	Parameters	Observed Values			Generic Effluent Standards Discharged into inland surface water, GoN 2001
		Site (W-1)	Site (W-2)	Site (W-3)	
22	Sodium(mg/L)	2.6	2.8	3.1	-
23	Potassium(mg/L)	3.1	3.2	3.65	-
24	Chromium (mg/L)	N.D.(<0.02)	N.D.(<0.02)	N.D.(<0.02)	-
25	Arsenic(mg/L)	N.D.(<0.01)	N.D.(<0.01)	N.D.(<0.01)	0.2,max
26	Mercury (mg/L)	N.D.(<0.0005)	N.D.(<0.0005)	N.D.(<0.0005)	0.01,max
27	Chlorophyll a(mg/m ³)	N.D.(<0.2)	N.D.(<0.2)	N.D.(<0.2)	-
28	Total Coliform Count (MPN Index /100mL)	150	1100	93	-
29	E.coli Count(MPN Index /100mL)	75	460	4	-

ND- Not deducted

Source: Water quality analysis (NESS Laboratory), 2018

4.1.10 Geology and Geomorphology

i) Geology of Nepal

The Nepal Himalaya is in the central part of the 2,400 km long Himalayan arc and extends for about one third (800 km) of its total length running from the Mechi River to the Mahakali River (east to west). Geographically, it is bounded by latitudes 26°2' N and 30°27' N and longitudes 80°11' E and 88°27' E. Like the entire Himalayan range, the Nepal Himalaya is divided into the five major tectonic zones namely a) Terai, b) Sub-Himalaya, c) Lesser Himalaya, d) Higher Himalaya and e) Tibetan–Tethys Himalaya.

The Budhi Ganga Hydropower Project lies in the Lesser Himalayan Crystalline Zone and occupies the central part of the Dadeldhura nappe in Sudurpaschim Province of Nepal.

ii) Regional Geology

The Budhi Ganga Hydropower Project lies in the Lesser Himalayan Crystalline Zone and occupies the central part of the Dadeldhura nappe in the Sudurpaschim Province of Nepal. Project area is about 40 km north of the MBT and about 65 km south of the MCT, where nappe of high grade metamorphic rocks is developed. Regional geology shows the rocks of the project area comprised of a rock unit Budhi Ganga Gneiss and quartzite and schist of the Kalikot formation of the Dadeldhura nappe. Budhi Ganga Gneiss comprises thick succession of augen gneiss with partings of schists which occupy the core of the Budhi Ganga faulted anticline.

The regional geological structure of western Nepal has two tectonic systems, one being the Himalayan gneiss zone and its klippe of allochthonous nature and the other being the Midland meta-sediment zone of autochthonous or parautochthonous nature; the former is thrust over the latter along a salient tectonic zone called the Main Central Thrust zone. Rocks to the north of the Main Central thrust are metamorphosed to amphibolite

facies, whereas the rocks of the Dadeldhura thrust sheet are generally in the upper green schist facies. The metamorphic rocks of the Dadeldhura thrust sheet consist of the Kalikot Schist and the Budhi Ganga and Salyanigad Gneisses (Fig. 4-5).

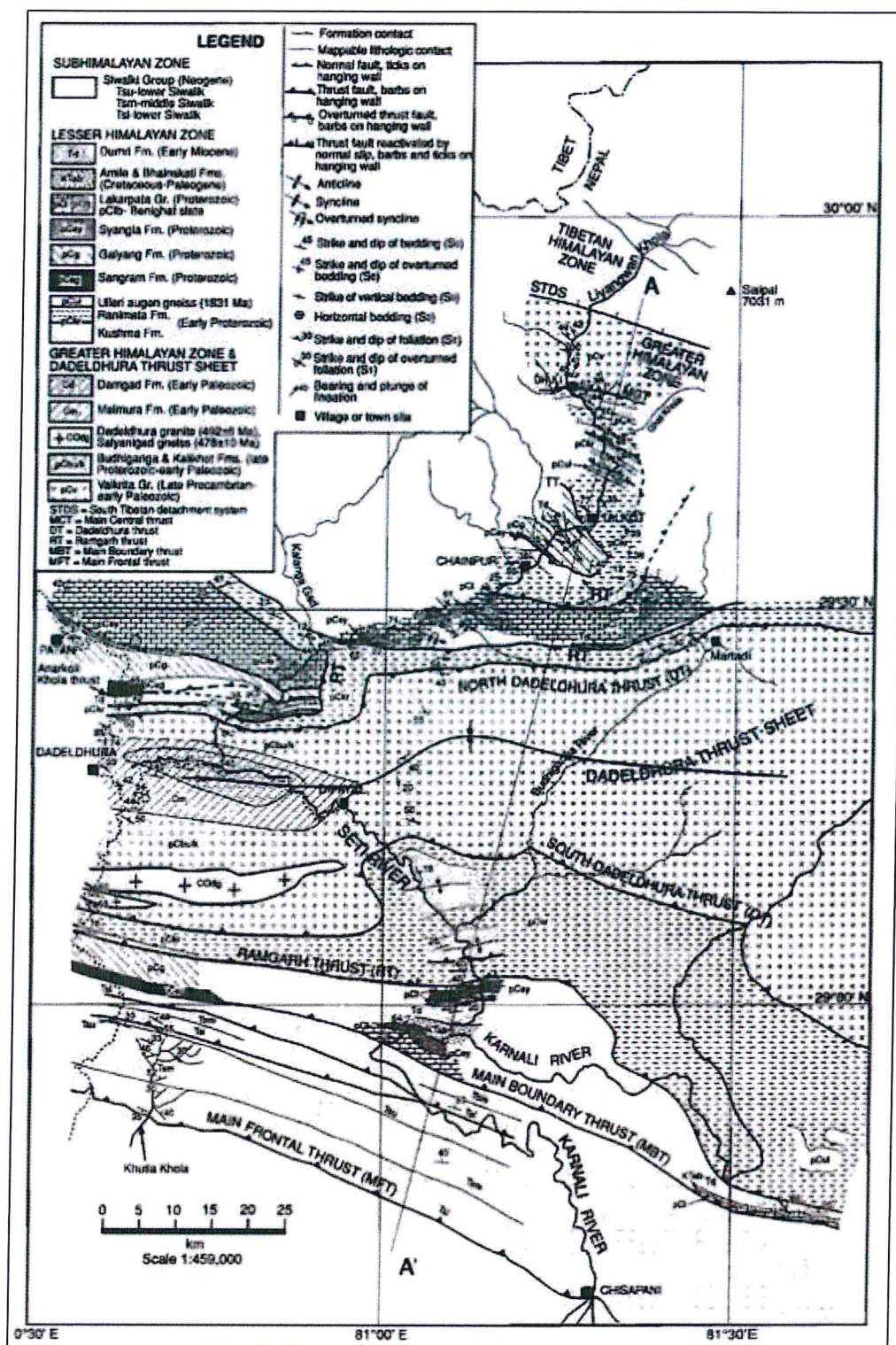


Figure 4-5: Regional geological map

Source: (After DeCelles et.al. 2001)

iii) Project Area

The project area is covered by rocks of the Precambrian age. The rock sequence of the area constitutes mainly of two litho-stratigraphic divisions i.e. Surkhet, Midland and Dadeldhura Group. The Budhi Ganga Hydropower Project lies in the Lesser Himalayan Crystalline belt and occupies the central portion of Dadeldhura nappe in the Far Western region of Nepal. The rocks of the project area have been affected by multiple phase of deformation due to north-east south west compression during Himalayan Orogeny.

The project area mainly characterized by augen gneiss, mica schist and psammitic schists inter bedded with quartzite. The bed rocks of the project area mainly augen gneiss, mica schist and psammitic schists inter-bedded with quartzite.

iv) Project Sites

Dam

The dam axis is located on well exposed rocks of augen gneiss on both the abutments where moderately fractured, moderately to highly weathered augen gneiss rocks are exposed on almost 50 to 55 degree slope. Left bank rises at a uniform moderate angle of 52° - 55° up to EL - 770m. From riverbed up to EL - 698m, a small outcrop of augen gneiss is present amidst superficial overburden. Thereafter the slope is covered with slope wash material under dense vegetation cover. The right bank rises at moderate angle of about 50° to 55° up to EL - 750m, thereafter, the slope becomes steeper (about 70° to 75°) and continues up to road level. Rock is exposed at the river bank up to EL - 695m and comprises of moderate fractured and moderately to highly weathered augen gneiss along with mica content.

Tunnel

The maximum rock cover above the diversion tunnel is about 66m and minimum cover is about 15m and outcrop of gneiss intercalated with schist are exposed at inlet and outlet portal. The surface geological information revealed that the area above the proposed diversion tunnel is mostly covered with 2-3m thick slope wash material and is under vegetation cover. The sporadic outcrops are exposed along the course of river at lower level near inlet and outlet portal.

Settling basin

Surge shaft area is located at hill slope near Hatikot where sporadic outcrop of augen gneiss and mica schist which is grey to dark grey coarse grained. The hill slope area around the surge shaft is covered with 5-6m thick colluvium. The proposed surge shaft site envisages the construction of 2.8m dia and 165m length where 5-6m thick over burden are anticipated based on drill holes and geophysical survey and lower portion of hill slope occupied by scanty outcrop of foliated augen gneiss and mica schist which are moderately to highly weathered and fractured with three set of joints. The rock mass quality is fair to poor rock near the settling basin area.

Penstock

The penstock alignment is about 476 m which passes through the area with moderate slope in the uphill side portion whereas steep slope in the lower portion towards drop

shaft. The alignment consists of colluvial deposits varying in depth from 6 m to 7m towards uphill side on the basis of drill report and 2D- ERT and visual inspection. The colluvial deposits of sub- rounded to angular cobble, pebble and boulders of gneiss, and schist etc. supported by the light grey sandy and silty matrix is observed along the hill slope.

Powerhouse

The surfacial deposit in the powerhouse area is mainly alluvial terrace and minor colluvial deposits. The deposit consists mainly of sub-angular to sub rounded few angular boulders to gravel sized rock fragments of schist and gneiss in sandy-silty matrix with little fines.

Tailrace

Approximately 40m long tailrace channel passes through the alluvial deposit. The alluvial deposit in tailrace box culvert consists of mainly paddy field and rounded to sub surround boulders and gravel of schist, quartzite and gneiss mixed in sandy-silty matrix. Hence, the tailrace channel will be excavated in alluvial deposit for which cut cover box culvert.



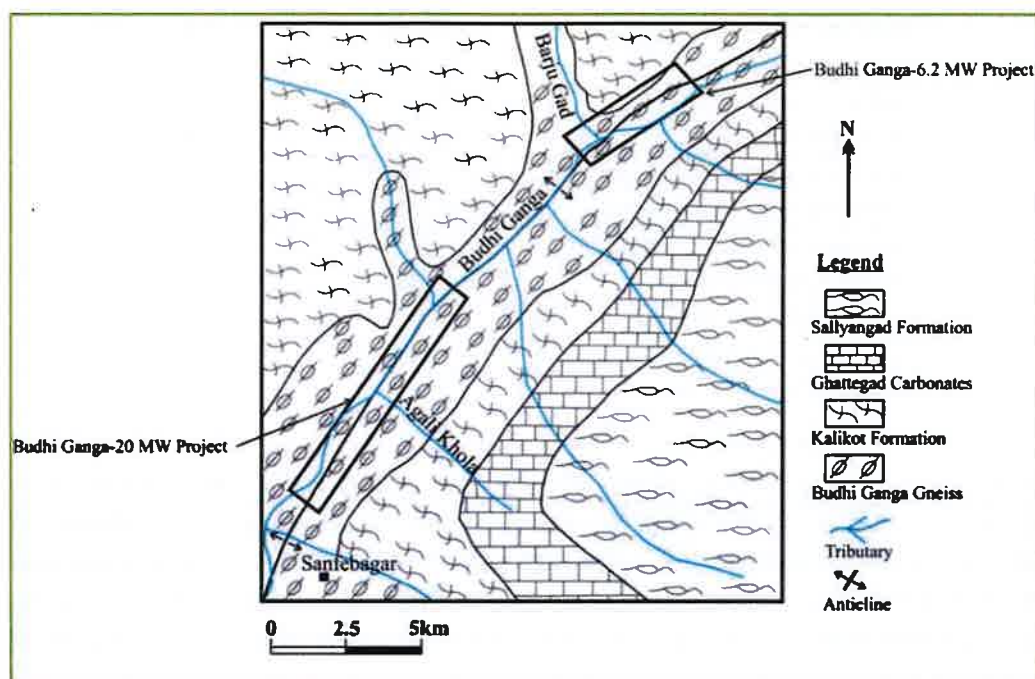


Figure 4-7: Geological Map of the project area

Source: modified after Shrestha et al., 1985; DMG

4.1.11 Seismology

4.1.11.1 Regional Seismicity

The evolution of the great Himalayan arc is the result of collision between the Indian and the Eurasian tectonic plates. As the Himalaya lies in the plate boundary, the region is considered as one of the seismically active zone of the world as evidenced by many great earthquakes from the historical time. 1897 Assam earthquake, 1905 Kumaon earthquake, 1934 Nepal-Bihar earthquake, 1950 Assam earthquake, 2005 Kashmir earthquake, 2015 Gorkha earthquake are the great earthquakes that shocked the entire Himalayan region during the last century.

4.1.11.2 Seismicity In Nepal

As Nepal lies in the central part of the Himalaya, many great to strong earthquakes have occurred since the historical time. However, the seismic network was introduced in 1978 by the National Seismological Centre (NSC) under Government of Nepal and evidences of strong to large historical earthquakes are recorded in monuments and other archaeological documents. In this regard the earthquake catalogue of the Nepal Himalaya is still incomplete so as to determine the nature of recurrent large earthquakes.

The tectonic features such as the Main Central Thrust, the Main Boundary Thrust, Himalayan Frontal Thrust and other active regional faults are the main sources of the earthquake in Nepal. Nepal has experienced several great and strong earthquakes over the past centuries that have resulted in substantial property damage and loss of life. Recent earthquakes of larger magnitude that have occurred in Nepal are summarized in Table 4-9.

Table 4-9: Summary of Earthquakes of Nepal with $M > 6$

S.N.	Location of epicenter	Year	Magnitudes
1	Sindhupalchok, Central Nepal	1833	8

2	Darchula, Far Western Nepal	1916	7.3
3	Chainpur, Eastern Nepal	1934	8.3
4	Dolakha, Central Nepal	1934	6.8
5	Kaski, Western Nepal	1954	6.4
6	Dharchula, Far Western Nepal	1966	6.3
7	Dharchula, Far Western Nepal	1966	6.1
8	Bajhang, Far Western Nepal	1980	6.5
9	Udaypur, Eastern Nepal	1988	6.6
10	Taplejung, Eastern Nepal	2011	6.9
11	Gorkha, Central Nepal	2015	7.8
12	Dolakha, Central Nepal	2015	7.3

1833 M8.0 Sindhupalchowk earthquake, 1916 M7.3 Darchula earthquake are the large earthquakes occurred during pre-instrumental time in Nepal. 1934 Nepal-Bihar earthquake epicentered at Chainpur of eastern Nepal severely devastated eastern part of Nepal including Kathmandu valley and Bihar. This earthquake with magnitude 8.3 is the largest earthquake in Nepal. However, many strong earthquakes such as Darchula earthquake, Bajhang earthquake, Udayapur earthquake, Taplejung earthquake shook the Nepal Himalaya, 2015 Gorkha earthquake is the only large earthquake with magnitude 7.8 that severely devastated several parts of Nepal after the 1934 Nepal-Bihar earthquake (Table 4-9).

Gorkha Nepal Earthquake, 2015

At 11:56 am on 15th April 2015, a large earthquake with magnitude 7.8 hit Barpak area of Gorkha district, Central Nepal. This earthquake is the repeat of 1833 Sindhupalchowk earthquake indicating inter-seismic period of >180Yrs. The rupture of this earthquake propagated towards southeast (Figure 4-6) severely devastating Gorkha, Dhading, Rasuwa, Sindhupalchowk and Dolakha districts of Nepal. The effect of this earthquake in the southern districts such as Nuwakot, Kathmandu, Bhaktapur, Lalitpur, Kabhrepalanchowk and Sindhuli districts was significant. The maximum peak ground acceleration (PGA) in Kathmandu valley was measured to 0.25g. The Gorkha earthquake was followed by thousands of aftershocks including 7.3 magnitude Dolakha earthquake on 12th May 2015 (Figure 4-8).

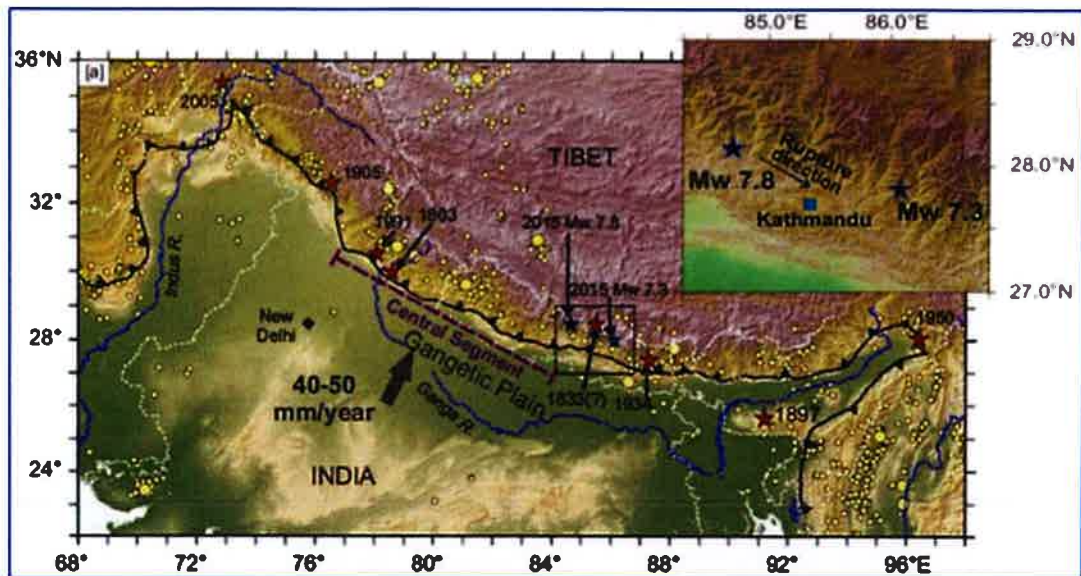


Figure 4-8: Regional seismicity map of the Himalaya

Source: after Parameswaran et al, 2015

Note: Red stars represent large historical earthquakes of the Himalaya. Blue stars represent 2015 events in Nepal Himalaya. Yellow circles represent background seismicity (size is proportional to magnitude). The inset map shows the rupture direction of the 2015 Gorkha earthquake

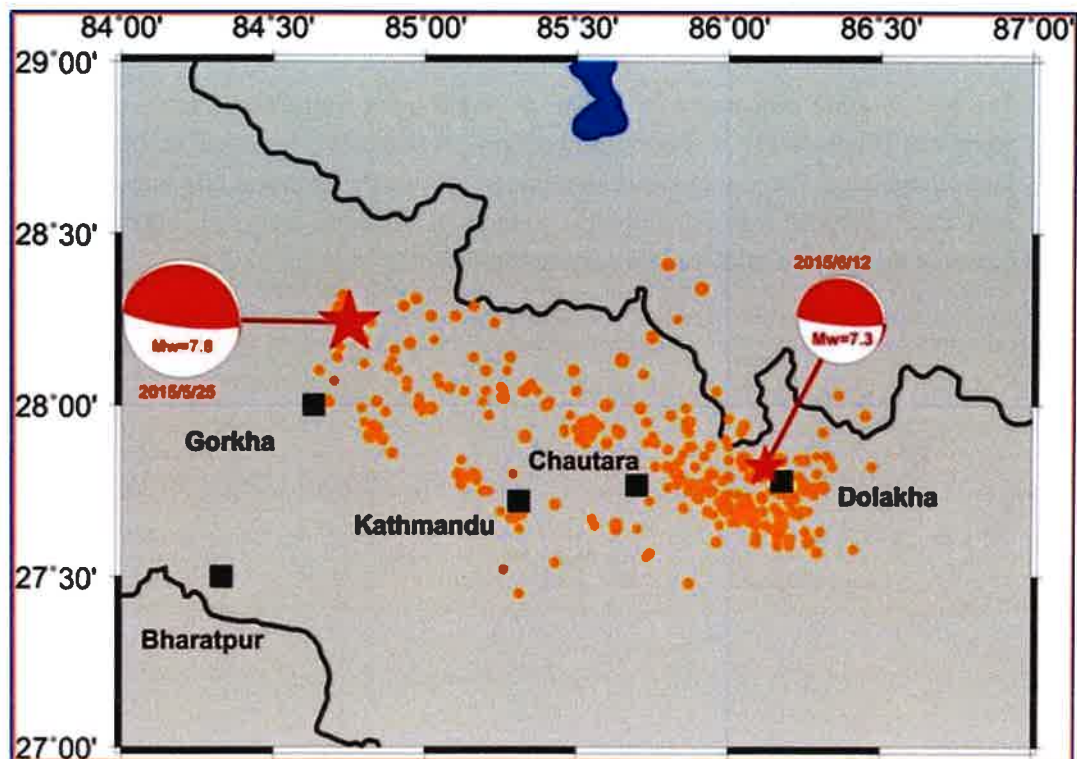


Figure 4-9: Aftershock Map of the 2015 Gorkha Earthquake

Source: after Parameswaran et al, 2015

Note: The red stars and associated beachballs represent earthquakes and their mechanism (with Mw > 7.0) respectively. Solid orange circles represent aftershocks with magnitude more than 5.

4.1.11.3 Histry of Seismic Activity Near Project Area

Historical data reveal that four (4) earthquakes of magnitude 5.7, 5.8 and 6 were observed within 65 years in Dipayal, but no significant earthquake has been recorded since the last 38 years. The details of the last major earthquakes recorded in the area has been presented in the Figure 4-10.

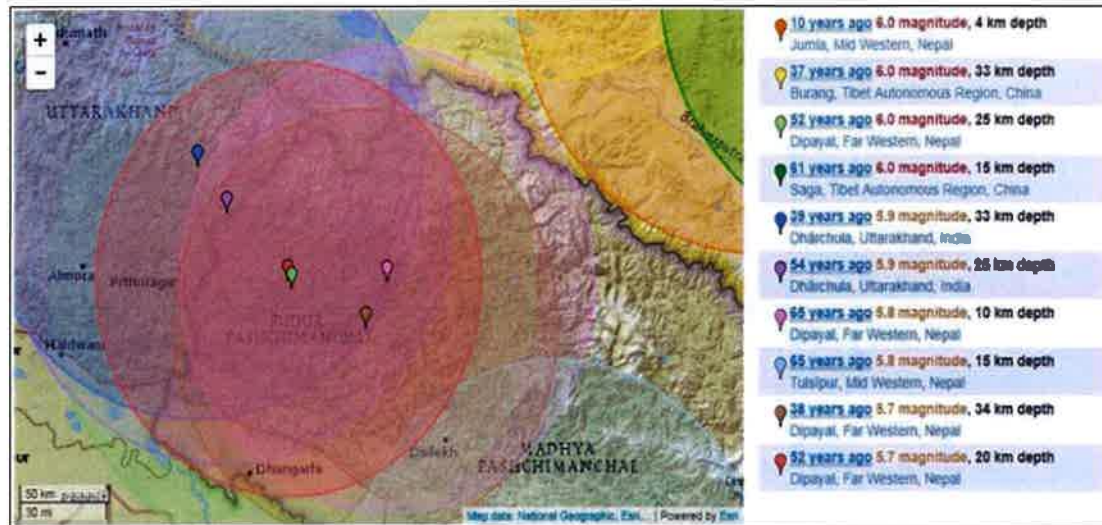


Figure 4-10: Major Earthquakes Recorded in the Project Area

Source: EarthquakeTracker.com, 2018

4.1.11.4 Seismicity Evaluation

The NSC in 2002 prepared a PGA map of Nepal using probabilistic seismic hazard mapping technique (Figure 4-11). It considered background seismicity, historical earthquakes and active faults in the area. There are several methods to convert the probable PGA into the design seismic coefficient. Simplest method, empirical method and dynamic analysis using dynamic model are common methods to establish the seismic coefficient.



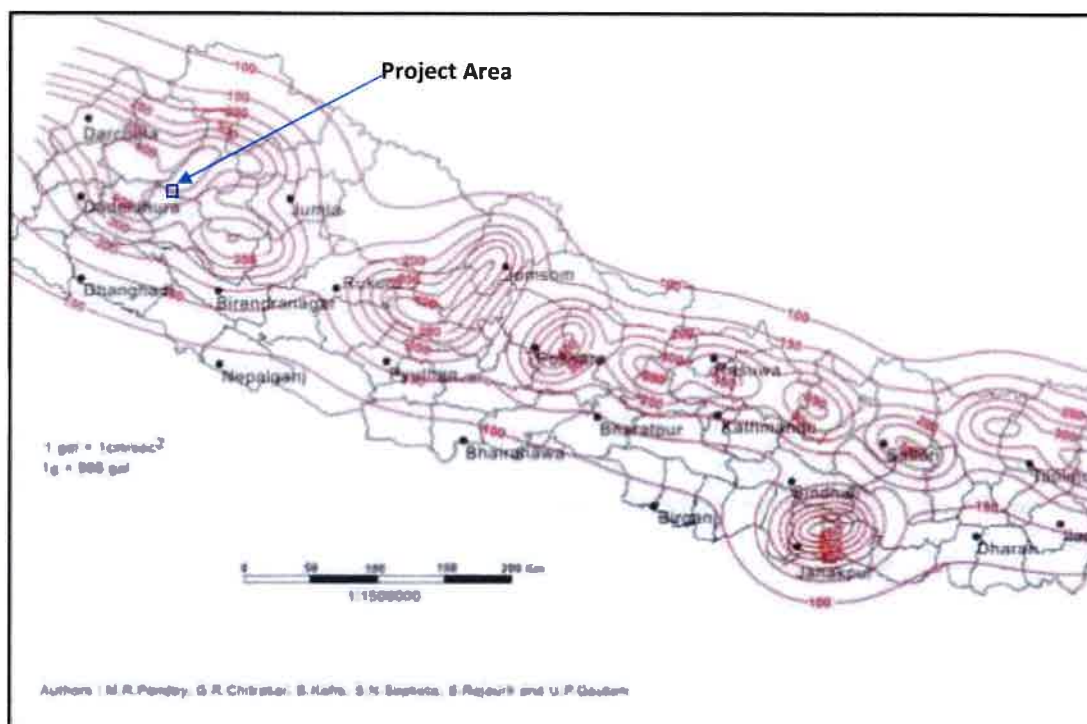


Figure 4-11: Seismic hazard map of Nepal with project area location

Source: M.R. Pandey et. al, 2002

In order to determine seismic coefficient, a seismic design code for Nepal has been prepared. By using Empirical method, the effective design coefficient according to seismic design code of Nepal is given by:

$$\alpha_{\text{eff}} = R\alpha = R A_{\text{max}}/980$$

Where,

α_{eff} = Effective design coefficient.

R = Reduction factor (empirical value, R = 0.5-0.65)

For maximum acceleration of 400 gal according to PGA map (Figure 4-11) and the maximum reduction factor 0.65, the calculated effective design seismic coefficient for BHP is 0.26g. The comparison of the calculated effective design seismic coefficient value with the seismic design parameter for different hydropower projects of Nepal (Table 4-10) shows a similar range of value for BHP.

Table 4-10: Seismic Design Parameter for Different Hydropower projects of Nepal

Hydropower Project	Calculated value
Arun-3	0.12 g for all components of design
Upper Arun	0.12 g for dam and 0.06 g for underground powerhouse
Mulghat (Tamor)	0.2 g for all components of design
Tamor (Mewa)	MDE = 0.25-0.24 g
	OBE = 0.16-0.15 g
Dudhkoshi-1	MDE = 0.37 g
	OBE = 0.22-0.23 g

Kaligandaki	OBE = 0.3g
Budhigandaki	OBE = 0.15g-0.16g
Khimti I	OBE = 0.25g-0.3g
Upper Karnali	0.24g
Middle Marsyandi	MDE = 0.25g-0.32g
	OBE = 0.22g-0.29g

Note: MDE- Maximum Design Earthquake OBE- Operation Basic Earthquake

4.1.12 Soils

The project area lies in the Lesser Himalayan belt and the Main Boundary Thrusts occurs 42 km south from the project area. The area includes the Kalikot formation comprising gametiferous biotite schist, augen gneiss and mica schists.

Medium to low steep slopes in the project area are covered by generally thick colluvial deposits. Medium terrace deposits occur 10m to 15m above the river course on the left bank of the Budhi Ganga.

Specific soil problems and threats to soil of the project area are soil productivity decline, soil erosion and land degradation. There is less soil organic matter decline due to heavy vegetation cover in the area. Loss of soil nutrient can be attributed to leaching by rain in the steep hill side.

Minerals

Individual mineral samples were analysed for the particle size >75 mm. In silt and clay size, clay minerals are predominant with granular particle of quartz grain. The amount of quartz, feldspar and other hard minerals present in sample is 48.7% (Detailed Design Report 2018).

4.1.13 Land Use

The total land of the project area is 7,295 ha (Fig 4-12). Cultivated land (4,000 ha) followed by forest (1,759 ha) and shrub land (1097 ha) are the major land use of the project area. The other land uses are grass land (265 ha), sandy area (101 ha), water body (73 ha) and rocky areas (9ha).

The land cover of the reservoir area is forest, river and ford. Small patch of private cultivated land is found in reservoir area. The land cover of dam site is forest mostly the bushes. The desanding basin is proposed in bush land. The construction yard for headworks is proposed in forest area. The proposed contractor camp is located on private cultivated land. This site was also used for camp during construction of Sanfe-Martadi road.

The headrace tunnel alignment passes through terraced cultivated land, grass land, forest area barren land and water bodies. Settlements are found above the proposed tunnel alignment. The surge shaft is proposed in grass land with partly forest area. The penstock is located in grass land whereas powerhouse is proposed in private cultivated land. Crushing plant is proposed in private barren land whereas spoil disposal sites are located partly in ford along with private thatch (Kharbari) land.



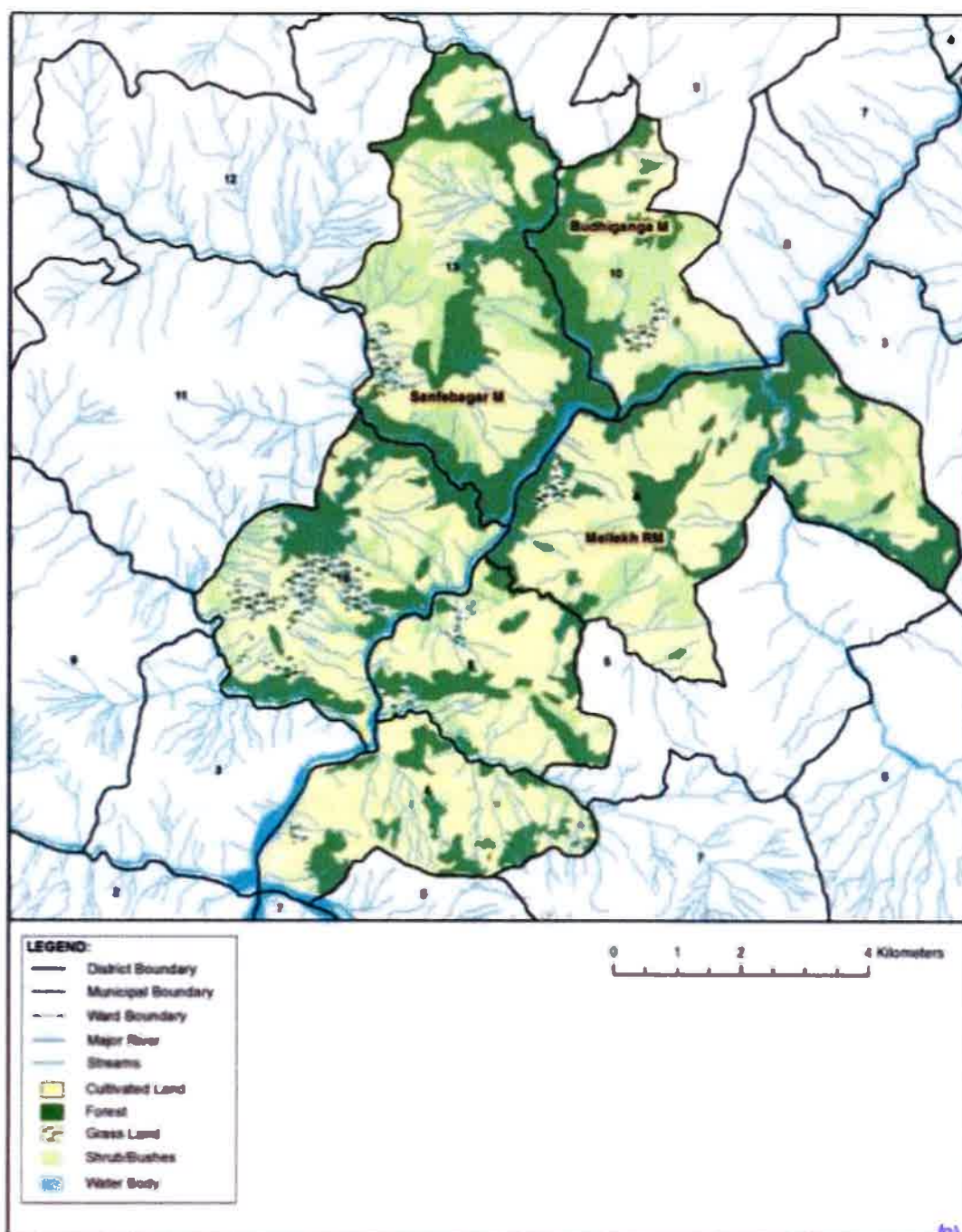


Figure 4-12: Land-use map

Source: DED, BHP, 2018

4.1.14 Landslides and Soil Erosion

Different forms of erosion, such as slope wash, land slips, sheet erosion and gully erosion are common on sloping terraces. Land instability in steeper sections of hills is a general problem, and the top soil is readily washed away by heavy rains even on very gentle slopes.

Active landslides of significance were not observed at the locations of the proposed project component sites and reservoir area. Both the bank of the proposed reservoir is covered with forest

and landslides are not found in this stretch of river. Landslide was noted on the left bank of river about 300m from the dam site. Besides this gully erosion is found at leftbank between the powerhouse tailrace to adit site. In addition, 4 other landslides of small size were also noted on the left bank of the river between headworks and powerhouse site. Sanfe-Martadi Road is found at right bank of the river and 5 small landslides were noted along the existing road.



Photo 4-1: Landslide below proposed dam site

Photo 4-2 Gully erosion in between powerhouse to adit

4.2 Biological Environment

The project area lies in the tropical bio-climatic zone and the altitudinal variation of the project site ranges from 700-1000m altitude. The project area does not lie in the national park, wildlife reserve, buffer Zone, conservation Area, wetlands, historically and archaeologically important sites and or environmentally sensitive/fragile areas. Khaptad National park is the nearest national park found in project district. The closest aerial distance of the Khaptad National Park from the Project area is about 5.25km. The core area of national park is situated at the cross point of Bajhang, Bajura, Doti and Achham Districts. The Park headquarter is located at Khaptad which is about 32 km walking distance from Chainpur Bazar of Bajhang district.

4.2.1 Terrestrial Environment

4.2.1.1 Forest and Vegetation Resources

1. Forest types and forest resources in project districts

A. Achham District

About 51.53% of the land area of the district is covered by the forest which comprises around 87,200 ha (total land area 169,200 ha). Similarly, the other land-use type represents bush land (2.39%), pastureland (8.84), agricultural land (33.36%) and remaining 3.38% include, settlement, river, cliffs and others.

Prominent forest trees of Achham district include Sal (*Shorea robusta*), Khayar (*Acacia catechu*), Sisau (*Dalbergia sissoo*), Tooni (*Toona ciliata*), Botdhairo (*Lagestroemia parviflora*), Pahadi Mauwa (*Englehardtia spicata*), Jamun (*Syzygium cuminii*), Saaj (*Terminalia tomentosa*), Uttis (*Alnus nepalensis*), Musure katus (*Castanopsis tribuloides*), Khote Salla (*Pinus roxburghii*), Gobre Salla (*Pinus wallichiana*), Sano Baanh (*Quercus leucotrichiphora*), Chilaune (*Schima wallichii*), Deodar (*Cedrus deodara*), Lali Guraans (*Rhododendron arboretum*), (DFO, 2072 BS).

Likewise, several plants of medicinal value and non-timber forest products that are in commercial use include Amala (*Phyllanthus emblica*), Jhyaau (*Parmelia nepalensis*), Kaulo (*Machilus*

odoratissima), Tejpaat (*Cinnamomum tamala*), Lokta (*Daphne bholua*), Allo (*Girardinia diversifolia*), Bojho (*Acorus calamus*), Chutro (*Berberis aristata*), Launth Salla (*Taxus wallichiana*), Titepati (*Artemisia indica*), (*Zanthoxylum armatum*), Chiraito (*Swertia chirayita*), Sugandhawal (*Valeriana wallichii*), Bish (*Aconitum spicatum*), Sungaabha (*Orchid sp.*) etc.

Division forest office has conducted four programs including community forest management program, leasehold forest and livestock development program, National forest development and management program and multi-stakeholder forest program. Though there has been practiced private tree plantation around house premises and agricultural lands, no private forests are legally recorded in Achham district.

Community and Leasehold Forests

In Achham district a total 375 forest users' groups have been formed and 39040.54 ha of forest land has been handed over to the CFUGs till fiscal year 2071/2072. Under leasehold forestry program, till 2070/71 B S, in total 139 such types of forests have been handed over equalling 629.65 ha for 1,529 HH. Most households in Bajura (55%) are involved in Forest User Groups, and around 20,784 households benefited directly from the community forest program. An additional 1,114 households have organized 134 groups under Leasehold Forest Development Program managing 646 ha of forest area. To date only 3.70 ha of forest has been handed over as religious forest around Narvadeswar Temple.

All the forest resources of the project sites are managed by community forest use groups (CFUG). The reservoir area is managed by Shree Juka Ban CFUG and Shree Rakshe Ban CFUG in Achham and Shree Juka Ban Lamkana CFUG in Bajura. Similarly, the forest falling on Adit area is managed by Shree Imaltukra Betalmandu CFUG (Achham). Likewise, road to adit area is managed by Sukethana CFUG (Achham).

B. Bajura District

Among the total land area of the Bajura district, the forest area and pasture land covers 98,646 ha and 38,095 ha respectively. The vegetation types include sub-tropical forest, lower temperate forest, upper temperate forest, subalpine forest, alpine forest and tundra. Cactus and olive forests are also found in rural municipality located in the northeast of Bajura. The Hill Sal Forest in Bajura district is characterized by the dominance of Sal over the broadleaved trees such as *Terminalia csebula*, Botdhairo (*Lagestroemia parviflora*), *Haldina cordifolia*, Amala (*Phyllanthus emblica*) Mauwa (*Englehardtia spicata*), *Albizzia sp.* The Chirpine broadleaved forest occupies the middle elevation between 1000-2000m and is generally composed of Khote Salla (*Pinus roxburghii*), Sano Baanjh (*Quercus sp.*) and Lali Guraans (*Rhododendron arboretum*).

2. Forest, vegetation and plant resources in project area

The project area is rich in terms of plant bio-diversity and 165 species of plants were identified from the project area (Vol.II, Appendix: C). The vegetation in this area is dominated by mixed hardwood forests predominantly composed of Sal (*Shorea robusta*) along with pine forests. But at the river valley and bottom of the hill, characteristic trees of riverine species namely Simal (*Bombax ceiba*), Sisso (*Dalbergia sissoo*), Khair (*Acacia catechu*) and Botdhairo (*Lagestroemia parviflora*) are found in significant numbers and there is rich biodiversity of other associated species as well. Apparently, pure Sal forest, mixed Sal forest, riverine deciduous forest and Chir

Pine forest were noticed in and around the project area. The project area is dominated by Sal and riverine forest with mostly represented by pole size trees.

The major vegetation (trees, shrubs and herbs) of this area include Sal, Khair, Haldu (*Haldina cordifolia*), SetoSiris (*Albizia procera*), Kalo Siris (*A. lebbek*), Botdhairo, Bhorla (*Bauhinia vahlii*), Badkaulo (*Casearia sp.*), Guelo (*Callicarpa arborea*), Khanayo (*Ficus cunia*), Sindure (*Mallotus philippinensis*), Bhimal (*Grewia oppositifolia*) and Amala (*Phyllanthus emblica*). Other vegetations found in the project area are Bhalayo (*Semecarpus anacardium*), Sisso, Simal, Harro (*Terminalia chebula*), Dhurseuli (*Colebrokia oppositifolia*), Sisno (*Urtica dioca*), Simali (*Vitex negundo*), Dhaiyaro (*Woodfordia fruticosa*), Aank (*Calotropis gigantea*), Geetha (*Dioscorea bulbifera*), Vyakur (*Dioscorea deltoidea*), Titepaati (*Artemisia indica*) and Kurilo (*Asparagus racemosus*).

3. Status of forest and common flora of the project sites

The prominent plant species of the project sites and ancillary facilities are described below:

a. Dam Site

Right bank of dam site is very steep and rocky area hence does not hold many mature trees. Sami (*Ficus benjamina*), Sindure, Khirro (*Sapium insigne*), Dhaiyaro (*Woodfordia fruticosa*), Areli (*Mimosa rubicaulis*), Kande Banamara (*Lantana camara*) and some thickets of grasses of Babio (*Eulaliopsis binata*) and Kaans (*Saccharum sp.*) are found in this area. However, on further higher altitude of dam site few trees of Sal are found to withstand on deposited soils.

Left bank of dam site is less steep and supports some significant vegetation cover composed of Pahadi Mauwa (*Englehardtia spicata*), Sindure, Khirro and Malato (*Macaranga sp.*) with the dense presence of shrubs and herbaceous species such as Ghangahru (*Pyracantha crenulata*), Asuro (*Justicia adhatoda*), Dhaiyaro, Karipatta (*Murraya coenigii*), Kande Banamara, Dhurseuli, Titepaati, Kaans, Khanayo, Sarpako Makai (*Ariesaema sp.*) and some Sal seedlings.



Photo 4-3: *Aeginetia indica* found in project area

Photo 4-4 *Mallotus philippinensis* found in reservoir area

b. Reservoir Area

Reservoir area is covered with dense forest stands on both banks of the river but due to rocky habitat condition the forest trees do not attend considerable height and diameter. The right bank of the reservoir area is very steep and rocky and does not hold many mature trees but at the confluence of Ikadi Gad (Khola), which is also border the Achham and Bajura districts, the area is open to some extent and supports some notable vegetation. Sal, Maloto, Sindure, Khirro and Badkaulo are the major tree species found on left bank of reservoir. The shrubs and herbs species

found in this area are Dhaiyaro, Amala, Areli, Kande Banamara, Dhurseuli, Asuro and Sisno. However, on gentle slopes some dense forest is established to grow, but due to the presence of boulders the growth is restricted (Photos 4-2, 4-3 and 4-4).

Left bank of reservoir also is very steep and rocky and does not hold many mature trees, but unlike the right bank, at the opposite of Ikadi Gad confluence, it is steeper and bears forest patches of limited growth condition. Prominent tree species of this site include Malato, Pahadi Mauwa, Tooni, Sindure and Khirro. Ground flora is composed of Dhurseuli, Asuro, Khanayo, Sisno and Sarpako Makai. However, in upper reaches of reservoir area, which is also very steep and inaccessible, several clumps of Babio are found. At the tail end of the reservoir close to the Sarane Gad confluence small patches of cultivated land and one small cottage is found. The ground vegetation around this area is composed of Badkaulo, Kanthkari etc.

c. Desanding Basin

This site (left bank of the river) has almost the same species with the species of left side of the dam and is composed of *Homalium nepalense*, *Englehardtia spicata*, *Albizia lebbek*, *Sapium insigne* and *Macaranga sp.* with the dense presence of shrubs and herbaceous species such as *Pyracantha crenulata*, *Justicia adhatoda*, *Woodfordia fruticosa*, *Murraya coenigii*, *Lantana camara*, *Colebrokia oppositifolia*, *Artemisia indica*, *Ageratina adenophora*, *Sonchus sp.*, *Pogonanthum sp.*, *Sarcococca*, *Dioscorea*, *Urtica macrophylla*, *Ariesaema*, *Dryopteris sp.*

d. Construction Yard

This site is close to the river bank (right side) and has very few trees represented by *Shorea robusta*, *Bombax ceiba*, *Ficus religiosa*, *Garuga pinnata*, *Phyllanthus emblica* and *Sapium insigne*. The ground area is covered by dense thickets of shrubs of *Lantana camara*, *Woodfordia fruticosa*, *Artemisia indica*, etc. Some common flora found on the ground are *Cassia tora*, *Euphorbia hirta*, *Pogonanthum sp.*, *Imperata cylindrica*, *Dioscorea sp.* The habitat is rocky with boulders of varying size.

e. Project road to Construction yard and Construction Camp

The road to dam site and other project components of headworks is aligned from right bank of Budhi Ganga River from the highway close to Budhabagar settlement. The vegetation pattern is similar to the construction yard but at intervals there are few standing trees of Sal (*Shorea robusta*), Rohini (*Mallotus philippinensis*), Dabdabe (*Garuga pinnata*), Seto Siris (*Albizia procera*), Khirro (*Sapium insigne*), etc in decreasing order. The ground flora is mostly covered by Kande Banamara (*Lantana camara*), Asuro (*Justicia adhatoda*), etc.

f. Dakraa Tapu

There is a formation of island with considerable area formed by Budhi Ganga River near Budhabagar. This island is mostly covered by Sisso (*Dalbergia sissoo*). Other tree species in this locality include Simal (*Bombax ceiba*), Seto Siris (*Albizia procera*), Tooni (*Toona ciliata*) and Dabdabe (*Garuga pinnata*).

g. Adit site

The site of adit entrance is located at vertical cliff and almost inaccessible to reach. The tree vegetation in this site and surrounding locality consists of *Macaranga pustulata*, *Pyrus pashia*, *Sapium insigne* and *Alnus nepalensis*. Ground flora is represented by *Rubus ellipticus*, *Urtica dioca*,

Ageratina adenophora, *Dioscorea bulbifera*, *Gonatanthus sp.* and *Urtica macrophylla* with some patches of wild banana having few stems.

h. Road to Adit and Surrounding Area of Powerhouse Site

The access road on way to adit passes through cultivated land, settlement, bush land, and some forest patch and is confined within a strip of 20m to 25m. Among the thinly dispersed tree species, prominent species include *Ficus sp.*, *Terminalia alata*, *Toona ciliata*, *Ficus cunia* and some Sal (*Shorea robusta*). Shrub sized trees of *Casearia* and *Desmodium sp.* are frequent. Significant part is covered by *Lanata camara*, *Artemisia sp.*, *Eulaiopsis binata* and *Themeda sp.*

The forest is found scattered in this section and there is a patch of Sal forest at the lower elevation whereas few Pine trees are observed on the ridges. The vegetated area also has few trees of *Albizia procera*, *A. lebbek*, *Englehardtia spicata* and *Sapium insigne* and it continues through a small forest patch of Sal near human settlement (Thapagaun). There are also some trees of Bhimal (*Grewia optiva*) and Saaj (*Terminalia alata*) and clumps of Bamboos. Around the houses there are several fruit trees including Banana, Mango and Papaya.

The Sal forest is immature one and is in proximity of the settlement and hence is found mixed with other tree species of domestic uses such as *Bombax ceiba*, *Toona ciliata*, *Sapium insigne*, *Syzygium cuminii*, *Grewia optiva*, *Lagestroemia parviflora* and *Ficus cunia*.

While approaching to the powerhouse site there exists a forest patch at the bottom of the forested hill slope which is completely dominated by Sal (*Shorea robusta*). Ground layer species are represented by *Casearia sp.*, *Pogonanthum sp.*, *Dioscorea sp.*, *Lantana camara* and *Cheilanthes sp.*

i. Surge shaft Area

The surge surge shaft area is mostly located in barren land and there is almost pure Sal forest around this locality. The growth status of the forest is in immature stage with the presence of many pole size trees and regenerating saplings/seedlings. However, there is insignificant presence of *Englehardtia spicata*, *Semecarpus anacardium* and *Casearia saplings*. The ground flora is represented by *Woodfordia fruticosa*, *Desmodium sp.*, *Murraya coenigii*, *Sida sp.*, *Pogonanthum crinitum*, *Dioscorea bulbifera* and *Imperata cylindrica*. At the edges of the forest *Lanata camara* is found to invade the area.

j. Powerhouse Area

Powerhouse site is in an agri-field (paddy field during scoping study) at the foot of hill slope. There is only one silk-cotton tree (*Bombax ceiba*) of any significance. Other common plants (shrubs and herbs) of the site are *Glycine max*, *Imperata cylindrica*, *Euphorbia hirta*, *Lantana camara*, *Artemisia*, *Colebrokia oppositifolia*, *Sapium insigne*, *Cassia tora* and *Gonatanthus sp.*

4. Protected plant species

Government of Nepal has imposed restriction on the export of plant species in unprocessed condition. Sal (*Shorea robusta*), the species available in the project area, is banned for felling, transportation and export as per the Forest Rules, 1995 (Table 4-11).



Table 4-11: Conservation status of the plants

SN	Local Name	Scientific Name	Threat Category			Remarks
			GoN	IUCN	CITES	
1	Sal	Shorea robusta	-	-	-	+++ Banned for felling, transport and export
2	Vyakur	Dioscorea deltoidea	-	T	II	

GoN category: +++ Trees banned for transportation, export and felling for commercial use

IUCN definitions: EN Endangered; V Vulnerable; R Rare; T Threatened

CITES category:

CITES I Include species threatened with extinction. Trade in specimen of these species is permitted only in exceptional circumstances

CITES II Not necessarily threatened with extinction but trade must be controlled

CITES III Contains species that are protected in at least one country, which has asked other CITES Parties for assistance in controlling the trade

Ethno-botany

Several plants found in and around the project locality carry traditional and ethno-botanical uses including medicinal, religious and economic values. Many of them are used widely in Ayurvedic medicine as well. Some of the common uses of the prominent species such as Kutch (*Acacia catechu*), medicinal (*Dalbergia sissoo*, *Terminalia chebula*, *Woodfordia fruticosa*, *Artemisia indica*, *Asparagus racemosus*, *Ageratina adenophora* and *Solanum xanthocarpum*) local umbrella of leaves (*Bauhinia vahlii*), fodder (*Ficus cunia*), edible fruit (*Phyllanthus emblica*), food in famine (*Urtica dioica*), spice (*Murraya sp.*), religious (*Desmostachys bipinnata*, *Achyranthes sp.*), edible vegetable (*Dryopteris cochleata*), roofing (*Heteropogon contortus*) and broom (*Thysanolaena maxima*). The details of various use categories of the plants found in the project area is given in Vol. II, Appendix: C.

Agro diversity

A sizable area is available for agricultural activity in the study area that comprises traditional farming system. It is characterized by integrated crop-livestock production sub-system for the subsistence of the households. Farmers cultivate mostly in pocket areas and grow cereals like paddy, maize, millets, wheat, various pulses, mustard, and vegetables and some perennial crops including fruits, fodder and timber species mostly for household consumption under rain-fed conditions that are also usually found in the hilly midland areas of western Nepal.

4.2.1.2 Wildlife

1) Mammals

A. Project Area

Wildlife species distribution in the project area is influenced by two major factors: habitat degradation and human disturbance (such as settlement, movements of vehicles construction of rural roads). Thirteen species of mammals are found in project area (Vol. II, Appendix: C). Out of

this 10 are common species and widely distributed in project area whereas as three species are occasionally seen in project area. The major mammal species found in project area are Rhesus Macaque (*Macaca mulatta*), Common Langur (*Semnopithecus hector*), Jackal (*Canis aureus*), Eurasian Wild Boar (*Sus scrofa*) and Barking Deer (*Muntiacus muntjak*). Local people from Budhabagar, Tansi Bazar and Thanti Bazar reported the presence of Leopard (*Panthera pardus*) and Ghoral (*Naemorhedus goral*) in upper reaches of the project area (Field Survey, 2016 and 2018).

B. Project Sites

Since project is located along the Sanfe- Martadi road diversity of wildlife is low in the immediate vicinity of the project sites because of movement of vehicles, increasing roadside settlements and associated human activities etc. Mixed forest is found at both bank of reservoir and Dam area. Sal (*Shorea robusta*), Maloto (*Macaranga sp*), Sindure (*Mallotus philippinensis*), Khirro (*Sapium insigne*), Badkaulo (*Casearia sp*), Pahadi Mauwa (*Englehardtia spicata*) and Tooni, are the major tree species found in reservoir area.

Presence of small patch of forest is also noted in adit site. Malato, Khirro and Utish are the major vegetation found in this area. The powerhouse is located in cultivated land. The wildlife diversity of headworks area is high compared to powerhouse site. Eight species of mammals are recorded from different project sites and immediate vicinity (within 500 m). Out of this, 7 are recorded from dam and reservoir area, 5 from adit area and 3 species are found in powerhouse area (Vol. II, Appendix: C). The mammal diversity of powerhouse seems low as it is located in cultivated land and close to settlement of Thanti Bazar (Field Survey, 2016 and 2018).

Mammals found in the project sites are Jackal (*Canis aureus*), Yellow-throated Marten (*Martes flavigula*), Lesser Bendicoot Rat (*Bandicota bengalensis*), Rhesus Macaque (*Macaca mulatta*), Common langur (*Semnopithecus hector*), Eurasian Wild Boar (*Sus scrofa*), Porcupine (*Hystrix indica*) and Barking Deer (*Muntiacus muntjak*).

Out of the 8 mammal species recorded during the field survey, three were observed (Jackal, Monkey and Langur) and the other five species were identified based on local information supplemented by indirect evidence and available literatures. The call of a Jackal was also heard from headworks area.

C. Habitat Continuity and Connectivity

Being accessible and highly disturbed by human encroachment, the project sites and immediate vicinity do not provide suitable habitat for wild animals. However, the upper reaches of project area are less accessible, intact and far from settlements and, as such, are considered suitable habitats for wild animals.

Since this area is not connected with dense forest and small settlements like Selgaun, Rithatoli, Paati, Toligaun, Badgaun, Mankali are found in between habitat continuity is not found at the left bank of reservoir area. In right bank of reservoir and dam area the Sanfe-Martadi road and settlements like KunwarTole, Baddakhet, Moudali, Mathisiun, Talisiun are found. In powerhouse area Thapagaun is the settlement close to powerhouse site. Other settlements including Saunde, TalloDumari, and Kandagaun are found in upper reaches.



Photo 4-5 Forest habitat at both bank of river

Photo 4-6 Forest habitat at right bank near Budhabagar

The field survey shows that site is not connected with important habitat area and existing forest habitat is discontinued due to presence of above mentioned settlements in between (Photo 4-5 and 4-6). The field observation shows the area is temporarily used by wildlife and does not serve as breeding or feeding ground. The overall habitat condition is highly degraded due to human encroachment. The presence of water hole is not found in project component site. Foot prints of wild animals and droppings were not found in the line transects surveyed in dam, adit and powerhouse areas.

2) Birds

A. Project Area

The mixed forests, bamboo grooves, agricultural terraces, villages, rivers, streams and cliffs provides habitat for bird species. Forty-seven species of birds were recorded from the project area (Vol. II, Appendix: C). The common bird species found in project area are Common Kestrel (*Falco tinnunculus*), Egyptian Vulture (*Neophron percnopterus*), Great Horned Owl (*Bubo bubo*), Common King Fisher (*Alcedo atthis*), Long-tailed Shrike (*Lanius schach*) and White Wagtail (*Motacilla alba*). Other common birds found in project area are Thick Billed Warbler (*Arundinax aedon*), Jungle Babbler (*Turdoides striata*), Yellow Billed Warbler (*Abroscopus superciliosus*) and Ban Shallow Martin (*Hirundo rustica*).

Of the recorded 47 species, 31 species are common, 4 are abundant and 12 species are occasionally seen in project area. Out of the total bird species recorded from the project area, 16 species are found in forest habitat, 8 species are riverine, 14 species prefer open areas and villages, and 9 species occupied mixed type of habitat consisting forest, open areas and river. Bird migration route is not found in project area.

B. Project Sites

Like mammals, the bird diversity in project sites is slightly low in comparison to project area. Twenty six species of birds were recorded from the project sites (Vol. II, Appendix: C). Of these bird species, 18 species were observed during the field survey and other 8 species were identified based on local information supplemented by indirect evidence and literature.

Out of the total recorded species, 26 are recorded from headwork area and 23 species are found in powerhouse area (Field Survey 2016 and 2018). The major bird species recorded from different projectsites and immediate vicinity are Spotted Dove (*Streptopelia chinensis*), Blossom Headed Parakeet (*Psittacula cyanocephala*), Rose Ringed Parakeet (*Psittacula krameri*), Common Myna

(*Acridotheres tristis*), Jungle Crow (*Corvus macrorhynchos*), House Crow (*Corvus splendens*), Red Billed Blue Magpie (*Urocissa erythroryncha*) and House Swift (*Appus affinis*).

Other bird species recorded from project sites and immediate vicinity are Tree Sparrow (*Passer montanus*), Oriental Robin (*Copsychus saularis*), Yellow Throated Warbler (*Phylloscopus cantator*), Ashy Drongo (*Dicrurus leucophaeus*), Red Vented Bulbul (*Pycnonotus cafer*) and Indian Roller (*Coracias benghalensis*). Forest, river, open areas, villages and cliffs provide habitat for avifauna. As mentioned above the project components are in highly disturbed areas therefore no specific habitat for bird is noted in project area.

4.2.1.3 Reptiles and Amphibians

A. Project Area

The distribution of reptiles in the project area is limited. Six species of reptiles were found in project area. Lizard (*Calotes versicolor*), Common Lizard (*Hemidactylus flavivirides*), Rat snake (*Ptyas mucosus*), Green Pit Viper (*Cryptelytrops albolabris*), Zayuan Mountain Pit Viper (*Ovophis zayuensis*) and Monitor Lizard (*Varanus bengalensis*) are the reptile species found in project area. The amphibians found in this area are frog (*Rana sp*) and toad (*Duttaphrynus melanostictus*).

B. Project Sites

Reptiles prefer to live in shady areas where leaves, litter and rotten log shelter are found. The reptilian fauna of project sites is similar to the project area. Out of the total 6 species of reptiles recorded from project sites, 2 species (*Calotes versicolor*) and Common Lizard (*Hemidactylus flavivirides*) were observed during field visit and remaining 4 species (*Ptyas mucosus*, *Cryptelytrops albolabris*, *Ovophis zayuensis* and *Varanus bengalensis*) were reported by local people.

Pools upstream and downstream of Budhi Ganga River and tributaries like Ardoli Gad and Angali Gad provide habitat for the amphibians. The frogs (*Rana sp*) and toads (*Duttaphrynus melanostictus*) were found in riverbanks and mud flats and pools at different locations.

4.2.1.4 Conservation Status

Only 39 species of animals, birds and reptiles are legally protected by the GoN, whereas CITES lists 114 species that occur in Nepal. Of these, 52 species listed under Appendix-I¹, 23 under Appendix-II and 39 under Appendix-III. Of the 13 mammal species found in the project area, three species fall under Appendix-I, one under Appendix-II and two under Appendix-III. Nine mammal species falls in Least Concern category and 3 species are categorized in Near Threatened category of IUCN red list. Thirty two bird species falls in IUCN red list consisting 1 in endangered category and 31 in Least Concern (Table 4-12).

¹CITES Appendix-I contains species that the parties have deemed to be threatened with extinction and which are, or may be, affected by trade. For these species, trade is strictly regulated and only permitted in special circumstances. Appendix-II contains species that, although not necessarily threatened, could become so if trade is not properly controlled. Appendix-III includes species that are identified by any party as being subject to regulation in that country and require international cooperation to control trade.

The species found in the project area are not protected under the National Park and Wildlife Conservation Act (NPWCA) 1973 of GoN (Baral H.S and Shah KB,2008).

Table 4-12: Conservation status of mammals, birds, reptiles and amphibians in the project area

S N	Name of Species		Protected status	
	Scientific	Common	CITES Category	IUCN Redlist
A	Mammals			
1	<i>Canis aureus</i>	Jackal	CITES III	LC
2	<i>Felis chaus</i>	Jungle cat	-	LC
3	<i>Hystrix indica</i>	Porcupine	-	LC
4	<i>Macaca mulatta</i>	Rhesus monkey	CITES II	LC
5	<i>Martes flavigula</i>	Yellow throated marten	CITES III	LC
6	<i>Panthera pardus</i>	Leopard	CITES I	
7	<i>Semnopithecus hector</i>	Common langur	CITES I	NT
8	<i>Bandicota bengalensis</i>	Lesser Bendicoot Rat	-	LC
9	<i>Herpestes auropunctatus</i>	Small Indian Mongoose		LC
10	<i>Naemorhedus goral</i>	Ghoral	CITES-I	NT
11	<i>Sus scrofa</i>	Eurasian Wild Boar		LC
12	<i>Miniopterus schreibersii</i>	Common Bent -Winged Bat		NT
13	<i>Muntiacus muntjak</i>	Barking deer	-	LC
B	Birds			
1	<i>Ardea cinerea</i>	Grey Heron	-	LC
2	<i>Spilornis cheela</i>	Crested Serpent -eagle	-	LC
3	<i>Ictinaetus malaiensis</i>	Black Eagle	-	LC
4	<i>Neophron percnopterus</i>	Egyptian Vulture	-	EN
5	<i>Falco tinnunculus</i>	Common Kestrel	-	LC
6	<i>Lophura leucomelanos</i>	Kalij Pheasant	-	LC
7	<i>Columba rupestris</i>	Hill Pigeon	-	LC
8	<i>Streptopelia decaocta</i>	Eurasian Collared -dove	-	LC
9	<i>Psittacula cyanocephala</i>	Blossom Headed Parakeet	-	LC
10	<i>Psittacula krameri</i>	Rose Ringed Parakeet	-	LC
11	<i>Cuculus canorus</i>	Common Cuckoo	-	LC
12	<i>Cuculus micropterus</i>	Indian Cuckoo	-	LC
13	<i>Milvus migrans</i>	Black Kite	-	LC
14	<i>Columba livia</i>	Rock Dove	CITES III	LC
15	<i>Coracias benghalensis</i>	Indian Roller	-	LC
16	<i>Alcedo atthis</i>	Common King Fisher	-	LC
17	<i>Pycnonotus cafer</i>	Red -vented Bulbul	-	LC
18	<i>Urocissa erythroryncha</i>	Red- billed Blue Magpie	-	LC
19	<i>Lanius schach</i>	Long- tailed Shrike	-	LC
20	<i>Dicrurus leucophaeus</i>	Ashy Drongo	-	LC
21	<i>Acridotheres tristis</i>	Common Myna	-	LC
22	<i>Corvus macrorhynchos</i>	Jungle Crow		LC



S N	Name of Species		Protected status	
	Scientific	Common	CITES Category	IUCN Redlist
23	<i>Corvus splendens</i>	House Crow	-	LC
24	<i>Pycnonotus cafer</i>	Red -Vented Bulbul	-	LC
25	<i>Alcurus striatus</i>	Striated Bulbul	-	LC
26	<i>Copsychus saularis</i>	Oriental- robin	-	LC
27	<i>Motacilla alba</i>	White Wagtail	-	LC
28	<i>Motacilla flava</i>	Western Yellow Wagtail	-	LC
29	<i>Arundinax aedon</i>	Thick- billed Warbler	-	LC
30	<i>Turdoides striata</i>	Jungle Babbler	-	LC
31	<i>Abroscopus superciliaris</i>	Yellow -billed Warbler	-	LC
32	<i>Merops orientalis</i>	Asian Green Bee -eater	-	LC
C	Reptiles			
1	<i>Cryptelytrops albolabris</i>	Green Pit Viper		LC
2	<i>Ovophis zayuensis</i>	Zayuan Mountain Pit Viper		LC
3	<i>Varanus bengalensis</i>	Monitor Lizard		LC
D	Amphibians			
1	<i>Duttaphrynus melanostictus</i>	Toad		LC
2	<i>Rana sp</i>	Frog		LC

Source: www.iucnredlist.org, Note: LC- Least concern, NT- Nearly threatened, Endangered

Although listed by International organizations some of these species are relatively common in Nepal. For example, Rhesus Macaque and Common Langur are widespread in Nepal as well as in project area.

4.2.1.5 Wildlife as Pest

The project area encompasses agricultural land and combination of forest; agriculture and settlement as seen in different areas. According to local information Rhesus Macaque, Common Langur, Barking Deer, Ghoral, Jackal and Porcupine are responsible for raiding crops. The number of animals in a raiding party differs from minimum (1-5) to maximum (5-10) depending on species. Raiding was reported every year during the crop season (June to November and March, April). Maize, wheat, and paddy are the major crops affected in the project area. The other crops affected by the raiding are vegetables, potato and fruits.

Rhesus Monkey and Mntellus monkey raid agricultural fields regularly throughout the project area. These primate species enjoy living in the forest near cultivation or human habitation. Porcupine also causes a great loss to crops. It prefers to feed on roots and sweet potato. The list of the wildlife species and their preferred crops for raiding is presented in Table 4-13.

Besides crop damage, the loss of domestic animal is also occasionally reported in project area. The predation cases of goat, cow and chicken are reported from Selgaun, KunwarTole, and Thapagaun area. Leopard, Jackal and Jungle Cat are the wild animals responsible for predation.



Many wildlife species such as Barking Deer, Eurasian Wild Boar and Kalij pheasant are hunted for meat.

Table 4-13: Wildlife as pest

S N	Name of the animals	Affected crop
1	Rhesus monkey	Maize , fruits, vegetables
2	Entellus monkey	Maize, fruits, vegetables
3	Porcupine	Sweet potato
4	Barking deer	Paddy
5	Squirrel	Vegetables
6	Eurasian Wild Boar	Paddy, wheat and vegetables
7	Field mice	Rice
8	Kalij Pheasant	Vegetables
9	Parakeets	Maize, fruits,
10	Crow	Maize, fruits,

Source: Field Survey 2016 and 2018

4.2.2 Aquatic Environment

4.2.2.1 Planktons and Aquatic Insects

I) Phytoplankton

Thirty three species of phytoplanktons of four different class were collected in the project area (Vol. II, Appendix: C). The major class of phytoplanktons recorded from Budhi Ganga River in the project area are Cyanophyceae, Chlorophyceae, Xanthophyceae and Bacillariophyceae. The species diversity is high (33 species) in upstream area (headworks) and low (27 species) in powerhouse area. Among the recorded 33 species 14 species belongs to the class Bacillariophyceae, seven (7) species from Cyanophyceae 10 species from Chlorophyceae and two (2) species from Xanthophyceae. The population density of phytoplanktons were 3,505 N/L in headworks area and 2,380 N/L in powerhouse area in April 2018 sample.

II) Zooplankton

Seventeen species of zooplanktons of three different orders namely Rotifera, Copepoda and Cladocera were found in Budhi Ganga River (Vol. II, Appendix: C). Like phytoplankton the species diversity of zooplankton is high (15 species) in upstream area (headworks) and slightly low (14 species) in powerhouse area. Among the recorded 17 species 9 species belong to the Rotifera and 4 each from Copepoda and Cladocera. The population density of phytoplanktons was 585 N/L in headworks area and 435 N/L in powerhouse area in April 2018 sample.

III) Aquatic Insects

Twenty three species of aquatic insects of six different orders namely Plecoptera, Ephemeroptera, Trichoptera, Coleoptera, Hemiptera and Diptera were recorded from the Budhi Ganga River in project area (Vol. II, Appendix: C). Like other aquatic life the species diversity of aquatic insect is high (21 species) in upstream area (headworks) and slightly low (18 species) in powerhouse area.



The diversity of order Ephemeroptera is high (6 species) in Budhi Ganga River followed by Diptera (5 species) and Coleoptera (4 species).

4.2.2.2 Fish

1) Aquatic Habitat

a) Budhi Ganga River Upstream of Dam

Budhi Ganga River at the confluence point of Sarane Gad and immediate upstream area is wide and broken into runs, riffles and pools offering varieties of micro and macro habitats for fishes. Sarane Gad is approximately 15m wide at confluence point and provides suitable spawning and rearing sites for snow trout. The presence of mid-range migratory species Katle and long distance migratory species Sahar/Mahseer is also noted at this site. The river below the Sarane Gad to proposed dam site flows through narrow gorge with steep slopes. Medium to small size boulders are found in this section with rapid and riffles habitat. Major section of river in this stretch is not accessible hence fishing is not noted. Ikri Gad is a small Khola joining Budhi Ganga River just upstream of the dam site. The Ikri Gad has moderate gradient with medium to small size boulders. The river section supports current loving species including Snow Trout, River Rohu, Mahseer, Copper mahseer and Catfishes. The confluence with Budhi Ganga River and 1km upstream area of Ikri Gad and Sarane Gad with Budhi Ganga River confluence area are suitable spawning site for Mahseer, River Rohu and Copper Mahseer.

b) Budhi Ganga River from dam to Powerhouse Tailrace

This section of the river covers the 6.87 km of river stretch from just below dam to proposed powerhouse tailrace. The river in this section is relatively wide with moderate gradient. The river receives Rakse Khola, Saine Khola, Ardoli Gad, Lata Khola and Angali Khola. Among the tributaries joining between headworks to Powerhouse the Ardoli Gad joins from the right bank of river at about 3km from downstream of dam site and Angali Khola joining from the left bank of river are perennial in nature and rest are seasonal and have flow in wet season only. The water temperature of Budhi Ganga River was 20°C and Ardoli Gad was 21°C measured at 6.15 pm and 6.45pm respectively.



Photo 4-7: Pool habitat below dam site

Photo 4-8: Riffle habitat and water is diverted for operation of water mill between dam to Ardoli Gad

Just downstream of the dam small section of river is bifurcated forming Small Island at center and pool type habitat is found at left bank and run habitat at right bank. This island is called Dakraa Tappu and mostly covered by Sisso along with other vegetation like Simal, SetoSiris, Tooni and Dabdabe. The river in this section has runs, riffles and pools offering varieties of micro and macro habitats for fishes (Photo 4-7 and 4-8). Altogether 5 small pools of 10m 15m length were found in left bank of river whereas 3 pools of 5 to 10m were found in right bank. These pools are suitable rearing ground for Snow Trout and Riverrohu. The run and riffle habitat are found in center and both banks of river. Budhi Ganga River, 1km section in Ardoli Gad (Photo 4-10) and 500m section in AngaliKhola are the suitable spawning (Photo 4-9) and rearing sites of Snow Trout, River Rohu and Catfishes.



Photo 4-9: Angali Gad providing suitable habitat Photo 4-10: Small pool serving rearing site at Ardoli Gad

c) Budhi Ganga River below Powerhouse Tailrace to Sanfebagar

Budhi Ganga River receives Bhimkoti Gad about 300 m downstream of the powerhouse tailrace. The river in this section is wide and provides run, pool and riffle types of habitat. The other tributaries joining in this stretch are Jijadi Gad and Chippi Khola. The confluence and about 1km upstream of Bhimkoti Gad and Jijadi Gad are considered suitable spawning and rearing ground for many migrant and resident species found in Budhi Ganga River. The river section supports species including Snow Trout, Mahseer, Copper Mahseer, River Rohu and Catfishes. Chippi Khola which joins from left bank of Budhi Ganga River in Sanfebagar is quite disturbed and does not provide suitable habitat for spawning and rearing. The boulders which provide shelters and food for fishes are extensively removed and hardly any boulders were seen at the surface of this Khola. The habitat preferred by different species is given in Table 4-14.

Table 4-14: Fish habitat of the important species in Budhi Ganga River

SN	Scientific Name of Fish	Local Name of Fish	Fish Habitat preference
1	<i>Anguilla bengalensis</i>	Rajbam	Pool, rapid and runs
2	<i>Barilius bendelisis</i>	Fageta	Shallow pool, riffles and rapids
3	<i>Barilius barila</i>	Fageta	Shallow pool, riffles
4	<i>Barilius shacra</i>	Fageta	Shallow pool, riffles
5	<i>Bagarius bagarius</i>	Gonch	Deep pools
6	<i>Botia almorhae</i>	Baghi	Shallow pool, riffles
7	<i>Clupisoma garua</i>	Jalkapur	Pool, rapids and runs

SN	Scientific Name of Fish	Local Name of Fish	Fish Habitat preference
8	<i>Garra gotyla</i>	Buduna	Backwater pool and confluence point
9	<i>Garra annandalei</i>	Nakatuwa	Backwater pool and confluence point
10	<i>Glyptothorax cavia</i>	Kapre	Head water springs, creeks and back water rocky boulders
11	<i>Glyptothorax pectinopterus</i>	Singhe	Head water springs, creeks and back water rocky boulders
12	<i>Bangana dero</i>	Gardi	Pool, rapids and runs
13	<i>Labeo angra</i>	Theed	Pool, rapids and runs
14	<i>Labeo dyocheilus</i>	Kalach	Pool, rapids and runs
15	<i>Neolissochilus hexagonolepis</i>	Katle	Pools and rapids
16	<i>Schistura beavani</i>	Gadela	Run and rapids
17	<i>Noemacheilus rupecola</i>	Gadela	Run and rapids
18	<i>Naziritor chelynoides</i>	Karange	Shallow pool and riffles
19	<i>Pseudecheneis sulcata</i>	Kabre	Head water and rapids
20	<i>Psilorhynchus pseudecheneis</i>	Tite	Head water and rapids
21	<i>Schizothorax progastus</i>	Chuche Asala	Rapids, pools and riffle
22	<i>Schizothorax plagiostomus</i>	Buche Asala	Rapids, pools and riffle
23	<i>Schizothorax richardsonii</i>	Buche Asala	Rapids, pools and riffle
24	<i>Tor putitora</i>	Mahseer	Pool, rapid and runs
25	<i>Tor tor</i>	Mahseer	Pool, rapid and runs

Source: Field Survey 2016 and 2018

II) Fish Diversity

The fishes of Nepal have wide distribution according to the climatic conditions and altitudinal variations. The faunal diversity of Nepalese waters includes 230 fish species belong to 104 genera, 34 families and 11 orders. The diversity of fish species is highest in the Terai and decreases with increase in elevation. Among the river basins, the highest number of species (195) is reported in Gandaki River, followed by 178 in Koshi River, and 153 in Karnali River of which Budhi Ganga River is a part.

Fish sampling along the Budhi Ganga River, observation of local catch at Budhabagar, Thanti Bazaar and Sanfebagar and local information collected in the field reveal the presence of 25 species of fish in the river (Vol. II, Appendix: C). Out of these, 17 species were collected (Photo 4-11) during different survey period (Table 4-15). The presence of 15 species is noted in August 2016 sample whereas 12 species are found in April 2018 sample at 5 different sites. The remaining 8 species were reported by local people.

The study shows that diversity of fish progressively increases downstream. Six species were recorded at upstream (station-1) section whereas 15 species were recorded in downstream section of river (station-5) in wet season sample conducted in August 2016. Like wet season fish diversity progressively increased in dry period sample conducted in April 2018. Seven species

were recorded from station-1 whereas 10 species were found in station 5. The detail of fish diversity and distribution pattern is presented in Table 4-15.



Photo 4-11: Fish diversity of Budhi

Photo 4-12: Bulk of Snow trout captured from the Ganga River
BudhiGanga River

Table 4-15: Species diversity and distribution pattern

S N	Name of fish		August 2016 Sample					April 2018 Sample				
	Scientific	Local	1	2	3	4	5	1	2	3	4	5
1	<i>Schizothorax progastus</i>	Chuche Asala	+	+	+	+	+	+	+	+	+	+
2	<i>Schizothorax plagiostomus</i>	Buche Asala	+	+	+	+	+	+	+	+	+	+
3	<i>Schizothorax richardsonii</i>	Buche Asala					+	+	+		+	+
4	<i>Neolissochilus hexagonolepis</i>	Katle	+	+	+	+	+	+	+	+	+	+
5	<i>Bangana dero</i>	Gardi			+	+	+			+	+	+
6	<i>Labeo angra</i>	Thed					+	+				+
7	<i>Labeo dyocheilus</i>	Kalach										+
8	<i>Tor putitora</i>	Mahseer/Satto	+	+	+	+	+	+	+	+	+	+
9	<i>Tor</i>	Mahseer/Satto	+	+			+		+		+	
10	<i>Naziritor chelynoides</i>	Karange			+	+	+			+	+	
11	<i>Barilius bendelisis</i>	Fageta		+	+	+	+					
12	<i>Barilius barila</i>	Fageta				+	+					
13	<i>Barilius shacra</i>	Fageta		+			+					
14	<i>Garra gotyla</i>	Buduna		+	+	+	+		+	+	+	+
15	<i>Anguilla bengalensis</i>						+					
16	<i>Glyptothorax cavia</i>	Kapre			+							
17	<i>Pseudecheneis sulcata</i>	Kabre	+				+	+		+		+
Total			6	8	9	9	15	7	7	8	9	10

Source: Field Survey 2016 and 2018

III) Species Composition



A total of 317 fish of 17 different species were collected from the Budhi Ganga River in wet and dry season sample conducted in August 2016 and April 2018. Thirteen fish of six species were collected in dry period sample 2016 whereas 22 fish of 7 species were collected in dry season sample 2018. Similarly, 47 fish of 15 species were collected in wet season and 52 fish of 10 species were collected in dry period sample from station 5. The sampling result shows that species diversity and density progressively increased in downstream areas during both samples. The species diversity is high in wet season compare to dry season whereas catch is high in dry period (Table 4-16).

Table 4-16: Species diversity at different sampling site

Station number	Wet season August 2016		Dry season, April 2018		Total Number of Species	Total Number of Fish Caught	Percent
	Fish caught	Species	Fish caught	species			
1	13	6	22	7	8	35	11
2	19	8	27	7	9	46	15
3	31	9	32	8	10	63	20
4	35	9	39	9	11	74	23
5	47	15	52	10	16	99	31
Total	145	15	172		17	317	100

Source: Field Survey 2016 and 2018

Schizothorax plagiostomus (Buche Asala) contributes 33.75 % of the total catch whereas composition of *Schizothorax progastus* (Chuche Asala) and *Schizothorax richardsonii* (Buche Asala) is 13.88 % and 6.94% respectively. The catch of above mentioned species are high in both dry and wet season sample. Snow Trout (*Schizothorax sp.*) contributes 54.57% of the total catch (Photo 4-12) throughout the year (Table 4-17). The contribution of River Rohu, Mahseer and Copper Mahseer is 10.09%, 9.15% and 7.57% respectively.

Table 4-17: Species composition in Budhi Ganga River

S N	Name of fish		Fish caught using cast net				Total	Percent
	Scientific	Local	Wet Season August 2016		Dry season April 2018			
			Number	Percent	Number	Percent		
1	<i>Schizothorax progastus</i>	Chuche Asala	19	13.1	25	14.53	44	13.88
2	<i>Schizothorax plagiostomus</i>	Buche Asala	36	24.83	71	41.28	107	33.75
3	<i>Schizothorax richardsonii</i>	Buche Asala	3	2.07	19	11.05	22	6.94
4	<i>Neolissochilus hexagonolepis</i>	Katle	14	9.66	10	5.81	24	7.57
5	<i>Bangana dero</i>	Gardi	13	8.97	12	6.98	25	7.89
6	<i>Labeo angra</i>	Thed	2	1.38	3	1.74	5	1.58
7	<i>Labeo dyocheilus</i>	Kalach	0	0	2	1.16	2	0.63
8	<i>Tor putitora</i>	Mahseer	11	7.59	11	6.4	22	6.94

S N	Name of fish		Fish caught using cast net				Total	Percent
	Scientific	Local	Wet Season August 2016		Dry season April 2018			
			Number	Percent	Number	Percent		
9	<i>Tor tor</i>	Mahseer	4	2.76	3	1.74	7	2.21
10	<i>Naziritor chelynoides</i>	Karange	13	8.97	3	1.74	16	5.05
11	<i>Barilius bendelisis</i>	Fageta	9	6.21	0	0	9	2.84
12	<i>Barilius barila</i>	Fageta	2	1.38	0	0	2	0.63
13	<i>Barilius shacra</i>	Fageta	4	2.76	0	0	4	1.26
14	<i>Garra gotyla</i>	Buduna	9	6.21	9	5.23	18	5.68
15	<i>Anguilla bengalensis</i>		1	0.69	0	0	1	0.32
16	<i>Glyptothorax cavia</i>	Kapre	1	0.69	0	0	1	0.32
17	<i>Pseudecheneis sulcata</i>	Kabre	4	2.76	4	2.33	8	2.52
	Total		145	100	172	100	317	100

Source: Field Survey 2016 and 2018

The average catch per unit effort of Budhi Ganga River is 0.16 fish throughout the year with highest catch at station 5 and lowest at Station 1. In general, 1 fish was caught in 6 efforts (Table 4-18).

Table 4-18: Catch per unit effort at different sampling station

Sampling station	August 2016				April 2018				Average CPU	Attempt catch ratio
	Level of effort	Number of fish caught	CPU effort	Total weight of fish (gm.)	Level of effort	Number of fish caught	CPU effort	Total weight of fish (gm.)		
1	200	13	0.07	302	200	22	0.11	1298	0.09	11.43
2	200	19	0.1	518.5	200	27	0.14	1660	0.12	8.7
3	200	31	0.16	1425.5	200	32	0.16	1838	0.16	6.35
4	200	35	0.18	1476.5	200	39	0.2	3617.5	0.19	5.41
5	200	47	0.24	2826.5	200	52	0.26	5069.5	0.25	4.04
Total/Average	1000	145	0.15	6549	1000	172	0.17	13483	0.16	6.31

Source: Field Survey, 2016 and 2018

a) Species Composition and Diversity at Upstream of Dam Site

Sampling stations 1 and 2 represent fish composition and diversity upstream of dam site.

Sampling station 1 (Confluence of Budhi Ganga River with Sarane Gad)

Altogether 35 fish of 8 species were collected at this station. Thirteen fish of 6 species were collected in this reach of river during the wet season sample 2016 whereas in dry period sample (2018) 22 fish of seven species were collected. This station represents 11% of the total catch. The catch per unit effort is 0.09 and 1 fish is caught at 11 attempts (Table 4-18). The average weight of the total catch is 302 gm in wet season and 1298 gm in dry season respectively. The maximum size of fish caught at this station is 23 cm long (*Schizothorax plagiostomus*) and weights 100 gm in

dryseason and 14 cm long (*Tor putitora*) and weighs 30gm in wet season sample. Out of the total collected fish species 2 are long distance migrants, 5 are mid-range migrants and 1 is resident (Vol. II, Appendix: C).

Sampling station 2 (Dam and Reservoir)

The species diversity slightly increases at this site during wet and dry season samples and altogether 46 fish of 9 species were collected. Nineteen fish of 8 species were collected in this reach of river during the wet season sample 2016 whereas in dry period sample (2018) 27 fish of seven species were collected. This station represents 15% of the total catch. The catch per unit effort is 0.12 and 1 fish is caught at 9 attempts (Table 4-18). The average weight of the total catch is 518.5 gm in wet season and 1660 gm in dry season respectively. The maximum size of fish caught at this station is 18 cm long (*Neolissochilus hexagonolepis*) and weighs 100 gm in wet season and 24 cm (*Schizothorax plagiostomus*) long and weighs 120 gm in dryseason sample. Out of the total collected fish species 2 are long distance migrants, 4 are mid-range migrants and 3 are (Vol. II, Appendix: C).

b) Species Composition and Diversity below Dam Site

The fish species composition and diversity below dam site is represented by station 3.

Sampling Station 3 (river reach between dam to powerhouse tailrace)

This station represents fish fauna between dam and powerhouse reach. A total of 63 fish of 10 species were collected at this station during the field survey. This station represents 20% of the total catch. The catch per unit effort is 0.16 fish and 1 fish is caught at 6 attempts. The species diversity and density both slightly increases in this reach of river. The maximum size of fish caught at this station is 22.5 cm long and weighs 90 gm (*Schizothorax plagiostomus*). Out of the total collected fish species 1 is long distance migrant, 5 are mid-range migrant and 4 are resident (Vol. II, Appendix: C).

c) Species Composition and Diversity below Powerhouse Tailrace

The fish species composition and diversity below powerhouse tailrace is represented by station 4 and 5.

Sampling Station 4 (Budhi Ganga River with Bhimkoti Khola Confluence)

Seventy four fish of 11 species were collected in this reach of river during different sampling period. The catch per unit effort is 0.19 fish and 1 fish is caught at five attempts. This station represents 23% of the total catch. The average weight of the total catch is 1,476.5 gm in wet season and 3,617.5 gm in dry period. The maximum size of fish caught at this station is 22 cm long and weighs 90 gm (*Bangana dero*) in wet season and 32 cm long and weighs 350 gm in dry season sample (*Bangana dero*). Out of the total collected fish species 2 are long distance migrants, 6 were mid-range migrants and 3 were resident (Vol. II, Appendix: C).

Sampling Station 5 (Budhi Ganga River with Jijadi Gad Confluence area)

Ninety nine fish of 16 different species were collected in this stretch of river during different sampling period. The catch per unit effort is 0.25 fish and one fish is caught at four attempts. This station represents 31% of the total catch. The average weight of the total catch is 2,826.5 gm in wet season and 5,069.5 gm in dry period. The maximum size of fish caught at this station is 22 cm long and weighs 90 gm (*Tor putitora*) in wet season and 33 cm long and weighs 350 gm in dry

season sample (*Schizothorax richardsonii*). Out of the total collected fish species three are long distance migrants, eight are mid-range migrants and five are resident (Vol. II, Appendix: C).

IV) Fish Migration

The fish sampling conducted in August 2016 and April 2018 and local information provided at site revealed the presence of 25 species of fish in Budhi Ganga River. Out of the total recorded species 5 are long distance migrants, 8 were mid range migrants and 12 were resident (Vol. II, Appendix: C). Of the 5 long distance migrants recorded in river, 3, (*Tor putitora*, *Tor tor*, *Anguilla bengalensis*) were collected during the survey and 2 species (*Clupisoma garua*, *Bagarius bagarius*) were reported by the local people. The presence of long distance migratory species are noted in upstream, reduced flow area and downstream area of the Budhi Ganga HPP. Among the 8 midrange migrant reported from the river (*Bangana dero*, *Labeo angra*, *Labeo dyocheilus*, *Neolissochilus hexagonolepis*, *Naziritor chelynoides*, *Schizothorax progastus*, *Schizothorax plagiostomus*, *Schizothorax richardsonii*) all were collected during the field survey.

These migratory species mostly migrate from Seti River and enter Budhi Ganga River during the migration period mostly between late May to July and the adult returns downstream from September to October. Since no natural obstruction is found in Budhi Ganga River and river gradient is also mild the presence of long distance migratory species were found in dam site and upstream area.

The Snow Trout, River Rohu, Copper Mahseer and other midrange migrants are commonly distributed throughout the Budhi Ganga River in project area. Among them Snow trout is highly dominant species and found in almost all sites of the project area. Snow trout make localized migration and are found in Budhi Ganga River throughout the year in similar composition. The composition of other migratory species such as River Rohu and Copper Mahseer changed in different time of year.

V) Food Feeding and Spawning Ecology

The habitat preference displayed by many species during spawning is closely related to the stage of the life cycle occurring in the monsoonal flooding.

i) Food feeding and spawning ecology of long distance migrant species

Mahseer (*Tor sp.*) is the most spectacular long distance migratory fish distributed in Budhi Ganga River throughout the project area. *Tor putitora* (Photo 4-13) is widely distributed in Budhi Ganga River throughout the project area and was captured at all five sampling sites in both wet and dry seasons. The presence of *Tor tor* (Photo 4-14) is noted at sites 1, 2 and 5 in the wet season and at sites 2 and 4 in dry season. *Tor tor* is column feeder omnivorous fish and feeds on insects, rotifers, protozoans and algae whereas *Tor putitora* is column feeder herbi-omnivorous in habit (Vol. II, Appendix: C). They migrate to upstream area of Budhi Ganga River for spawning. This species prefers pools and rapids for rearing and spawning. The migration range of this species is reported by local people up to the Malagad area near Bamka Bazar in upstream and Seti River in downstream and Karnali River further downstream. According to local information the upstream migration of Mahseer starts from May when the water temperature in downstream part of river rises. However, their mass migration starts in June only after the first rain when the river becomes turbid due to monsoon in search of ideal spawning ground and leave the spawning ground after spawning is over in September- October.

Photo 4-13: *Tor putitora*Photo 4-14: *Tor tor*

According to available information this species migrates in well organized shoals headed by the largest Mahseer followed by 5-17 Mahseer (Nautiyal 1994). The migration of juveniles is not clearly known either for rearing or migration with adult. However, based on available information about presence of fingerlings in local catch in other months of the year it is assumed that fry and fingerlings may stay for few months more.

Normally, a Sahar attains the length of 400mm within three years from hatching. The ideal time for spawning is September/October when the river has high water. Sahar prefers shallow semi stagnant water in general and stones for spawning. This fish spawns in banks of Budhi Ganga River and its major tributaries such as Sarane Gad, Ikri Gad, Ardoli Gad, Angali Khola, and Jijadi Gad in project area. Normally spawning of Sahar takes place at the confluences of the tributaries with the main stream where water is well oxygenated and has a moderate velocity and water depth is 1-2 meter.

The Mahseer caught during the field visit was of 22 cm (Vol. II, Appendix: C). Local people reported the incidents of catching the fish up to 7 kg between powerhouse tailrace and Jijadi Gad Budhi Ganga River confluence area in 2018 during upward migration. The artificial propagation of this species is available.

Fresh Water Eel (*Anguilla bengalensis*) is commonly known as Rajbam in the project area and is an excellent game fish (Photo 4-15). Eels live in deep crevices of stone and among dead twigs. This fish was not collected during the field visit but the local fishermen have reported their presence. Fresh Water Eel is carnivorous fish feeds on molluscs crabs, shrimps, tadpoles frogs and large insects. The Eel is a long distance (catadromous) migratory fish and reaches the ocean (Bay of Bengal) for breeding purpose. Its migratory routes in Nepalese river system are not clearly known.

Photo 4-15: *Anguilla bengalensis*Photo 4-16: *Schizothorax plagiostomus*

An Eel measuring up to 71 cm in length and weight of 860 gm was caught just upstream of Budhi Ganga River with Jijadi Gad. This species cannot be breed under artificial condition, as fish requires special condition for spawning in seawater.

ii) Food feeding and spawning ecology of midrange migrant species

Asala (*Schizothorax plagiostomus*, *S. richardsonii* and *Schizothorax progastus*) are dominant species in project area and contribute 54.57% of the total catch. It is omnivorous fish and feeds on algae, pieces of aquatic plants and mud (Vol. II, Appendix: C). An analysis of the gut content of

Asala showed the presence of green algae, filamentous algae, diatoms, rotifers and aquatic insects. This species becomes sexually mature in 1-2 years depending upon the food supply and spawns in the gravel bed of Budhi Ganga and its feeder streams (Photos 5-16 and 5-17).

Asala breeds twice in a year in autumn (September-October) and spring (March-April). Asala is a moderate size fish and at its full maturity weighs as much as 1.5 kg and attains 40-50 cm in length.

This species prefers rapids, pools and riffle type of habitat. The Snow Trout spawn in slight gravel depressions on shallow banks vegetated with the water moss. The artificial breeding technology of this species is available in Nepal.



Photo 4-17: *Schizothorax progastus*

Photo 4-18: *Neolissochilus hexagonolepis*

Copper Mahseer (*Neolissochilus hexagonolepis*) is commonly known as Katle in the project area (Photo 4-18). This species is distributed throughout the project area and contributes 7.57% of the total catch. Copper Mahseer feeds on euophagus animal, plant and detritus (Vol. II, Appendix: C). Katles are short distance migrants. The migration of this species was reported to start from late May to end of June from downstream of Budhi Ganga River and Seti River as the discharge of river begins to increase. Katle migrate up to Malagad area near Bamka Bazar during the breeding season.

This fish spawns in banks of Budhi Ganga River and its major tributaries such as Sarane Gad, Ikri Gad, Ardoli Gad, Angali Khola, and Jijadi Gad in the project area. Adult Katles remain in the spawning grounds for a short period and then migrate downstream. *Neolissochilus hexagonolepis* prefers rapids and pools.

The female attains maturity in the months of July to August and release ova during the period of August to September. They breed once a year but release several batches of eggs during the breeding season. It is regarded as a fractional spawner (Shrestha, 1990). Based on stomach analysis, fresh water invertebrates and algae form the major component of food. This fish is successfully breed at Godawari and Trishuli Fisheries Research Center NARC/Nepal.

River Rohu (*Labeo sp*): River Rohu is graceful riverine fish which attains a length of about 65cm (Photos 4-19, 4-20 and 4-21). It is essentially a bottom feeder fish and feeds on decaying vegetation and other plant food. This fish is mid range migrant and found in high water phases in Budhi Ganga River.



Photo 4-19: *Bangana dero*

Photo 4-20: *Labeo dyocheilus*



Three species of Rohu namely *Banjana dero*, *Labeo angra* and *Labeo dyocheilus* are found in Budhi Ganga River. *Labeo sp.* is widely distributed in Budhi Ganga River mostly in downstream section of the project area was captured at stations 1, 3, 4, and 5. This fish contributes 10.09 % of the total catch. This fish spawns in banks of Budhi Ganga River and its major tributaries such as Ardoli Gad, Bhimkoti Gad and Jijadi Gad in project area.

Photo 4-21: *Labeo angra*Photo 4-22: *Garra gotyla*

iii) Food feeding and spawning ecology of resident species

Sucker Head (*Garra sp.*) is locally known as Buduna. This fish has a slender body with a C-shaped mouth (Photo 4-22). The ventral adhesive disc is used for climbing or adhering over rocks and stones. The color of the fish is greenish yellowish. This fish grows up to 150 mm. *Garra gotyla* feeds on algae. This fish spawns in late June and occurs in Budhi Ganga River and its feeder streams (Vol. II, Appendix: C). This species prefers backwater pools and rocky areas. *Garra sp.* also prefers to remain at confluence point where tributary with warm water mixes in the Budhi Ganga River.

Faketa (*Barilius sp.*) is an important resident fish of the project area with maximum size of 7-13 cm in length. This fish spawns in tributaries and rearing area was noted in pools of the Ikri Gad, Ardoli Gad and Jijadi Gad.

Stone Loach (*Noemacheilus sp.*) locally known, as Gadela is a common fish occurring in springs and creeks. Its spindle shaped body is crossed with 9 to 10 vertical bands. The general body color is yellowish brown. Generally, the dorsal and caudal fins have dark bands. The fish is found mostly in tributaries of Budhi Ganga River. This fish is known to occur between 300 to 3,000 masl and breeds in April and May on the feeder streams. Gadela prefers to hide under stones.

Catfish (*Pseudecheneis sulcata*) is also common species of Budhi Ganga River. It has a conical and tapered body (Photo 4-23). Its adhesive disc is composed of 16 transverse folds on the chest. The maximum size attained by the species is 18 cm. *Pseudecheneis sulcata* feeds on aquatic insects and earthworms. This fish spawns in May to June and prefers rocky boulders.

Photo 4-23: *Pseudecheneis sulcata*Photo 4-24: *Psilorhynchus pseudecheneis*

Stone-carp (*Psilorhynchus pseudecheneis*) is elongated depressed and flattened with distinct 3 to 5 transverse folds on the ventral side (Photo 4-24). It is known as Titae, because of its acrid taste. It grows to 10-12 cm. This species feeds on mud algae and drifting fruits. It spawns during May to August.

VI) Economic Importance of Fish

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, good fresh and flavour of excellent taste and fetch in good price. Medium food value (M) fishes of medium to large size are of inferior taste in comparison to that of former. Low food value (L) generally small sized fish like *Noemacheilus sp.* This species is also used as bait to lure the fish predators.

The food value is characterized considering the delicious aspect, demand of and price. Fishes like *Neolissochilus hexagonolepis*, *Schizothorax sp.* *Labeo sp.* and *Tor sp.* have high food value. Although the hill stream fishes like *Glyptothorax sp.* are known to be very tasty but due to their small size are grouped under medium value. *Anguilla bengalensis*, *Bagarius bagarius*, *Glyptothorax sp.* and *Garra sp.* are grouped under medium food value. The small size fish like *Barilius sp.* and *Noemacheilus sp.* are grouped under low food value (Vol. II, Appendix C).

Very little is known about the medicinal value of the fishes of Nepal as well as the Budhi Ganga River. Titae (*Psilorhynchus pseudecheneis*) is taken to increase the appetite especially in summer months. Similarly, Gadela (*Noemacheilus sp.*) is used as a medicine for tooth pain. It is also used as medicine to grow the teeth of young babies by rubbing the smoked Gadela on the jaws. The gall bladder and brain of Sahar (*Tor putitora*) are used for fever and burns respectively. Small fish species like *Barilius sp.* can be used as a biological controller to control water borne diseases.

i) Conservation Status of Fish

Although the fish species found in Nepal are not listed in conservation category by the Government of Nepal, some species found in Nepalese River System as well as Budhi Ganga River are categorized in different conservation category by IUCN. Out of 25 species reported from Budhi Ganga River 14 species falls in Least Concern category, 3 falls in Near Threatened category, 1 in Endangered and 2 Vulnerable category of IUCN redlist. The *Tor tor* species is listed in data deficient(DD) category (Table 4-19).



Table 4-19: IUCN Red list fish species present in Budhi Ganga River

S.No	Scientific Name of Fish	Local Name of Fish	Protected Status
1	<i>Anguilla bengalensis</i>	Rajbam	NT
2	<i>Barilius bendelisis</i>	Fageta	LC
3	<i>Barilius barila</i>	Fageta	LC
4	<i>Barilius shacra</i>	Fageta	LC
5	<i>Bagarius bagarius</i>	Gonch	NT
6	<i>Botia almorhae</i>	Baghi	LC
7	<i>Clupisoma garua</i>	Jalkapur	LC
8	<i>Garra gotyla</i>	Buduna	LC
9	<i>Garra annandalei</i>	Nakatuwa	LC
10	<i>Glyptothorax cavia</i>	Kapre	LC
11	<i>Glyptothorax pectinopterus</i>	Singhe	LC
12	<i>Bangana (Labeo) dero</i>	Gardi	LC
13	<i>Labeo angra</i>	Thed	LC
14	<i>Labeo dyocheilus</i>	Kalach	LC
15	<i>Neolissochilus hexagonolepis</i>	Katle	NT
16	<i>Naziritor chelynoideis</i>	Karange	VU
17	<i>Psilorhynchus pseudecheneis</i>	Tite	LC
18	<i>Schizothorax richardsonii</i>	Buche Asala	VU
19	<i>Tor putitora</i>	Mahseer	EN
20	<i>Tor tor</i>	Mahseer	DD
21	<i>Schizothorax progastus</i>	Chuche Asala	Least Concerned
22	<i>Schizothorax richardsonii</i>	BucheAsala	Vulnerable
23	<i>Bangana dero</i>	Gardi	Least Concerned
24	<i>Labeo angra</i>	Thed	Least Concerned
25	<i>Labeo dyocheilus</i>	Kalach	Least Concerned
26	<i>Tor putitora</i>	Mahseer	Vulnerable
27	<i>Tor tor</i>	Mahseer	Data deficient
28	<i>Barilius bendelisis</i>	Fageta	Least Concerned
29	<i>Barilius barila</i>	Fageta	Least Concerned
30	<i>Barilius shacra</i>	Fageta	Least Concerned
31	<i>Garra gotyla</i>	Buduna	Least Concerned
32	<i>Anguilla bengalensis</i>	Rajbam	Nearly Threatened
33	<i>Glyptothorax cavia</i>	Kapre	Least Concerned

Source: www.iucn redlist.org.

ii) Fishing Activity and Fish Catch

Nearly all caste/ethnic groups are found involved in occasional fishing. Since these people mostly use their catch for their own consumption they are not able to say their income from selling fish. According to local people they sell fish only if they have bulk catch and more than sufficient for their own consumption. Budhi Ganga River is a common ground for fishing. However, fishing is

also noted in downstream tributaries like Bhimkoti Gad, Ardoli Gad and Jijadi Gad and Ikri Gad upstream of dam.

Based on interviews with the fishermen, fishing takes place throughout the year, but the peak fishing is reported to be practiced mainly from March to June and September to November. The gears most commonly used are cast net, rod line and gill net.

4.3 Socio Economic and Cultural Environment

4.3.1 Socio-economic Condition of the Project Districts

The BHP is located in Achham and Bajura districts of Sudurpashchim Pradesh of Nepal. The GoN has categorized Bajura as a mountain district and Achham as a hill district. The project site is located along the Sanfebagar-Martadi Road and accessible with regular public transportation service from Attariya and Dhangadhi of Kailali district.

After the opening of the Bhimdatta Highway and construction of Dadeldhura-Sanfe-Martadi road the project districts are directly connected with Kathmandu and other districts of the country. However, despite continued government commitment for balanced regional development, this region lags the other regions in terms of socio-economic, poverty and development indicators. Among the districts of Sudurpashchim Pradesh, Bajura district is generally more under developed compared to the other districts due to its geophysical location and accessibility.

Bajura district is larger than Achham district in terms of its area however; it has only 9.21% arable land whereas Achham has 33.36% arable land. There are 6 Rural Municipalities and 4 municipalities in Achham district. Similarly, there are 5 Rural Municipalities and 4 municipalities in Bajura district. Administratively, the rural municipality/municipality form the lowest political-administrative unit of governance and act as local government in the country.

The total population of the project districts is 392,389 including 65.6% population of Achham and 34.4% of Bajura. There are 73,259 households in the project districts including 48,351 households in Achham district and 24,908 households in Bajura district. The average household size is slightly lower (5.33) in Achham compared to Bajura (5.42) district. Key indicators of the project districts are summarized in Table 4-20 below.

Table 4-20: Key indicators of the project districts

Key Indicators	District	
	Achham	Bajura
Area (km ²)	1,692	2,188
Arable land (%)	33.36	9.21
Total Rural Municipalities	6	5
Total Municipalities	4	4
No. of households	48,351	24,908
Population	257,477	134,912
Male	120,008	65,806
Female	137,469	69,106
Sex ratio	87.3	95.22
Average household size	5.33	5.42
Density (person/ km ²)	153	61.66



Literacy (6 years +)	55.65	55.7
**UNDP Human Development Index	0.378	0.364
**UNDP Human Poverty Index	46.68	43.28

Source: Central Bureau of Statistics, 2012, Nepal Human Dev. Report, 2014, NPC/UNDP, District Profiles of Bajura and Achham, and latest Mun./VDCs publication, MOFALD, 2016.

The project districts are diverse in caste/ethnicity. More than 34 different caste/ethnic groups of hill and Terai origin are living in the districts. Of the population, Chhetri is the dominant (59.70%) caste/ethnic group in the districts. Dalit is the second largest (28.29%) caste/ethnic group and Brahmin is the third largest (9.11%) group in the districts. The other minor caste/ethnic groups in the district are Janjati, Dashnami/Sanyasi, Terai origin caste/ethnic groups, Bangali, Muslim and others.

Of the population, 98.71.0% is Hindu, 1.05% is Buddhist, 0.13% is Muslim, 0.6% is Christian and 0.5% is of other religions in Bajura district. Similarly of the population, there is 99.43% Hindu, 0.30% is Buddhist, 0.13% is Christian, 0.10% is Muslim and 0.04% is of other religions in Achham.

Nepali is the main mother tongue of the people in the project districts. Of the population, 99.03% of Bajura and 66.39% of Achham reported Nepali as their mother tongue. The other reported languages as mother tongue are Magar, Sherpa, Dotali, Maithili, Tharu and Tamang.

Agriculture is the main occupation of local people of the districts. However, due to subsistence nature of farming and low level of agricultural production most households of the districts face acute food shortages for a large part of the year. In terms of food sufficiency, Achham district is better than Bajura district.

Paddy, maize, wheat, and potato are the major crops produced in the districts. Walnut, pear, peach, mango, guava, papaya, banana, jackfruit, peach, apple, orange, lemon and other citrus species are commonly grown as per geophysical locations of the districts. However, most of the fruits are grown for self-consumption.

Animal husbandry is an integral part of subsistence farming of local people of the districts. The common livestock raised by the local people are goat, sheep, cattle, buffalo and pigs. Poultry is also commonly raised in the districts.

Due to subsistence nature of farming, low agriculture production and unemployment, seasonal migration (up to six months) to India is a common and historical phenomenon of livelihood strategy of local people of the districts. However, due to lack of education and skill, almost all the migrant workers are employed in low paid jobs in India. They are normally employed as wage labor, watchman, hotel worker, housekeeper, gardener etc. in the cities of India including Delhi, Mumbai, Punjab, Simla, Pithauragarh, Garhwal and Bangalore. Recently, migration to Gulf countries and Malaysia is also an increasing trend in the districts.

A small proportion of the population of the districts is also engaged in wage employment, petty business, hotels/tea shops, salaried jobs, cottage industries and transportation sector in the districts.

Sanfebagar, Mangalsain, Bayalpata, Jaygadh, Mellekh, Binayak, Dhakari, Turmakhand, Thanti, Chaurpati, Chaukhutte and Kamal Bazar are the main market centers of Achham district. Similarly, Martadi, Kolti, Tipada, Betalmandu, Bamka Bazar and Rithe Bazar are main market centers of

Bajura district. Due to the road networks, some new market centers/growth centers are also emerging along the road alignment of the project districts.

Most Rural Municipalities of Achham district and some Rural Municipalities of Bajura district have access to transportation services through district road networks and rural access roads. However, mules, rams and porters are also the common means of transporting goods in rural areas particularly in Bajura district. Kolti was the only operational airport in the project districts that connects Bajura district with Nepalgunj with limited flights. However, recently the airport of Sanfebagar has been reconstructed and a test-flight was initiated in April 2018. This airport was destroyed during insurgency (at the time of Sanfebagar and Mangalsen attacks).

Almost all Rural Municipalities of Achham and Bajura have access to communication facilities (mobile phone sets) and landline telephones are only available in district headquarters. Postal services are provided through District Post Office, Ilaka-level and additional Post Offices in the districts.

Only few Rural Municipalities of the districts have access to electricity through the national grid (Achham) and micro hydropower. Solar power is also common for lighting by some of the households of the district. Fuel-wood is the major source of cooking energy for almost all the households of the project districts. However, a few households particularly in market areas also use LPG for cooking.

Almost all households of the districts have access to piped water through public taps whereas some rely on springs, wells, river and other sources. Both the districts are declared as Open Defecation Free (ODF) districts.

The prevalent diseases of the districts are Upper Respiratory Tract Infection, Gastritis (APD), Headache, Lower Respiratory Tract Infection, Amoebic Dysentery, Presumed Non-Infectious Diarrhoea, Falls/Injuries/Fractures, Pyrexia of Unknown Origin (PUO) and Intestinal Worms.

There are District Hospitals, Primary Health Centers, and Health Posts as government institutions to provide health services in the districts. Similarly, there is one community hospital in Achham District which has best reputation for its health services in the area. Further, many NGOs/INGOs are also working in the health sector particularly in the preventive aspects in the districts. There are some private clinics and medical shops particularly in the district headquarters and accessible locations of the districts.

Both the districts are rich in water resources. The major rivers of Achham are Karnali, Seti, Budhi Ganga, Kailash Khola, Lugreli Khola, Prawali Gad, Jijadi Gad, Ikarigad Gad, Kasha Gad, Sarani Gad and Ardali Gad. Similarly, the major rivers of Bajura are Karnali, Budhi Ganga, Mala Gad, Barju Gad, Kodi Gad, Dansag Gad, Kwadi Gad and Ikari Gad. There are several lakes in the districts such as Khaptad Lake (in Khaptad National Park), Chhede Daha in Bajura, and Rishi Daha and 12 lakes (Baraband) in the Ramaroson Rural Municipality (then Ramaroson VDC) of Achham district.

Both districts have high potentiality of tourism development and it could be an important source of income generation of the local people. However, due to lack of infrastructure (road, air service, hotels, travel agencies), lack of information and communication, advertisement, accessibility these districts are far behind in tourism development.

The important festivals of the area are Dashain, Tihar, Maghesakaranti, Faghu Purnima (Holi). Bisu (New Year), Maha Shivaratri, Potisarai, Saune Shakarantri, Jethase Purnima, Janai Purnima, Putala



Parwa, Chaite Dasai, Bhadaure Shakaranti, Ghase Shakarantri (Aswin 1), Krishna Astami, Kartik Purnima, Tihar, Pushe Purnima (Bhaile Aunsi), Makar Shakarantri, Bhuwa Aunshi and Basanta Panchami.

The important historical, religious and cultural places of Achham district are Baijanath temple, Bannighadhi of Bardadevi, Shodasadevi, Tripurasundari, Nadai, Biltham (Bindhabasini and Gangajamuna), Khaptad, Panch Dewal of Binayak, Janalibandali, Choti Malika and Bhawathan of Barala. Similarly, important historical, religious and cultural places of Bajura district include Badimalika, Martadi, Tante, Nateswari, Chededaha and Khaptad.

4.3.2 Socio-economic Condition of People of the Project Area

The project covers ward numbers 4, 13 and 10 of Sanfebagar Municipality (former Sanfebagar Municipality ward 6, Ghughurkot and Babala VDCs) and ward numbers 4 and 8 of Mellekh Rural Municipality (former Kushkot and Hatikot VDCs) of Achham district, and ward number 10 of Budhiganga Municipality (former Barhabis VDC ward numbers 1, 2 & 4) of Bajura district.

This section details the existing socioeconomic condition of people of the project area based on analysis of the data collected from fieldwork and desk study.

4.3.2.1 Population

The total population of the project area is 18926 consisting of 45.7% male and 54.3% female. The total number of households in the project area is 3563 and the average household size is 5.3 persons. Ward number 4 of Mellekh Rural Municipality of Achham district has the highest number of HHs (792) whereas ward number 8 of Mellekh Rural Municipality has lowest (346) number of HHs (Table 4-21).

Table 4-21: Population and households in the project area

Municipality/Rural Municipality	HHs	Population	Average HH Size	Male	Percent	Female	Percent
Bajura							
Budhiganga Mun.-10	563	3,067	5.4	1415	46.1	1,652	53.9
Achham							
Sanfebagar Mun.-4	702	3,441	4.9	1615	46.9	1826	53.1
Sanfebagar Mun.-10	621	3124	5.03	1409	45.1	1715	54.9
Sanfebagar Mun.-13	539	2813	5.22	1243	44.2	1570	55.8
Mellekh R. Mun.-4	792	4634	5.85	2186	47.2	2448	52.8
Mellekh R. Mun.--8	346	1847	5.34	783	42.4	1064	57.6
All	3563	18926	5.3	8651	45.7	10275	54.3

Source: Central Bureau of Statistics, 2012

Among broader age groups, 46.9% of the population is in the age group of 15-59 years (economically active), 44.2 % is below 15 years of age (children) and 8.9 % is in the age group of 60 years and above (Table 4-22).

Table 4-22: Distribution of population by broader age group

Table 4-22: Distribution of population by broader age group							
Municipality/Rural Municipality	Below 15 Yrs.		15 – 59 Yrs.		60 Yrs. and Above		Total
	N	%	N	%	N	%	
Bajura							
Budhiganga Mun.-10	1407	45.9	1401	45.7	259	8.4	3,067
Achham							

Sanfebagar Mun.-4	1394	40.5	1790	52.0	257	7.5	3441
Sanfebagar Mun.-10	1295	41.5	1533	49.1	296	9.5	3124
Sanfebagar Mun.-13	1184	42.1	1349	48.0	280	10	2813
Mellekh R. Mun.-4	2201	47.2	2029	44.1	404	8.7	4634
Mellekh R. Mun.-8	891	48.2	772	41.8	184	10	1847
All	8372	44.2	8874	46.9	1680	8.9	18926

Source: Central Bureau of Statistics, 2014

4.3.2.2 Caste/Ethnicity

The project area is diverse in terms of caste/ethnicity. There are more than 10 different caste/ethnic groups making up distinct communities in the project area. Population of the project area is dominated by Chhetri caste/ethnic groups (60.9%) followed by Dalits (29.2%). Among the Dalits, Kami (Blacksmith) is dominant group (8.2%) in the area. The other caste/ethnic groups of the project area are Brahmin (5.3%), Magar (0.9%), Tamang, Tharu and others (Table 4-23).

Table 4-23: Population by caste/ethnicity

Municipality/ Rural Municipality	Chhetri	Brahman	Magar	Tamang	Tharu	Kami	Damai	Sarki	Dalit Other	Others	Total
Bajura											
Budhiganga Mun.-10	1832	42	34			443	156	213	187	160	3067
Achham											
Sanfebagar Mun.-4	1554	232	123	65	68	614	167	113	287	218	3441
Sanfebagar Mun.-10	1422	450	16		24	152	169	349	465	77	3124
Sanfebagar Mun.-13	1947	105		14		233	154		329	31	2813
Mellekh R. Mun.-4	3581	51				92	199	458	207	46	4634
Mellekh R. Mun.-8	1190	129				11			517		1847
Total	11526	1009	173	79	92	1545	845	1133	1992	532	18926
Percentage	60.9	5.3	0.9	0.4	0.5	8.2	4.5	6.0	10.5	2.8	

Source: Central Bureau of Statistics, 2014

4.3.2.3 Mother Tongue

Achhami is the mother tongue of 78.3 % of the population and Nepali is the second dominant mother tongue of 19.6% population of the project area. A small proportion of the population also reported Bajureli and other languages as their mother tongue. Interestingly, over 98.0% people of Budhiganga Municipality ward no. 10 reported Nepali as mother tongue (Table 4-24).

Table 4-24: Population by mother tongue

Municipality/Rural	Mother Tongue					
Municipality	Achhami	Nepali	Doteli	Bajureli	Others*	Total
Bajura						
Budhiganga Mun.-10	0	3012	0	0	55	3067
Achham						
Sanfebagar Mun.-4	2608	643	31	27	132	3441

Sanfebagar Mun.-10	2978	48		36	62	3124
Sanfebagar Mun.-13	2770				43	2813
Mellekh R. Mun.-4	4620	14				4634
Mellekh R. Mun.-8	1837				10	1847
Total	14813	3717	31	63	302	18926
Percentage	78.3	19.6	0.2	0.3	1.6	

Source: Central Bureau of Statistics, 2014

* Other includes Hindi, Santhali, Baitadali, Urdu, Newari, Kham, Gurung, Bhojpuri, Bajhangi, Rai, sign language, etc. None of the population of Bajura reported Bajurali, Santhali, Urdu, Kham, Bhojpuri, Bajhangi and Rai as mother tongue.

4.3.2.4 Settlement Pattern and Housing Condition

Settlement patterns in the project area appear to be generally influenced by the availability of productive land and other public facilities. Dense settlements are situated in market areas (Photo 4-27) located along the road sides and agriculturally productive areas whereas scattered settlements are mostly found in the hilly areas of the project area (Photo 4-28). There are altogether 71 major settlements in the project area (Table 4-25).

Table 4-25: Major settlements in the project area

District	Municipality/Rural Municipality	No. of Settlements	Name of Major Settlements
Achham	Mellekh R. Mun.-8	9	Saunde, Thapagaun Tole, Tallo Dumari, Mallo Dumari, Sanna, Loharbada, Hatikot, Kandagaun, Jimitada.
	Mellekh R. Mun.-4	9	Selgaun, Rithatoli, Paati, Toligaun, Badgaun, Mankali, Ranfa, Golabhat, Saud Tole.
	Sanfebagar Mun.-4	7	Bhandari Gaun, Gaira Khalsen, Danda Khalsen, Paidi, Bhuwasen, Lakhetola, Kotegada.
	Sanfebagar Mun.-10	18	Kotwada, Kumaisthan, Kalam, Thanti, Puwagaun, Muskani, Mahatgaun, Rautwata, Kotelbada, Bhatbata, Ghungurkot, Indresal, Golukada, Etbada, Tansi Tole, Sangramtole, Padada, Chulthe.
	Sanfebagar Mun.-13	11	Kunwar Tole, Baddakhet, Moudali, Mathisiun, Talisiun, Budhabagar, Bataligaun, Bhuldanda, Babli Tole, Nepali Tole, Budhabagar.
Bajura	Budhiganga Mun.-10	17	Singada, Dhab Bazaar, Betalmandu Bazaar, Malika Bazar, Dungritola, Siralabata, Timada, Selapakha, Badedda, Bhandargaun, Nuwakot, Juwapani, Kapritola, Dewalsain, Kharkhet, Bayal, Simalkot.
Total	6	71	-

Source: Field Survey





Photo 4-27: Tansi Bazar road side settlement



Photo 4-28: Typical Settlement (Hill) of the project area

An assessment of households by ownership of house/housing unit in use is made. Of the 3,563 houses, the proportion of households residing in their own housing is 93.5%, which is higher than national average (90%). Of the households, 3.2% are residing in rental house and remaining 3.4% are living in institutional and other residing places (Table 4-26).

Table 4-26: Households by ownership of house/housing unit in use

Municipality/Rural Municipality	Ownership of House/Housing Unit				Total
	Owned	Rented	Institutional	Others	
Bajura					
Budhiganga Mun.-10	540	15	1	7	563
Achham					
Sanfebagar Mun.-4	616	72	5	9	702
Sanfebagar Mun.-10	528	16	1	76	621
Sanfebagar Mun.-13	520	9	2	8	539
Mellekh R. Mun.-4	790	1	0	1	792
Mellekh R. Mun.-8	338	0	0	8	346
Total	3332	113	9	109	3563
Percentage	93.5	3.2	0.3	3.1	

Source: Central Bureau of Statistics, 2014

The roof of a house is an economic indicator in the context of Nepal. Normally, the richer households own Reinforced Cement Concrete (RCC) roofed house and galvanized iron sheet roofed house based on accessibility and availability of the roofing materials. However, the poorer households hardly afford RCC roofed and galvanized iron sheet roofed house. Normally, they own thatched roofed house and some better off households own tile/slate roofed house.

Regarding roofing of house/housing unit in the project area, of the households 76.8% own tile/slate roofed house and 14.9% own thatch/straw roofed house. The proportion of households having galvanized iron sheet (Zasta Pata) roofed house is 5.2% and RCC roofed house is 1.9% in the project area (Table 4-27).

Table 4-27: Households by roof of house/housing unit

Municipality /Rural Municipality	Type of Roof								
	Thatch/Straw	Galvanized Iron	Tile/Slate	RCC	Wood /Plank	Mud	Others	Not Stated	Total HHs
Bajura									
Budhiganga Mun.-10	146	38	373	0	0	0	0	6	563
Achham									
Sanfebagar Mun.-4	64	92	483	54	0	0	0	9	702
Sanfebagar Mun.-10	109	51	443	12	0	0	5	1	621

Sanfebagar Mun.-13	43	0	485	1	0	0	0	10	539
Mellekh R. Mun.-4	146	0	635	1	0	0	0	10	792
Mellekh R. Mun.-8	23	3	316	1	0	0	0	3	346
Total	531	184	2735	69	0	0	5	39	3563
Percentage	14.9	5.2	76.8	1.9	0.0	0.0	0.1	1.1	

Source: Central Bureau of Statistics, 2014

4.3.2.5 Literacy and Education

As per the National Population and Housing Census, 2011, the overall literacy rate of the project area is 60.0%. The literacy rate of male is 76.1% and the female is 47.0% in the project area. The female literacy rate is very low compared to the male literacy rate of the project area.

The overall literacy rate is low (55.1%) in Mellekh Rural Municipality ward no. 4 and high (66.8%) in Sanfebagar Municipality ward no. 4. Similarly, the female literacy rate is high (52.9%) in Sanfebagar Municipality ward no. 4. and low (40.9%) in Budhiganga Municipality ward no. 10. In general, the female literacy rate of is low as compared to males in all the wards of the project area (Table 4-28).

Table 4-28: Population aged 5 years and above by sex and literacy status

Municipality/Rural Municipality	Literacy Status													
	Total			Can Read and Write		Can Read Only		Can Not Read		Not State d		Literacy Rate (%)		
	M	F	Both	M	F	M	F	M	F	M	F	M	F	Both
Bajura														
Budhiganga Mun.-10	1278	1538	2816	944	631	53	31	281	874	0	2	73.9	40.9	55.8
Achham														
Sanfebagar Mun.-4	1483	1654	3137	1226	875	26	39	230	738	1	2	82.7	52.9	66.8
Sanfebagar Mun.-10	1229	1519	2748	981	714	41	66	204	736	3	3	79.8	47.00	61.7
Sanfebagar Mun.-13	1069	1377	2446	810	637	39	44	218	695	2	1	75.7	46.2	59.1
Mellekh R. Mun.-4	1834	2109	3943	1253	921	98	116	483	1071	0	1	68.3	43.6	55.1
Mellekh R. Mun.-8	641	929	1570	489	478	36	50	113	395	3	6	76.3	51.4	61.6
Total	7534	9126	16660	5703	4256	293	346	1529	4509	9	15	-	-	-
Percentage	-	-	-	75.7	46.6	3.9	3.8	20.3	49.4	0.12	0.16	76.1	47.0	60.0

Source: Central Bureau of Statistics, 2014

According to the local people the reasons for low female literacy are lack of awareness, poverty, inaccessibility to schools, household work and existing traditional beliefs (girls will go to their husband's house after marriage) and early marriage. However, enrolment of children in the school of the project area is in increasing trend in the recent years due to awareness among their parents. It has resulted positively due to a range of educational programs of GoN and NGO/INGOs, scholarship, school tiffin, literacy classes, various awareness raising activities and other reasons.

Of the total population (10,678) aged 5 years and above, 58.8% has educational attainment of beginner/primary level, 17.3% has lower secondary level and 9.4% has secondary level education.

Similarly, of the population 5.5% has SLC level, 3.8% has educational attainment of intermediate level, 0.9% has graduation level, and 0.1% of post-graduation level. Similarly, the percentage of neo-literates (non-formal) is 3.6% in the project area. It shows that the educational attainment from primary level to higher levels is in decreasing trend (Table 4-29).

Table 4-29: Population aged 5 years and above by educational attainment

Municipality/Rural Municipality	Big/Primary (up to 5)	Lower Sec (6-8)	Secondary (9-10)	SLC or Eq.	Interm. or Eq.	Grad. or Eq.	Post Grad. +	Non-formal	Others/ Not Stated	Total
Bajura										
Budhiganga Mun.-10	1154	271	121	87	44	13	2	61	4	1757
Achham										
Sanfebagar Mun.-4	987	418	288	191	102	34	5	98	11	2134
Sanfebagar Mun.-10	999	292	257	72	108	23	4	63	20	1838
Sanfebagar Mun.-13	812	268	137	117	67	9	2	99	2	1513
Mellekh R. Mun.-4	1663	420	122	100	56	15	1	4	2	2383
Mellekh R. Mun.-8	662	176	79	22	33	5	2	72	2	1053
Total	6277	1845	1004	589	410	99	16	397	41	10678
Percentage	58.8	17.3	9.4	5.5	3.8	0.9	0.1	3.7	0.4	100

Source: Central Bureau of Statistics, 2014

The population between the ages of 5-25 years is considered as school going aged population in Nepal. As per the census 2011, total school aged population of the project area is 74.7% including 80.7% male and 69.5% female.

There are altogether 36 public (government) schools in the project area. Of the schools, 58.3% are primary, 13.9% are lower secondary, 16.7% are secondary and 11.1% are higher secondary levels. Students of the area normally go to Mangalsen, Dhangadhi, Mahendra Nagar and Kathmandu for higher education in different streams. Ward number 4 of Mellekh Rural Municipality has the highest number of government schools (9) whereas Sanfebagar Mun.-4 has the lowest (4) number of public schools in the project area (Table 4-30).

Table 4-30: Public schools in the project area

Municipality/Rural Municipality	Type of School				Total
	Primary	Lower Secondary	Secondary	Higher Secondary	
Achham District					
Mellekh Rural Municipality - 8	4		1		5
Sanfebagar Municipality-13	5		-	1	6
Mellekh Rural Municipality - 4	5	3	1	-	9
Sanfebagar Municipality-10	3	1	1	1	6
Sanfebagar Municipality- 4	1	1	1	1	4
Sub-total	18	5	4	3	30
Bajura District					
Budhiganga Municipality-10	3		2	1	6
Total	21	5	6	4	36
Percentage	58.3	13.9	16.7	11.1	100

Source: District Education Office, Achham 2072 and VDC Profile of Barhabis, 2067

There are altogether 28 Child Development Centers (Bal Bikas Kendra) that provide pre-primary level of education in the project area. It has helped children of the area to prepare themselves to enrol in the primary level, the first stage of formal education (Table 4-31).

Table 4-31: Child Development Centre in the project area

Municipality/Rural Municipality	No. of Child Development Centers
Achham	
Sanfebagar Municipality - 4	5
Sanfebagar Municipality - 10	6
Sanfebagar Municipality - 13	5
Mellekh Rural Municipality - 4	5
Mellekh Rural Municipality - 8	
Sub-total	25
Bajura	
Budhiganga Municipality-10	3
Total	28

Source: District Education Office, Achham 2072 and VDC Profile of Barhabis, 2067

Apart from the government schools there are some boarding schools providing pre-primary and primary level education in the project area.

Based on discussion with local people and field observation during the scoping study, the majority of schools in the project area lack physical facilities such as building/class room, toilet, drinking water, sports ground, furniture, athletics materials and library. The physical condition of almost all the schools is in poor condition. As per the local people almost all schools of the project area require external support for physical facility improvement.

4.3.2.6 Source of Energy

Fuel wood is the main source of energy for cooking. Of the households, 97.1% use fuel wood for cooking. LPG 1.3%, kerosene 0.3%, biogas 0.1% and others 0.3% are the remaining sources of energy for cooking in the project area (Table 4-32).

Table 4-32: Types of fuel used by households for cooking

Municipality/ Rural Municipality	Fuel Used for Cooking							Total HHs
	Fuel Wood	Kerosene	LPG	Biogas	Electricity	Others	Not Stated	
Bajura								
Budhiganga Mun.-10	555	1	1	1	0	0	5	563
Achham								
Sanfebagar Mun.-4	626	9	47	0	0	11	9	702
Sanfebagar Mun.-10	619	0	0	2	0	0	0	621
Sanfebagar Mun.-13	531	1	0	0	0	0	7	539
Mellekh R. Mun.-4	786	0	0	0	0	0	6	792
Mellekh R. Mun.-8	341	0	0	1	0	0	4	346
Total	3458	11	48	4	0	11	31	3563

Source: Central Bureau of Statistics, 2014



Community forest is the main source of fuel wood for the local people of the project area. Similarly, private forest, thatch land (Kharbari) and government forests are the other sources of fuel wood for the local people of the area.

Regarding source of lighting, more than half (55.4%) of households of the project area use other sources for lighting. Solar power is used by 23.33% of the households in the project area whereas the use of electricity is about 19.0% (Table 4-33).

Table 4-33: Source of lightings for households of the project area

Municipality/Rural Municipality	Fuel Used for Lighting					Total HHs
	Electricity	Kerosene	Solar	Others	Not Stated	
Bajura						
Budhiganga -10	1	1	153	391	5	550
Achham						
Sanfebagar -4	164	33	46	106	4	351
Sanfebagar -10	0	1	263	357	0	621
Sanfebagar -13	0	2	117	414	6	539
Mellekh -4	552	1	40	193	6	792
Mellekh -8	0	1	116	227	2	346
Total	717	39	735	1688	23	3199
Percentage	18.95	1.55	23.33	55.4	0.77	

Source: Central Bureau of Statistics, 2014

4.3.2.7 Livelihood

As in other hilly areas of Nepal, subsistence farming is the main source of livelihood of the local people in the project area. Other sources of livelihood of the local people are seasonal migration to India (remittance), wage labor, salaried job, pension/allowance, animal husbandry, petty business/trade, and other off-farm activities. A few households of the area, collect and sell non-timber forest products (NTFP), to generate supplementary income for subsistence. As expressed by the local people, the project area has potential for livestock raising (goat), poultry, vegetable farming and horticulture.

4.3.2.8 Agriculture

Crops grown in the project area are paddy, maize, millet, wheat, potato, buckwheat, barley, pulse and oilseeds. Paddy (Photo 4-31), maize, wheat, millet, potato are the major crops produced in the area. Green vegetables and fruits like orange, lemon, guava, banana, pear and peach are also produced in the area. However, their production is limited to self-consumption level. A few households of the area also produce seasonal vegetables for cash earning.

The cropping pattern of the area varies from site to site depending upon the altitude, land quality and availability of irrigation. More fertile and year round irrigated lands are cultivated three times a year whereas non-irrigated lands are cultivated once a year. The selection of crops is based on the land quality and available irrigation facilities. The prevailing cropping pattern in the project area is mentioned in Table 4-34.

Table 4-34: Cropping pattern in the project area

Khet (Low Land)	Bari (Up Land)
Paddy-Wheat	Paddy/millet-wheat
Paddy-vegetable-potato	Maize/paddy- wheat-lentil
Paddy-wheat- winter maize	Paddy/maize/millet-fallow
	Maize/millet-wheat
	Soybean/black gram-fallow

Source: District profile of Achham, 2014 and public consultation

Farmers of the area are practicing agricultural biodiversity in the project which includes mixed farming (different cropping patterns), selection of crop varieties (vegetables), and agro-forestry in and around their fields.

The project area is a food deficit area. Only some households of the project area can grow food grains for annual consumption. Small land holding, poor quality of agriculture lands, use of traditional farming methods, lack of irrigation facilities and agricultural inputs are the main reasons for low agricultural productivity.

To copewith food deficiency, the majority of households depend on remittances from foreign employment (mostly seasonal migration to India) and wage employment. Other sources of income are salaried jobs, pension, petty business/trade, contract work, collection and sale of herbs and minor forest products. The local people purchase food grains mainly rice and other consumption goods from local market, Thanti Bazar, Sanfebagar and Babala of Achham, and Malika Bazaar, Betalmandu, Rittha bazaar, Bamkabazar and other small market centers along the Sanfe-Martadi Road of Bajura.

4.3.2.9 Livestock

Animal husbandry is an integral part of subsistence farming for the local people of the project area. Goat, cattle and buffalo are the common livestock raised in the area (Photo 4-29). A few households of the area also keep pigs. The population of goat and cattle is high in the project area. People keep the livestock for meat, milk/ghee, manure and ploughing.



Photo 4-29: Livestock of the area

Almost all the livestock of the area are of local breed and their productivity is low. Further, most households of the area also keep fowl for meat, rituals and supplementary income. A few

households are also involved in poultry farming due to accessibility, local demand, development projects and market growth.

Naumuthe Gai (very small cow) is an indigenous very small breed of cow which is only found in Achham district and unique in the area/Nepal (Photo 4-30). The government of Nepal has taken steps to preserve its breed by providing incentives to farmers. Local people estimated that the total number of this breed is less than 2,000 in the district.



Photo 4- 30: Naumuthe Gai (very small cow) of Achham

Photo 4- 31: Rice cultivation

4.3.2.10 Migration

Seasonal migration particularly to India is a common and historical phenomenon to cope with food deficiency and poverty of the area. As per the local people, at least one family member from almost all households migrates seasonally (normally 6-8 months) to India for employment for subsistence.

Of the total households (3,563), 39.6% were absent households (one or more family members absent at the time of enumeration). The percentage of absent households is high (55.8%) in ward no. 8 of Mellekh Rural Municipality whereas low (31.5%) in ward no. 4 of Sanfebagar Municipality.

Similarly, of the total population 15.3% is absentee population. The percentage of absentee population is high (19.3%) in ward 8 of Mellekh Rural Municipality whereas it is low (9.1%) in ward no. 4 of Mellekh Rural Municipality. The percentage of male absentee population is 76.9% and female is 23.1% in the project area. Further, the percentage of female absentee population is high (29.3%) in ward no. 4 of Sanfebagar Municipality and low (12.1%) in ward no. 4 of Mellekh Rural Municipality (Table 4-35).

Table 4-35: Absentee households and population

Municipality / Rural Municipality/Ward	Total		Absent Household		Absent population					
	HH	Population			Total		Male		Female	
			No.	%	No.	%	No.	%	No.	%
Bajura										
Budhiganga Municipality - 10	563	3067	207	36.8	412	13.4	301	73.1	111	26.9
Achham										
Sanfebagar Municipality - 4	702	3441	221	31.5	724	21.0	512	70.7	212	29.3
Sanfebagar Municipality - 10	621	3124	283	45.6	524	16.8	406	77.5	118	22.5

Sanfebagar Municipality - 13	539	2813	216	40.1	452	16.1	342	75.7	110	24.3
Mellekh Rural Municipality - 4	792	4634	291	36.7	422	9.1	371	87.9	51	12.1
Mellekh Rural Municipality -8	346	1847	193	55.8	357	19.3	292	81.8	65	18.2
Total	3563	18926	1411	39.6	2891	15.3	2224	76.9	667	23.1

Source: Central Bureau of Statistics, 2014

Migration to India is common as it costs less for migration, accessibility, free movement facility and nexus to India. Most of the migrant workers work as watchman, cook/waiter and labourer and are lowly paid.

The popular destinations of the migrant workers of the area are Delhi and Mumbai and other major cities of India. However, in recent years, abroad migration (Gulf countries and Malaysia) is also increasing in the project area.

Poverty, unemployment, subsistence level of economy, lack of infrastructure and industry, low agricultural production, hardship of the area and desire of improving quality of life are the main reasons of migration.

Remittance is one of the major income sources for almost all households of the project area. It has a positive impact on improving socio-economic status of the migrant households. It is one of the prominent sources of livelihood for most households of the project area. The migrants' families have used remittance for food, clothing, education to children, treatment, and repayment of loans.

However, migration has also resulted in negative impacts such as shortage of human resources for farming, increased workload on women and children, lack of family support during illness and infection with vulnerable disease such as STD and HIV/AIDS. Achham district is one of the HIV/AIDS prone districts in the country because of returnee migrant workers from India.

Lack of guardianship for dependents, misguided children, family-break, trafficking of women alcohol consumption, gambling, loss of property and belongings etc. are the other major problems faced by the migrants' family. Local people suggested creating employment opportunities to reduce migration rate of the project area by creating jobs and agricultural development.

4.3.2.11 Industries, Trade and Business

Except for a few small cottage industries (agro processing, small hydropower plants, water mills, workshops), there are no large industries established in the project area. There are some retail shops, hotels/lodges and teashops in the area. Sanfebagar, Thanti Bazar (Ghugurkot), Budha Bagar (Babala), Bamka Bazar, Ritha Bazar, Dab, Malika Bazar and Betalmandu (Barabish) are the main trade and business centres for the local people. Except Sanfebagar, all are emerging growth/market centres of the area due to access road.

Similarly, some other small market centres are also emerging along the Sanfe-Martadi Road corridor due to accessibility and migration of people from rural areas to roadside. Due to accessibility, small hotel/lodge, teashops and retail shops are increasing and are more concentrated along the Sanfe-Martadi Road.

The main imports to the project area are consumable goods, food grains and construction materials while the main exports are paddy, potato, turmeric, ginger, beans, goats and ghee.

4.3.2.12 Health and Sanitation

Government health facilities are the main facilities providing health services to the local people of the project area. There are six health-posts, some private clinics and medical shops in the project area. As per the local people, the quality of health service provided by these health institutions is generally satisfactory. In all the healthpost there are birthing centers.

However, almost all the government health institutions of the area have poor physical facilities (building/room, drinking water, and toilet) and lack of essential drugs. Availability of health service providers in the health institutions is also a common problem in the area. As provision of health services is now under the jurisdiction of local bodies (local government), local communities hope the service quality of the local health institutions will improve in the future.

The prevailing diseases in the area are common cold, fever, diarrhoea, gastro-intestinal diseases, skin diseases, dysentery, acute respiratory infection (ARI), pneumonia and typhoid. It is noted that water borne diseases are more common in the area due to lack of potable water. Most people of the area use traditional methods of treatment such as calling faith healers, use of herbs and home remedies first at home and if not cured visit health posts or health service providers and private clinics.

Some cases of sexually transmitted diseases such as HIV/AIDS and death due to the disease were reported during the field study. However, as it is a confidential issue, no authentic data was available. As many people from this area go to India for employment, the risk of bringing HIV/AIDS and STDs by the migrant workers is high in the area.

The causes of the high prevalence of uterus prolapse in Nepal are complex and manifold. Within Nepal, there are various sociocultural norms that expose women to multiple risk factors that decrease the age at which prolapse occurs, and increase the prevalence of the condition within the country. Nepal is a patriarchal society, within which gender has immediate implications for health and wellbeing throughout one's life course. While many women in Nepal experience uterine prolapse after having given birth, women who have never been pregnant may also experience the condition at all degrees of severity. Uterus prolapse is a significant public health problem in Nepal. The United Nations Population Fund reported a global prevalence between 2% to 20% in 2006 and approximately 10% for Nepali women (Sybrecht G.R, Ghimire P (2015).

The project area has been declared as open defecation free (ODF) area. However, of the total 3563 HHs of the project area about 78.0% have toilets. The percentage of HHs having toilet is high (95.4%) in Mellekh ward no.8 and low (51.0%) in Budhiganga ward no 10 compared to the other wards of the project area (Table 4-36).

Table 4-36: Household having toilets in the project area

Municipality/Rural Municipality	Total No. Of HHs	HHs Having Toilet	
		HHs	Percent
Bajura			
Budhiganga Municipality-10	563	287	51.0
Achham			
Sanfebagar Municipality -4	702	449	64.0
Sanfebagar Municipality -10	621	497	80.0

Sanfebagar Municipality -13	539	483	89.6
Mellekh Rural Municipality-4	792	724	91.4
Mellekh Rural Municipality-8	346	330	95.4
Total	3563	2770	77.7

Source: District profile of Achham, 2014 and public consultation

The use of toilets could be correlated with awareness level and socio-economic status of the people, and availability of water. Of the households who use toilets, 81.8% use flush toilet and 17.1% use ordinary toilets. The remaining 1.1% has not stated the type of toilet they use. Mellekh Rural Municipality no. 8 has the highest percentage (98.2%) of households with flush toilets whereas Budhiganga Municipality ward no. 10 has the lowest percentage (51.9%) of households having flush toilets (Table 4-37).

Table 4-37: Households with types of toilets

Table 4-37: Households with types of toilets

Municipality/Rural Municipality	Type of Toilet						Total HHs
	Flushed Toilet		Ordinary Toilet		Not Stated		
	HHs	%	HHs	%	HHs	%	
Bajura							
Budhiganga Municipality -10	149	51.9	129	44.9	9	3.1	287
Achham							
Sanfebagar Municipality - 4	298	66.4	146	32.5	5	1.1	449
Sanfebagar Municipality -10	444	89.3	53.0	10.7	0	0	497
Sanfebagar Municipality - 13	362	74.9	114	23.6	7	1.4	483
Mellekh Rural Municipality -4	689	95.2	29.0	4.0	6	0.8	724
Mellekh Rural Municipality -8	324	98.2	2.0	0.6	4	1.2	330
Total	2266	81.8	473	17.1	31	1.1	2770

Source: District profile of Achham, 2014 and public consultation

4.3.2.13 Drinking Water

According to the Population and Housing Census of 2011, the project area's highest source of drinking water is tap/piped water (69.7%) followed by spout water (18.5%), uncovered well (5.3%), covered well (4.1%) and river/stream (Table 4-38).

Table 4-38: Households by the source of drinking water

Municipality/Rural Municipality	Main Source of Drinking Water							Total
	Tap/Piped	Covered Well	Uncovered Well	Spout Water	River/Stream	Others	Not Stated	
Bajura								
Budhiganga Mun.-10	309	0	41	205	0	0	8	563
Achham								
Sanfebagar Mun.-4	398	65	63	132	12	0	32	702
Sanfebagar Mun.-13	469	0	9	47	7	0	7	539
Sanfebagar Mun.-10	384	36	31	167	0	3	0	621
Mellekh R. Mun.-4	705	15	41	25	0	0	6	792

Mellekh R. Mun.-8	218	29	4	83	8	0	4	346
Total	2483	145	189	659	27	3	57	3563
Percentage	69.7	4.1	5.3	18.5	0.8	0.1	1.6	-

Source: District profile of Achham, 2014 and public consultation

4.3.2.14 Vulnerable Segments

Women/single women headed households, Dalit, women, people with disability and infected with chronic disease, STDs and HIV/AIDS, children and old people are considered as vulnerable groups/segments in society. Poverty, illiteracy, domestic violence, lack of awareness and traditional beliefs are the main governing factors that promote vulnerability to the segment. The women of the project area are prone to STD, HIV/AIDS due to India migrants (mostly from Mumbai and Delhi). Similarly, in some areas particularly in rural/remote areas women are forced to stay in ChaupadiGoth (shed) during menstruation period where their life is in high risk (rape, victim of wild animals, snake bite, psychological affects).

4.3.2.15 Water Uses

Budhi Ganga, Ikri Gad, Ardali Gad, Angali Gad and Bhimkoti Khola are some important rivers of the project area.

Upstream of the dam, one water mill is currently in operation by using water of Ikri Gad. The water mill located about 700m downstream of the proposed dam site using water of Budhi Ganga River is not in operation at present. In reduced flow section at the confluence of Ardoli Gad four water mills are in operation using water of Ardoli Gad (Photo 4-32). These Ghattas/water mills do not use water of Budhi Ganga River even in dry period. About 20m downstream of the confluence of Angali Gad with Budhi Ganga River two water mills are in operation using water of Angali Gad. Local people reported that these two water mills also used water of Budhi Ganga River during dry period when the discharge of Angali Gad is not enough to operate the water mills.

The Budhi Ganga River is also used for irrigation and drinking purpose for the settlement located just upstream of the proposed powerhouse site (Photo 4-33).

There are three cremation sites between headworks to powerhouse tailrace. Ardali Gad Ghat, Budhabagar Ghat (Mellekh Rural Municipality ward no. 4 and Sanfebagar Municipality ward no.13), Budhi Ghat near the confluence of Angali Khola. Out of the above mentioned cremation sites only the cremation site of Budhabagar Ghat is using water of Budhi Ganga River and others are using water of tributaries. There is no conflict among the local people regarding water use resource in the project area.



Photo 4-32: Water mill in operation from Ardoli Gad Photo 4-33: Irrigation canal using water of Budhi Ganga River

4.3.2.16 Infrastructure and Facilities

The physical infrastructure and facilities, such as health facilities (health-posts), private health clinics/medical shops, schools, post offices, police posts, cooperatives, drinking water, suspension bridges, livestock service centres and agriculture sub-centres, micro hydropower projects (completed and under construction), irrigation schemes are in existence in the project area.

The area is linked with Martadi-Sanfebagar road and has regular (day/night) public transportation services from Kathmandu, Dhangadhi and Mahendranagar. Telecommunication facilities are available in the project area through wireless technology (CDMA, GSM etc.). This has helped to ease communication in the area and increase efficiency in the local people. Mobile phone sets are common in the area.

4.3.2.17 Cultural Environment

Hindu culture is dominant in the project area. Almost all people follow cultural values and norms of Hinduism. The Dalits of the project area have still low social status and normally known as Tallo Jati, though caste based discrimination is illegal in the country.

The social relationship between different caste/ethnic groups is cordial in the project areas. The Dalits and advanced cast/ethnic groups live together in the project area with mutual understanding and co-operate each other. However, there is still some discrimination between high caste and low caste groups (Dalits) particularly in the remote locations of the project area.

There is a unique tradition "Chaupadi" in hill districts of Far-west Provincen and it is more widespread in Achham district. In this tradition woman/young girls are kept in a small shed "Chaupadi Goth" during menstruation away from main resident house for at least 4 days and imposing restriction on entering main house as well as touching food and other household goods. Due to this tradition, many women/young girls become victims of wild animals and rape case and often die due to unhygienic living conditions. The government has already declared it illegal. Despite the efforts of government as well as many International Non-Governmental Organization (INGOs) and Non-Governmental Organization (NGOs) to eliminate the tradition this tradition still exists in the project district. However the project area is free from Chaupadi tradition.

Almost all the people of the project area follow Hindu religion whereas a few also follow Christianity and Muslim religions.

As in the districts, the important festivals of the area are Dashain, Tihar, Maghesakaranti, Faghu Purnima (Holi). Bisu (New Year), Maha Shivaratri, Potisarai, Saune Shakarantri, Jethase Purnima, Janai Purnima, Putala Parwa, Chaite Dasai, Bhadaure Shakaranti, Ghase Shakarantri (Aswin 1), Krishna Astami, Kartik Purnima, Tihar, Pushe Purnima (Bhaile Aunsi), Makar Shakarantri, Bhuwa Aunshi and Basanta Panchami. Like other parts of Nepal Marriage (Photo 4-26), Bratbandha and Daha Sanskar (funeral) are the cultures practiced in the Hindu community of the area.

The local people are devoted to their tradition and cultural practices. They celebrate their ceremony, festivals, and perform rituals as per their traditional cultural practices and caste/ethnic groups.

There are few cultural, religious and historical sites recorded in the project area however they do not have national importance. A small shrine is located in proposed reservoir area which is occasionally used for worship by local people.



There are a few remains of old palaces of less importance, made by kings who ruled the area, before unification of Nepal by the late king Prithivi Narayan Shah. These are Bhimkot Durbar (Mellekh Rural Municipality ward no. 8), Sannikot (Sanfebagar Municipality ward no. 13) and Bayalchaka (Budhiganga Municipality ward no. 13). According to the local people, there are some historical pillars (Birkhamba) and Dewal in Sanfebagar Municipality ward no. 13 which have archaeological values.

Similarly, there are several temples of god and goddess (Photo 4-25) such as Betal Dauta, Malika Devi and Betalmandu, Shiva Temple and Navadurga Temple (Sanfebagar Municipality ward no. 13), Shiva Temple, Mastamandu Temple, Chulthe Devi Temple in Budhiganga Municipality ward no. 10, and Lingkot religious place/temple (Mellekh Rural Municipality ward no. 4).

Further, there are some tourist centers locally known as Babaidhara, Suka Daha in Sanfebagar Municipality ward no. 13 and Tushare Dhara, Dhaulpura Kukurdhoul cave and Bhagawati Stone (large stone where about 400 people can stay in Budhiganga Municipality).



Photo 4- 25: Typical Temple of the Area



Photo 4- 26: Traditional Wedding Ceremony

4.3.3 Socio-economic Characteristics of Project Affected Families

This section describes socio-economic status of directly project-affected households/families based on the findings of socio-economic survey (80 households) of the project area. These households are directly affected by the project due to acquisition of agriculture land, house and other private properties for the proposed Budhi Ganga Hydropower Project.

4.3.3.1 Population

Altogether 80 households were identified as directly affected families and interviewed for socio-economic baseline survey. As per the survey, the total population of the affected households is 669 including 49.78% male and 50.22% female. The average household size is 8.4 persons (Table 4-39).

Table 4-39: Distribution of surveyed households and population

Municipality /Rural Municipality	Population				Households	
	Male	Female	Total	Sex Ratio	Total	Average HH Size
Bajura district						
Budhiganga Municipality ward-10	32	27	59	1.19	5	12

Achham district						
Sanfebagar Municipality ward-4	15	15	30	1	4	7.5
Sanfebagar Municipality ward-13	37	36	73	1.03	10	7.3
Sanfebagar Municipality ward-10	56	62	118	0.9	16	7.4
Mellekh Rural Municipality ward-4	35	31	66	1.13	8	8.3
Mellekh Rural Municipality ward-8	158	165	323	0.96	37	8.7
Total/Avg.	333	336	669	0.99	80	8.4

Source: Field Survey, 2018

Of the total population (669), 26.3% is in the age group of 0-14 years, 61.1% is between the age group of 15-59 years and 12.6% is in the 60 years and above age group. The proportion of 15-49 age group, which is considered economically active population, is higher than the national average of 54.2% in the area (Table 4-40).

Table 4-40: Distribution of surveyed population by broad age groups

Municipality /Rural Municipality	Broad Age Groups			Total Population
	0-14 Years	15-59 Years	60 Years and Above	
Bajura district				
Budhiganga Municipality ward-10	16	36	7	59
Achham district				
Sanfebagar Municipality ward-4	8	19	3	30
Sanfebagar Municipality ward-13	20	44	9	73
Sanfebagar Municipality ward-10	36	70	12	118
Mellekh Rural Municipality ward-4	16	39	11	66
Mellekh Rural Municipality ward-8	80	201	42	323
Total	176	409	84	669
Percentage	26.3	61.1	12.6	100

Source: Field Survey, 2018

Regarding family structure, joint family is high (63.70%) compared to nuclear family (36.30%) among the affected HHs. The practice of living in a joint family is high in Budhiganga Municipality followed by the wards of Mellekh Rural Municipality (Table 4-41).

Table 4-41: Distribution of surveyed households by family type

Municipality /Rural Municipality	Total HHs	Family Type	
		Joint	Nuclear
Bajura district			
Budhiganga Municipality ward-10	5	5	
Achham district			
Sanfebagar Municipality ward-4	4	1	3
Sanfebagar Municipality ward-13	10	6	4
Sanfebagar Municipality ward-10	16	9	7
Mellekh Rural Municipality ward-4	8	3	5
Mellekh Rural Municipality ward-8	37	27	10

Total	80	51	29
Percentage		63.70%	36.30%

Source: Field Survey, 2018

Regarding marital status of the surveyed population, 51.42% are married, 44.84 % are unmarried and 3.74% are widow or widower. The percentage of married population is high (54.79%) in Sanfebagar Municipality ward no. 13 than other project affected wards (Table 4-42).

Table 4-42: Marital status of the surveyed population

Municipality /Rural Municipality	Population			Total
	Unmarried	Married	Widow	
Bajura district				
Budhiganga Municipality ward-10	27	29	3	59
Achham district				
Sanfebagar Municipality ward-4	15	13	2	30
Sanfebagar Municipality ward-13	29	40	4	73
Sanfebagar Municipality ward-10	54	61	3	118
Mellekh Rural Municipality ward-4	30	34	2	66
Mellekh Rural Municipality ward-8	145	167	11	323
Total	300	344	25	669
Percentage	44.84	51.42	3.74	100

Source: Field Survey, 2018

4.3.3.2 Education

Of the surveyed population aged six years and above, 27.6% are illiterate and 72.4% are literate. The gender gap in literacy is wide. The illiteracy among women is high (36.8%) whereas it is low (17.8%) among the men (Table 4-43).

Table 4-43: Literacy status of the surveyed households (6 years and above)

Literacy Status	Male		Female		Total	
	No.	%	No.	%	No.	%
Illiterate	52	17.8	114	36.8	166	27.6
Literate	240	82.2	196	63.2	436	72.4
Total	292	100	310	100	602	100

Source: Field Survey, 2018

Regarding educational attainment of the literate population, 16.1 % had non-formal education and 21.3% had completed primary level of education. Similarly, 18.1% had passed lower secondary level, 15.8% had passed secondary level of education and 13.1% had passed the School Leaving Certificate (SLC) Level. Further, 10.8% had passed the intermediate level and 4.8% had a bachelor or higher degree.

It is interesting to note that the dropout level is high after Intermediate level. It could be due to poor economic status of the households and lack of awareness among the parents regarding education (Table 4-44).

Table 4-44: Educational attainment among the literate population

Educational Attainment	Male		Female		Total	
	No.	%	No.	%	No.	%
Literate only	25	10.4	45	23	70	16.1
Primary level	52	21.7	41	20.9	93	21.3
Lower secondary	42	17.5	37	18.9	79	18.1
Secondary	34	14.2	35	17.9	69	15.8
SLC	37	15.4	20	10.2	57	13.1
Intermediate	32	13.3	15	7.7	47	10.8
Bachelor's and above	18	7.5	3	1.5	21	4.8
Total (Literate)	240	100	196	100	436	100

Source: Field survey, 2018

4.3.3.3 Caste/Ethnic Composition and Religion

Chhetri is the main directly affected caste/ethnic group followed by Dalit (Lohar) in the BHP area. Of the affected households, 94.2% are Chhetri and 5.8% are Dalit (Table 4-45). All surveyed households follow Hindu religion and living in the place of residence from generations.

Table 4-45: Caste/ethnic composition of the surveyed population

Ethnic/Caste Composition	No. of HHs.	Percentage
Chhetri	76	95
*Dalit (Lohar)	4	5
Total	80	100

Source: Field Survey 2018, Note: * in Mellekh Rural Municipality only

4.3.3.4 Spoken Language

Achhami is the main spoken language of the households. Of the surveyed households, 67.5 % speak Achhami whereas 32.5 % speak Nepali language. All the households of Sanfebagar Municipality wards 4 and 10 reported Achhami as their spoken language (Table 4-46).

Table 4-46: Distribution of surveyed households by spoken language

Municipality /Rural Municipality	Language				Total Households
	Nepali		Achhami		
	No.	%	No.	%	
Bajura district					
Budhiganga Municipality ward-10	3	60	2	40	5
Achham district					
Sanfebagar Municipality ward-4			4	100	4
Sanfebagar Municipality ward-10	4	25	12	75	16
Sanfebagar Municipality ward-13			10	100	10
Mellekh Rural Municipality ward-4	3	37.5	5	62.5	8
Mellekh Rural Municipality ward-8	16	43.2	21	56.8	37
Total	26	32.5	54	67.5	80

Source: Field survey, 2018



4.3.3.5 Economic Characteristics

I) Occupation/employment

Of the economically active population (15 – 59 years), 75.6% are engaged in different types of occupation/employment for livelihoods where as 24.4% are students. Agriculture is the main occupation of 47.1% people. Similarly, 6% are engaged in household work, 7.4% are in salaried job in Nepal and 2.6% abroad in salaried job. The other sectors of employment/occupation of the surveyed population are wage labor (4.8%) in country and abroad (3.6%), and business and small industry (4%).

The proportion of male population having agriculture as main occupation is low (38.2%) compared to the female population in the project area. Of the surveyed population, no male population is engaged in household work such as cooking, cleaning, care of old/child, livestock etc. (Table 4-47)

Table 4-47: Occupational composition of surveyed population (15 to 59 years)

Main Occupation	Male		Female		Total	
	No.	%	No.	%	No.	%
Agriculture	96	38.2	139	56	235	47.1
Business and small industry	15	6	5	2	20	4
Labor/Wage (In Country)	18	7.2	6	2.4	24	4.8
Labor/Wage (Outside Country)	16	6.4	2	0.8	18	3.6
Service (Inside Country)	32	12.7	5	2	37	7.4
Service (Other Country)	12	4.8	1	0.4	13	2.6
Student	62	24.7	60	24.2	122	24.4
Household Works	-	-	30	12.1	30	6
Total	251	100	248	100	499	100

Source: Field Survey, 2018

II) Ownership of House and Valuable Household Assets

Ownership of residential house is one of the indicators of well being. Of the surveyed HHs, 97.5% reside in their own housing unit whereas 2.5 % reside in other housing units. One household of Sanfebagar ward no. 10 and one household of Mellekh ward no. 8 reported no housing unit (Table 4-48).

Table 4-48: Ownership of house

Municipality /Rural Municipality	Ownership		
	Yes	No	Total No. of HHs
Bajura district			
Budhiganga Municipality ward-10	5	-	5
Achham district			
Sanfebagar Municipality ward-4	4		4
Sanfebagar Municipality ward-10	15	1	16
Sanfebagar Municipality ward-13	10		10
Mellekh Rural Municipality ward-4	8		8
Mellekh Rural Municipality ward-8	36	1	37
Total	78	2	80
Percentage	97.5	2.5	100

Source: Field Survey, 2018

Regarding type of residential units, of the households 90% live in Kachi (made of mud and thatched roofed) house whereas 10% live in Pakki houses. Further, only the HHs of Mellekh Municipality ward no. 8 live in Pakki houses (Table 4-49).

Table 4-49: Distribution of houses by type

Municipality /Rural Municipality	Type		
	Kachi	Pakki	Total No. of HHs
Bajura district			
Budhiganga Municipality ward-10	5	-	5
Achham district			
Sanfebagar Municipality ward-4	4		4
Sanfebagar Municipality ward-10	16		16
Sanfebagar Municipality ward-13	10		10
Mellekh Rural Municipality ward-4	8		8
Mellekh Rural Municipality ward-8	29	8	37
Total	72	8	80
Percentage	90	10	100

Source: Field survey, 2018

Regarding types of housing units, 73.7% own two storey house, 23.8% own three or more number of stories and 2.5% own one storey housing unit (Table 4-50).

Table 4-50: Distribution of houses by number of storey

Municipality /Rural Municipality	Number of Story's			
	One	Two	Three or More	Total No. of HHs
Bajura district				
Budhiganga municipality ward-10		3	2	5
Achham district				
Sanfebagar municipality ward-4	1	2	1	4
Sanfebagar municipality ward-10		13	3	16
Sanfebagar municipality ward-13	1	7	2	10
Mellekh Rural Municipality ward-4		7	1	8
Mellekh Rural Municipality ward-8		27	10	37
Total	2	59	19	80
Percentage	2.5	73.7	23.8	100

Field Survey 2018, Note: All the houses are with wood/mud floor

The roofing material of houses is related to the safety and wellbeing of the occupants. As common in the hill districts, houses with slate roofs are common in the area. Of the HHs, 73.75% HHs live in a slate roofed house, 7.5% live in RCC roofed house, 11.25% reside in the building roofed with galvanized zinc sheets and 7.5% live in a house roofed with thatch (Table 4-51).

Table 4-51: Distribution of houses by roof type

Municipality /Rural Municipality	Number of story's				
	Thatched	Zinc	Slate / Tiles	RCC	Total No. of HHs
Bajura district					
Budhiganga /municipality ward-10		1	4		5
Achham district					

Sanfebagar Municipality ward-4		1	3		4
Sanfebagar Municipality ward-10	2	2	12		16
Sanfebagar municipality ward-13		1	9		10
Mellekh Rural Municipality ward-4	2	2	4		8
Mellekh Rural Municipality ward-8	2	2	27	6	37
Total	6	9	59	6	80
Percentage	7.5	11.25	73.75	7.5	100

Source: Field Survey 2018

Ownership of household assets is also an indicator of economic well being. An assessment of household assets of the surveyed HHs was made. Mobile phones and radios are the common HH assets of the HHs followed by cabinet and televisions. Of the HHs, 89.8% have mobile phone sets of an average value of Rs. 4,700 and 43.2% have radio sets with average value of Rs. 1,500. Only 8.7% of the HHs have a television with estimated average value of Rs. 15,500. Similarly, 5.8% of the households have computer/printer of average value of Rs. 60,000. Similarly, 4.4% of the HHs own motorcycle/scooter (Table 4-52).

Table 4-52: Percentage of households having household assets

Assets	Ownership (%)		Average Value (Rs.)
	Yes	No	
Mobile phone	89.8	10.2	4700/-
Television	8.7	91.3	15500/-
Computer/printer	5.8	94.2	60000/-
Motorcycle/scooter	4.4	95.6	152000/-
Cabinet	13.5	86.5	4500/-
Radio	43.5	56.5	1500/-

Source: Field survey, 2018

III) Food Security

Regarding food security, only 33.75% HHs can grow enough food grains for their annual consumption from their own production whereas 66.25% can not (Table 4-53).

Table 4-53: Food sufficiency of the surveyed households by own production

Municipality /Rural Municipality	Sufficiency		
	Yes	No	Total No. of Households
Bajura district			
Budhiganga Municipality ward-10	2	3	5
Achham district			
Sanfebagar Municipality ward-4	2	2	4
Sanfebagar Municipality ward-10	3	13	16
Sanfebagar Municipality ward-13	2	8	10
Mellekh Rural Municipality ward-4	3	5	8
Mellekh Rural Municipality ward-8	15	22	37
Total	27	53	80
Percentage	33.75	66.25	100

Source: Field survey, 2018

The area is food deficit area. Of the HHs who said they have food deficit, only 5.7% grow enough food for more than 9 months whereas 94.3% grow food only for less than 9 months in the year for their consumption (Table 4-54).

Table 4-54: Food deficiency of the surveyed households

Municipality /Rural Municipality	Food Deficit Months				Total No. of Households
	< 3	3-5	5-9	> 9	
Bajura district					
Budhiganga Municipality ward-10	2		1		3
Achham district					
Sanfebagar Municipality ward-4	2				2
Sanfebagar Municipality ward-10	2	4	4	3	13
Sanfebagar Municipality ward-13	2	2	4		8
Mellekh Rural Municipality ward-4	2	2	1		5
Mellekh Rural Municipality ward-8	7	9	6		22
Total	17	17	16	3	53
Percentage	32	32.1	30.2	5.7	100

Source: Field Survey, 2018

The surveyed households use different strategies to cope with food shortage. Of the households, 34% work as wage labor, 24.5% take loan, 18.9% rely on remittance, 13.2% on petty business, 9.4% dependent on salaried job to manage the food deficiency (Table 4-55).

Table 4-55: Strategy of the surveyed households to cope the food deficiency

Municipality /Rural Municipality	Strategies					
	Loan	Wage Labor	Remittance	Service Income	Business Income	Total No. of HHs
Bajura district						
Budhiganga Municipality ward-10	1		1		1	3
Achham district						
Sanfebagar Municipality ward-4					2	2
Sanfebagar Municipality ward-10	2	4	3	2	2	13
Sanfebagar Municipality ward-13	2	3	1		2	8
Mellekh Rural Municipality ward-4		3	2			5
Mellekh Rural Municipality ward-8	8	8	3	3		22
Total	13	18	10	5	7	53
Percentage	24.5	34	18.9	9.4	13.2	100

Source: Field survey, 2018



IV) Family Debt

Family debt is another indicator of economic well being. Therefore, an assessment of the HHs was made regarding family debt. Of the HHs, 66.2% have family debt whereas 33.8% have no debt (Table 4-56).

Table 4-56: Debt status of the surveyed households

Municipality /Rural Municipality	Debt Status		
	Yes	No	Total No. of HHs
Bajura district			
Budhiganga Municipality ward-10	4	1	5
Achham district			
Sanfebagar Municipality ward-4	3	1	4
Sanfebagar municipality ward-10	12	4	16
Sanfebagar Municipality ward-13	7	3	10
Mellekh Rural Municipality ward-4	5	3	8
Mellekh Rural Municipality ward-8	22	15	37
Total	53	27	80
Percentage	66.2	33.8	100

Source: Field Survey, 2018

The households have taken loan for different purposes such as food/clothing (35.8%), Education (35.8%) and 7.5% each for social/religious work, investment in business and treatment. A small percent of the HHs have taken loan for house repair (Table 4-57).

Table 4-57: Reason for taking loan by the surveyed households

Municipality /Rural Municipality	Reason							
	House repair	Purchase Agri. land	Health Treatment	Education	Start Business	Marriage /rituals	Food/ Clothing	Total No. of HHs
Bajura district								
Budhiganga Municipality ward-10		1			2		1	4
Achham district								
Sanfebagar Municipality ward-4				1		2		3
Sanfebagar Municipality ward-10	1		2	5			4	12
Sanfebagar Municipality ward-13				3	2	1	1	7
Mellekh Rural	1			3			1	5

Municipality ward-4								
Mellekh Rural Municipality ward-8			2	7		1	12	22
Total	2	1	4	19	4	4	19	53
Percentage	3.8	1.9	7.5	35.8	7.5	7.5	35.8	100

Source: Field survey, 2018

V) Income

The average annual income of the surveyed HHs is Rs. 143,216. Non-agricultural income has the highest share (97.75%) in the annual household income of the surveyed HHs. The other nominal sources of income are agriculture and livestock (Table 4-58).

Table 4-58: Average annual income of surveyed households

Municipality /Rural Municipality	Annual Average Income from Different Sources							
	Agriculture		Livestock		Non-Agriculture		Total	
	Rs	%	Rs	%	Rs	%	Rs	
Bajura district								
Budhiganga Municipality ward-10					141666	100	141666	
Achham district								
Sanfebagar Municipality ward-4					121750	100	121750	
Sanfebagar Municipality ward-10					105000	100	105000	
Sanfebagar Municipality ward-13	725	0.6	6230	5.1	114600	94	121555	
Mellekh Rural Municipality ward-4					69696	100	69696	
Mellekh Rural Municipality ward-8	120	0.1	4297	2.6	157393	97	161810	
Average	168		3048		140000		143216	

Source: Field survey, 2018

Regarding further details of the annual income, the share of daily wage/porter is highest (25.6%) followed by salaried job (24.9%) and remittance (22.5%). Similarly, business/petty business (15.4%), contractual income (3.0%), animal husbandry and sale of agriculture production are the other sources of HH income (Table 4-59).

Table 4-59: Annual household income by type of income

Income Source	Average Income	%
Agriculture Income (Net Income from Cereals and Cash Crop Production)	168	0.1
Animal Husbandry (Sale of Animals, Milk and Milk Products)	3048	2.1
Service	35696	24.9
Daily wages/porter	36710	25.6
Pension and Briddha Bhatta (Old Allowance)	9000	6.3



Business/trade/ petty business(shop, retail shops)	22014	15.4
Contractual Income	4348	3
Remittance	32232	22.5
Total average income	143216	100

Source: Field survey, 2018

The households were asked regarding their minimum required monthly income to fulfil basic requirements of their family (food, clothing, education and other basic requirements). Of the total households, about 27.5% said that they require Rs. less than 15,000 per month whereas about 26.25 said requirement of more than Rs.300000. Likewise, 23.75% households said they require Rs. up to Rs. 15,000- 20,000, 13.75% said requirement of Rs. 20,000 to 25,000 and 8.75% said Rs. 25,000 to 30,000 per month (Table 4-60).

Table 4-60: Required minimum monthly income of HHs for basic requirements

Municipality /Rural Municipality	HHs by Required Monthly Income (Rs.)					Total No. of HHs
	< 15000	15-20000	20-25000	25-30000	>30000	
Bajura district						
Budhiganga Municipality ward-10		1	1	1	2	5
Achham district						
Sanfebagar Municipality ward-4	1			2	1	4
Sanfebagar Municipality ward-10	3	3	4		6	16
Sanfebagar Municipality ward-13		1	1	3	5	10
Mellekh Rural Municipality ward-4	3	2	2		1	8
Mellekh Rural Municipality ward-8	15	12	3	1	6	37
Total	22	19	11	7	21	80
Percentage	27.5	23.75	13.75	8.75	26.25	100

Source: Field survey, 2018

VI) Expenditure

The expenditure of the surveyed households could be broadly categorized under two headings: expenditure on food items and expenditure on non-food items. The non-food item heading includes clothing, education, fuel, communication, medicine (regular use) and transportation.

The weighted average annual expenditure of the surveyed households is Rs. 135,928. Food items are the largest expense category, accounting for 43.3% of total reported expenditure. Expenditure on education (17.5%) and clothing are the other important categories. The other expenditure categories are transportation (8.5%), fuel (7.2%), medicine (4.5%), and communication. The average annual income of the HHs is low in Mellekh Rural Municipality wards no. 4 and high in Mellekh Rural Municipality ward no. 8 (Table 4-61).



Table 4-61: Annual household expenditure by expenditure headings

Municipality /Rural Municipality	Expenditure Headings (%)							Total Expend (NRs)
	Food Items	Clothing	Education	Fuel	Communication	Treatment/ Medicine	Transportation	
Bajura district								
Budhiganga Municipality ward-10	49.9	16.2	12.9	7.5	3.2	1.4	8.8	136530
Achham district								
Sanfebagar Municipality ward -4	39.9	13.5	25.1	7.1	2.1	4.6	7.8	131650
Sanfebagar Municipality ward -10	40.4	17.9	16.8	6.3	2.7	6.5	9.2	123450
Sanfebagar Municipality ward -13	41.4	18.2	17.3	6.3	2.2	4.7	9.9	132036
Mellekh Rural Municipality ward -4	48.2	11.9	17.9	10	2	2.8	7.2	72667
Mellekh Rural Municipality ward -8	43.7	16.3	17.7	7.5	2.5	4.4	7.9	148006
Percentage/Average	43.3	16.6	17.5	7.2	2.5	4.5	8.5	135928

Source: Field survey, 2018

VII) Energy Sources

As per the HH survey, all the households use fuel wood as their sole source of fuel for cooking purpose. The average monthly requirement of fuel wood is 220 kg. for each the household. Community forests are the major source of fuel wood for about 85.0% of the HHs and private forest for 15% HHs (Table 4-62).

Table 4-62: Source of fuel wood for the surveyed households

Municipality /Rural Municipality	Source			
	Community Forest		Private Forest	
	N	%	N	%
Bajura district				
Budhiganga Municipality ward-10	4	80	1	20
Achham district				
Sanfebagar Municipality ward-4			4	100
Sanfebagar Municipality ward-10	13	81.3	3	18.8
Sanfebagar Municipality ward-13	10	100		
Mellekh Rural Municipality ward-4	8	100		
Mellekh Rural Municipality ward-8	33	89.2	4	10.8
Total	68	85	12	15

Source: Field survey, 2018

The households collect fuel wood from three different community forests as per their accessibility. There are five community forests in the core project area from where people collect fuel wood and other forest products for subsistence livelihood. Juka Lamkana CF (Budhiganga-10), Juka CF (Mellekh -4), Imil Tukra CF (Mellekh -8), Sukethana CF (Mellekh -8) and Raksha CF, (Sanfebagar -13) are the main community forests of the area accessible to the local HHs.

Solar energy is the main source of lighting for the HHs. Of the HHs, 83.8% use solar energy, 15% use electricity and 1.2% use Kerosene for lighting (Table 4-63).

Table 4-63: Source of lighting of the surveyed households

Municipality /Rural Municipality	Source					
	Solar		Kerosene Lamp		Electricity	
	N	%	N	%	N	%
Bajura district						
Budhiganga Municipality ward-10	5	100				
Achham district						
Sanfebagar Municipality ward-4					4	100
Sanfebagar Municipality ward-10	16	100				
Sanfebagar Municipality ward-13	10	100				
Mellekh Rural Municipality ward-4	7	88			1	12.5
Mellekh Rural Municipality ward-8	29	78	1	2.7	7	18.9
Total	67	84	1	1.2	12	15

Source: Field survey, 2018

VIII) Agriculture

Land is regarded a permanent productive asset for subsistence for the surveyed HHs. It is inherited in Nepal and ownership of 'large' (greater than 40ha) landholdings is also symbolic of economic and social status of the households. Land is a major asset for subsistence of local people however poor soil fertility, lack of irrigation, traditional methods of farming and poor quality of agriculture inputs production of food crops is very low. Thus, the area is food deficit and is as a pushing factor for migration.

Crop Production

According to the household surveys, paddy, wheat, maize, millet and potato are the main crops grown in the project affected area. In terms of area coverage, paddy cultivation ranks first (16.37 ha), followed by wheat (13.87 ha), millet (4.19 ha), and maize (0.99 ha). Potato is also grown by the farmers as a cash crop. Regarding crop yield, the yield of paddy is 2.87 MT/ha, maize is 1.21 MT/ha, yield of wheat is 1.16 MT/ha, and millet is 1.15 MT/ha. Similarly, the yield of potato is 2.65 MT/ha. As most of the household own Khet land, the coverage of paddy and wheat is high in the area (Table 4-64).

Table 4-64: Major crop area coverage, production and yield

Description	Major Crops					
	Paddy	Wheat	Maize	Millet	Potato	Pulses
Total area cropped (ha)	16.37	13.87	0.99	4.19	1.62	2.76
Khet (ha)	16.27	13.72	0.36	0.45	0.46	0.31

Bari (ha)	0.1	0.15	0.63	3.74	1.16	2.45
Total production (metric tonne)	47	16.1	1.2	4.8	4.3	1.8
Yield (metric tonne/ha)	2.87	1.16	1.21	1.15	2.65	0.65

Source: Field survey, 2018

Landholding

The surveyed households own and operate 61.75 ha land. This land consists of 32.68 ha Khet (low land), 7.79 ha Bari (cultivated upland), 21.21 ha Thatch land (Kharbari/Pakho). The average land holding size of the surveyed households is 0.77 ha (Table 4-65).

Table 4-65: Landholdings of the surveyed households by type of land

Municipality /Rural Municipality	HH	Irrigated	Un-irrigated	Bari	Bhir/Pakho	Total	Ha/HH
		Khet (Ha)	Khet (Ha)	(Ha)	(Ha)		
Bajura district							
Budhiganga Municipality ward-10	5	1.57	1.27	0.05	2.84	5.73	1.15
Achham district							
Sanfebagar Municipality ward-4	4	0.76	0.51	1.68	1.52	4.47	1.12
Sanfebagar Municipality ward-10	16	3.1	0.66	1.05	3.22	8.03	0.5
Sanfebagar Municipality ward-13	10	1.77	1.77	0.54	4.4	8.48	0.85
Mellekh Rural Municipality ward-4	8	1.93	0.47	1.83	2.33	6.56	0.82
Mellekh Rural Municipality ward-8	37	11.76	7.11	2.64	6.97	28.48	0.77
Total /Average	80	20.89	11.79	7.79	21.28	61.75	0.77

Source: Field survey, 2018

Of the surveyed HHs, 33.8% are marginal farmers (up to 0.5 ha), who own and operate 13.05% of the total land. Similarly, 61.3% are small farmers (0.5 – 2 ha) who hold 71.79% of land and 5% are medium land holders (2-4 ha) who hold about 15.16% of total land (Table 4-66).

Table 4-66: Distribution of households by landholding size

Landholding Categories*		Households		Total Landholding	
Category	Size of Holding (ha)	No.	%	Area (ha)	%
Marginal	Up to 0.5	27	33.8	8.06	13.05
Small	0.5 – 1.0	33	41.3	23.29	37.72
	1.0 - 1.5	12	15	14.4	23.32
	1.5 – 2.0	4	5	6.64	10.75
Medium	2.0 - 4.0	4	5	9.36	15.16
Large	> 4.0 ha.	-	-	-	-
Total		80	100	61.75	100

Source: Household Survey Note: *Landholding categories based on Rural Credit Review Study 1991/92, Nepal Rastra Bank (Central Bank of Nepal), 1993

Regarding sex of HH head of the surveyed households, 75 (93.75%) are male headed and 5 (6.25%) are female headed. An average holding of female headed households is 0.94 ha whereas it is 0.76 ha for male headed households (Table 4-67).

Table 4-67: Distribution of households by landholding size

Landholding Categories		Number of Households		Total Area (ha)		Average Holding per Household (ha)	
Category	Size of Holding (ha)	Male-headed	Female-headed	Male-headed	Female-headed	Male-headed	Female-headed
Marginal	Up to 0.5	26	1	7.86	0.2	0.3	0.2
Small	0.50 - 1.00	30	3	21.31	1.98	0.71	0.66
	1.00 - 1.50	12	-	14.4	-	1.2	-
	1.50 - 2.00	4	-	6.64	-	1.66	-
Medium	2.00 - 4.00	3	1	6.82	2.54	2.27	2.54
Large	> 4.0 ha.						
Total		75	5	57.03	4.72	0.76	0.94

Source: Field survey, 2018

Regarding distribution of land by caste/ethnicity, Chhetri own 98.02% of the total land whereas Dalit own only 1.98% of the total land. Similarly, average land holding of Chhetri is also high compared to the Dalit (Table 4-68).

Table 4-68: Landholding by caste/ethnicity of the affected households

Caste/Ethnic Group	Total Landholding		Households	Average per Household (ha)
	Ha	%		
Dalit	1.22	1.98	4	0.31
Chhetri	60.53	98.02	76	0.8
Total	61.75	100	80	0.77

Source: Field survey, 2018

IX) Livestock

Livestock is an integral part of subsistence agriculture for the surveyed households of the project area. A majority (92.7%) of surveyed households keep livestock and fowl (Table 4-69).

Table 4-69: Percentage of households having livestock

Municipality /Rural Municipality	Livestock		
	Yes	No	Total No. of HHs
Bajura district			
Budhiganga Municipality ward-10	100		5
Achham district			
Sanfebagar Municipality ward-4	75	25	4
Sanfebagar Municipality ward-10	91.7	8.3	16
Sanfebagar Municipality ward-13	100		10
Mellekh Rural Municipality ward-4	66.7	33.3	38
Mellekh Rural Municipality ward-8	94	6	37
Percentage	92.7	7.3	80

Source: Field survey, 2018

Goat, cattle and buffalo are the commonly raised livestock by the surveyed HHs. Of them goat is dominant (49.1%). A few surveyed households of the area also keep fowl mainly for self consumption. The average livestock holding of the HHs is 5.6. It is high in Budhiganga Municipality ward no. 10 (Table 4-70).

Table 4-70: Livestock population by type

Municipality /Rural Municipality	Type of Livestock						Fowls
	Cattle	Ox	Buffalo	Goat/ Sheep	Total	Average per HH	
Bajura district							
Budhiganga Municipality ward-10	15	6	9	16	46	7.7	12
Achham district							
Sanfebagar Municipality ward-4	1	2	-	11	14	3.5	
Sanfebagar Municipality ward-13	8	16	6	19	49	4.5	
Sanfebagar Municipality ward-10	7	21	1	49	78	6.5	14
Mellekh Rural Municipality ward-4	1	2	1	4	8	2.7	1
Mellekh Rural Municipality ward-8	36	39	28	93	196	5.9	
Total	68	86	45	192	391	5.6	
Percent	17.4	22	11.5	49.1	100		

Source: Field Survey 2018

Almost all livestock is of local breed and its productivity is low due to various reasons such as lack of fodder/feed, livestock health services, management etc.

4.3.3.6 Drinking Water, Sanitation and Health

I) Drinking Water and Sanitation

Of the surveyed households, 60.0% households are using public taps, 15% households are using piped water connected to home as the source of drinking. Further, 23.8% households are using spring/well. The coverage of public taps is 100% in Mellekh Rural Municipality ward no. 4 (Table 4-71).

Table 4-71: Source of drinking water

Municipality /Rural Municipality	Source							
	Private Tap		Public Tap		River/Stream		Spring/Well	
	N	%	N	%	N	%	N	%
Bajura district								
Budhiganga Municipality ward-10	1	20	4	80.0				
Achham district								
Sanfebagar Municipality ward-4	1		1	33.3			2	66.7
Sanfebagar Municipality ward-10			8	50.0			8	50.0
Sanfebagar Municipality ward-13	6	60	3	30.0			1	10.0

Source: Field Survey, 2018

Table 4-72: Fulfilment of drinking water demand by the existing water sources

Source: Field Survey, 2018

Table 4-73: Methods of solid waste disposal

Source: Field survey, 2018

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Table 4-74: Methods of liquid waste disposal

Municipality/Rural Municipality	Location							
	Closed Drain (Sewerage)		Open Drain		Flows to Khet/Bari		Others	
	N	%	N	%	N	%	N	%
Bajura district								
Budhiganga Municipality ward-10			4	80	1	20.0		
Achham district								
Sanfebagar Municipality ward-4	1	25.0	2	50	1	25.0		
Sanfebagar Municipality ward-10	1	6.3	6	37.5	9	56.3		
Sanfebagar Municipality ward-13			3	30	7	70.0		
Mellekh Rural Municipality ward-4	2	25.0	2	25	4	50.0		
Mellekh Rural Municipality ward-8	16	43.2	3	8.1	16	43.2	2	5.5
Total	20	24.6	20	23.2	38	49.3	2	2.5

Source: Field survey, 2018

II) Health

Of the surveyed HHs, 28.75% reported sick family members during the last one year. The number of sick family is high (37.84%) in Mellekh Rural Municipality ward 8 within one year (Table 4-75). Pneumonia, asthma, jaundice, gastric diabetes and ulcer common cold/fever are the main illnesses reported.

Table 4-75: Household reporting seriously sick family members within one year

Municipality /Rural Municipality	Sick					
	Yes		No		Total	
	N	%	N	%	N	%
Bajura district						
Budhiganga Municipality ward-10			5	100	5	100
Achham district						
Sanfebagar Municipality ward-4			4	100	4	100
Sanfebagar Municipality ward-10	4	25.0	12	75.0	16	100
Sanfebagar Municipality ward-13	3	30.0	7	70.0	10	100
Mellekh Rural Municipality ward-4	2	25.0	6	75.0	8	100
Mellekh Rural Municipality ward-8	14	37.84	23	62.16	37	100
Total	23	28.75	57	71.25	80	

Source: Field survey, 2018

4.3.3.7 Knowledge, Attitude and Expectations of the Affected Households

Most of the affected HHs are aware of BHP and have positive attitude regarding implementation of the project. They suggested quick implementation of the project. Their main source of information regarding the project includes government officials, project team/office, different survey team, and local and national party leaders.



Of the HHs, 46.25% are expecting employment, 31.25% expecting electricity, 16.25% expecting local development and 6.25 expect skill training (Table 4-76).

Table 4-76: Expectation from the project

Municipality /Rural Municipality	Expectation			
	Skill Training	Employment	Electricity Facility	Local Development
Bajura district				
Budhiganga Municipality ward-10		2	2	1
Achham district				
Sanfebagar Municipality ward-4		4		
Sanfebagar Municipality ward-10	1	7	4	4
Sanfebagar Municipality ward-13	1	3	3	3
Mellekh Rural Municipality ward-4		5	2	1
Mellekh Rural Municipality ward-8	3	16	14	4
Total	5	37	25	13
Percentage	6.25	46.25	31.25	16.25

Source: Field survey, 2018

Unemployment (31.3%), poverty (28.8%) and lack of physical facilities (21.3%) are the major reported problems of the HHs surveyed (Table 4-77).

Table 4-77: Major problems reported by the surveyed households

Municipality /Rural Municipality	Major Problems			
	Poverty	Lack of Physical Facilities	Unemployment	Poor Educational Facility
Bajura district				
Budhiganga Municipality ward-10	3		2	
Achham district				
Sanfebagar Municipality ward-4		2		2
Sanfebagar Municipality ward-10	6	4	5	1
Sanfebagar Municipality ward-13	4	2	3	1
Mellekh Rural Municipality ward-4	3	3	1	1
Mellekh Rural Municipality ward-8	7	6	14	10
Total	23	17	25	15
Percentage	28.8	21.3	31.3	18.8

Source: Field Survey, Note: Physical facilities include supply of drinking water, irrigation facilities, road network, better health and other service centres and infrastructure

5. IMPACT ASSESSMENT

5.1 General

This Chapter illustrates the potential beneficial and adverse impacts that are likely to accrue because of implementation of the proposed Budhi Ganga Hydropower Project. Based on the project details and the baseline environmental status, potential environmental impacts have been identified because of the construction and operation of the project.

Environmental impacts of the proposed project have been identified for the project structures and facilities i.e. headwork, headrace tunnel, surge shaft, powerhouse, tailrace tunnel and switch yard, project facilities viz. workers' camps, staff camps, construction yard, spoil/muck disposal sites, crushing/batching plant and project component roads covering the physical, biological, and socioeconomic and cultural environments. The beneficial impacts are given in sub-heading 5.2 and adverse impacts are mentioned in sub-heading 5.3.

The construction phase and operation phase comprises of various activities each of which is likely to have an impact on the existing environment. The potential impacts have been predicted in terms of their nature (direct and indirect), magnitude of impact (low, moderate and high), extent (site specific, local and regional) and duration (short term, medium term and long term). As possible, the impacts have been quantified and otherwise, qualitative assessment has been made. Impact assessment matrix for all the three environmental components are presented in Table 5-1, Table 5-2 and Table 5-3. This chapter covers the issues identified in the approved Scoping and Terms of Reference for EIA of Budhi Ganga Hydropower Project documents.

5.2 Beneficial Impacts

The key beneficial impacts identified during construction and operation phase of the project are increase in employment opportunities, increase in economic opportunities in the area (businesses/enterprise development, house rental, market development etc.), increase in land value, enhancement of social service and facilities, increase in local skills in the relevant areas and revenue generation for local development.

5.2.1 Construction Phase

5.2.1.1 Employment Generation

One of the important beneficial impacts of the project during construction is employment generation at local level. The estimated construction period of the project is 4 years. The construction module, which emphasizes labour-based approach using local people, tends to benefit directly to the people living in the area. The construction works offers a wide range of employment opportunity to local people. During the peak construction period the project will require about 75 skilled, 150 semi-skilled and 175 unskilled construction personnel. Most of the unskilled and semi-skilled personnel will be hired locally. The cash amount they receive as wage earnings will ultimately flow into the local economy that will directly enhance the quality of life of the local people. This will also create demand for consumption goods and services as well as provide opportunity for initiation of different economic activities such as market/enterprise development, improved farming and animal husbandry. As a result, living conditions of the local people will improve.

As there is high prevalence of migration to India in the project area, availability of employment opportunity at local level will minimize the out migration and enhance the local economy and social relations. The impact is direct in nature with high magnitude, local extent and for short duration.

5.2.1.2 Enterprises Development and Commercialization

The workforce who will reside at different locations of the project area for a considerable period will depend on local market for their daily consumable goods. During construction period, different types of commercial activities in different economic sectors such as agriculture, business/trade, service etc. will come into operation to meet the demand of the workforce (labour groups, construction crew and project team) and visitors.

Local people having experiences in running hotels, lodges, restaurants and grocery shops might start their own business/enterprises and create employment opportunities for family and others. The demand for local products such as milk, meat, vegetables, fruits etc. will increase during the construction period, which may provide added impetus for local production and marketing. As a result of increased commercial activities a significant amount of cash will flow in the local economy. The increase in trade and business will create economic opportunities and enhance the economic value of the area and living condition of local people. This is an indirect impact of moderate magnitude, local extent and of short term duration.

5.2.1.3 Increase in Local Skill

The project requires professional technical persons for implementation of the construction works. Local people who will work with these professionals will get opportunities to learn knowledge and skills from them (technology transfer). The knowledge and skills learned during the construction of the project, local people will be able to get employment in similar projects elsewhere. Such knowledge and skills will be obtained, particularly in the areas of tunnel construction, river diversion, heavy equipment operation, masonry, construction of dry walls, gabion walls etc.

There is evidence that the local construction workers who were involved in construction of similar hydropower projects with BPC, HPL, NEA, JICA, Sino Hydro and several other national and international contractors became semi-skilled and skilled persons and their demand is high in other new projects particularly in tunnelling, river diversion, headwork construction, heavy equipment operation etc. The impact is direct in nature with high magnitude, local extent and for long duration.

5.2.1.4 Induced Development

As a result of the project implementation induced economic development will take place in the area. Due to change in demand and supply situation, increase in economic activities, cash flow, accessibility to services, infrastructure development will provide opportunity for emergence of commercial banks, government and non-government organizations, health and educational facilities, tourism, industry etc., and development of market/growth centres, enterprises, agro based industries and activities. The availability of better services will improve the quality of life of local people, increase land value and condition of infrastructures/facilities in the area. The impact is direct of moderate magnitude, local extent and for long duration.

5.2.2 Operation Phase

5.2.2.1 Employment Generation

After completion of construction work, the project will employ about 45 people for smooth operation and maintenance (O&M) of the power plant. Of the required employees, most will be hired locally for administrative and technical works as per their qualifications and skills. The employment will give permanent income source to some households of the area. In addition, short term employment for periodic maintenance work will be beneficial for the local unemployed people to supplement their household income as well as acquire knowledge and skills of the work.

The implementation of the project will provide an opportunity for expansion of rural electrification in the area. The increase in number of households having electricity will require more technical persons for house wiring and fix frequent problems in electrical connections, meters and electrical appliances. Similarly, development of market/trade and entrepreneurship will help to create employment and provide long term income source to the local people. The impact is direct in nature, moderate in magnitude, local extent and for long-term.

5.2.2.2 Increase in Revenue

Nepal is facing shortage of electricity due to imbalance in demand and supply of electricity. It has direct impact on national economy and development. This imbalanced situation is managed by NEA by importing 372 MW of electricity from India and purchasing 220 MW from private sector (press release of NEA, December 21, 2017).

As electricity is one of the essential requirements for social and industrial sectors, in its absence almost all the major and sensitive social service sectors, health sector, education, tourism, trade/industries have been adversely affected and have direct adverse impact on revenue and development.

The project will generate average 109.61 GWh electrical energy/year. It will be connected to national grid through 132 kV transmission line and contribute to revenue generation for the Government of Nepal. This source of revenue will support the local governments to invest in social sector such as health, education, drinking water, irrigation, access road, rural electrification, communication, agriculture, and other required areas to improve quality of life of people. This is direct impact of high magnitude, national extent and for long duration.

5.2.2.3 Induced Development

The infrastructure developed during project construction will be continued during operation phase also. In addition, some new development activities might occur in the area due to easy access and availability of the reliable energy. The operation of the project offices and infrastructure will enhance the economic activities of the area. The availability of quality hotel and easy access will also promote the tourism development in the area [Khaptad National Park (Bajhang, Doti, Achham and Bajura)], Ramarosan and Badi Malika (Bajura), Baijayanath Dham (Sanfebagar) and Karnali (Rakam). The impact is indirect in nature, moderate in magnitude, regional extent and for long-term.



5.2.2.4 Increase in Land Value

As the area is accessible and the trend of migration from hills to valley in the accessible areas along the Sanfe-Martadi Road alignment increasing the process of urbanization and development of growth centres in the area. The major settlements of the area located along the road alignment including Thanti Bazar, Budhabagar, Malika Bazar, Tashi Bazar, Dhaph and Batelmandu are developing as emerging growth centres. Consequently, the land value of the area is increasing and it will further increase due to the BHP. Implementation of the project will also contribute in rising land values in the area along the road alignment and near project structures. High value land is one of the important assets easily accepted by banks, financial institutions and cooperatives for credit as collateral. Increased land values will enhance people's capability for investment, production, consumption and saving. This is indirect impact of moderate magnitude, local extent and for long duration.

5.2.2.5 National Development

The project will generate royalty as per the provision made in the prevailing legal provisions. According to the Hydropower Development Policy, 1990 the project will pay capacity royalty (per kilowatt) and energy royalty (per kWh) for the duration mentioned in the policy as per the rate fixed by Government of Nepal. The revenue generated through royalty will directly contribute for national development and welfare of people. This is direct impact of high magnitude, national extent and for long duration.

5.2.2.6 Electrification

The generation of the power will expand the door for the expansion of rural electrification program in the project area as well as in different parts of the country. The implementation of the project will provide opportunity for electrification in the wards and settlements of the project municipalities and rural municipalities. Connection of the generated power with integrated national power system (INPS), the area will receive reliable and quality electricity supply. This is direct impact of high magnitude, national extent and for long duration.

5.2.2.7 Potential Reduction in Carbon Emission from Nepal

Nepal is facing power shortage at present and the gap between the demand and supply is managed by operating diesel power plants, importing power from India and scheduling the power supply. The operation of diesel generators not only increases air and noise pollution of the area but also contributes to green house gas emissions. Hydropower is a clean energy and development of hydropower project will replace or minimize the use of diesel powerplants. The use of electricity will also minimize the pressure on forest resources for heating and cooking and reduce the use of fossil fuel thus further reducing green house gas emission in the long run.

Kyoto Protocol (1996) set a binding target for the developed countries to reduce GHG emissions within a certain timeframe. However, irrespective of how environment-friendly they make their industries, the developed countries cannot significantly reduce GHG emissions. In this context, by way of compensation, the developed countries need to pay money to the developing countries for reducing carbon emission. Nepal is also a signatory country of the Kyoto Protocol.

The Forest Users Group community of Nepal already started earning money through carbon credit sales. The first-ever pilot Forest Carbon Trust Fund in Nepal, representatives from three

watersheds in Dolakha, Gorkha, and Chitwan districts received a total sum of US\$ 95,000 on behalf of community forest user groups at a ceremony organised at the International Centre for Integrated Mountain Development (ICIMOD) on 15 June 2011.

First time in Nepal and South Asia, a micro-hydro project has issued carbon credits by displacing diesel fuel with renewable energy. These credits are sold and the revenue helps pay for operation and maintenance of the hydro Project. The large and medium scale hydropower projects especially the pondage run of river and run of river power plants are eligible for carbon trading in long run and country can get benefit from this. The magnitude of impact is considered medium, national/international extent and long term.



Table 5-1: Prioritized value and significance of positive impacts

Table 5-2: Prioritized value and significance of positive impacts																			
S.No.	Activities/Resources	Impacts	Nature of Impact		Weighting for Prioritization of Impacts										Scoring Criteria for Significance Value			Significance of Impacts	Prioritized Impacts
					Magnitude			Extent			Duration			Total Prioritized Value	Importance of Impacts				
5.2 Positive Impacts			D	I	H	M	L	R	L	S	LT	MT	ST		H	M	L		
A. Construction Phase																			
i	Employment generation	Employment of 400 unskilled, semi skilled and skilled human resources	D		60				20				5	85	3			255	H
ii	Enterprises development and commercialization	Increase in economic opportunity due to enterprises development and local products		I		20			20				5	45	3			135	M
iii	Local skills	Increase in skill of local people particularly in tunnel construction, river diversion, heavy equipment operation, masonry, construction of dry walls, gabion walls	D		60				20				5	85	3			255	H
iv	Induced development	Opportunity for emergence of commercial banks, government and non-government organizations, health and educational facilities, and development of market centers		I		20			20		20			60		2		120	M
B. Operation Phase																			
i	Employment generation	Employment opportunity during operation	D		60				20		20			100		2		200	H
ii	Increase in revenue	Project will generate revenue and certain portion of the revenue will be used for local development	D		60				20		20			100	3			300	H
iii	Induced development	Enhance economic opportunity and promote tourism development		I		20		60			20			100			1	100	M
iv	Land value	Land value of Thanti Bazar, Budhabagar, Malika Bazar, Tashi Bazar, Dhaph and Batelmandu will increase		I		20				10	20			50		2		100	M
v	National development	Revenue generated through royalty will directly contribute for national development and welfare of people	D		60			60			20			140	3			420	H
vi	Rural electrification	Generated power will expand the door of rural electrification	D		60			60			20			140	3			420	H
vii	Carbon trading	The project can earn money by carbon trading in long run		I		20		60			20			100		2		200	M

Note: Magnitude Weighting
H= High (60)
M = Medium (20)
L =Low (10)

Extent (Weighting)
R= Regional (60)
L= Local (20)
S= Site specific (10)

Duration
LT= Long Term -20 (20 years and above)
MT= Medium Term -10 (5-10 years)
ST= Short Term - 5(up to 5 years)

Prioritization of Impacts
H= Significance value 200 and above
M= Significance value 100-to below 200
L= Significance value below 100



5.3 Adverse Impacts

The issues related to construction and operation of the project, as identified in ToR, were assessed extensively during the EIA. Based on the analysis of collected qualitative and quantitative data and expert's judgment, the following impacts are identified for the physical, biological, socio-economic and cultural environments of the project.

5.3.1 Physical Environment

5.3.1.1 Pre-Construction Phase

The impacts of construction activities and its related impacts as identified by the study are as follows:

i) Re-Location of foot trails

The cremation sites are located downstream of the dam close to proposed construction yards and contractors camp. Further access trail at right bank will be also affected due to construction of desander basin. The construction of alternatives foot trails will disturb the land use of the particular site. Since the land proposed for construction of new foot trails is within the boundary of project-acquired land, the magnitude of the impact is considered low, site specific and short term.

ii). Increase in air and noise pollution

No significant impact is expected since construction equipment's are not used at this stage. The construction of foot trail will be conducted using local human resources and materials.

5.3.1.2 Construction Phase

i) Topography and Landscape

The topography of the project component site has steep to moderate slope. The construction of the project component roads involves excavation, slope cutting and grading which leads to changes in local topography and disturbs the fragile slopes. Topographical changes are also expected in dam site, settling basin, penstock, quarry and disposal sites. In headworks site earth excavation will be conducted for the foundation works. The topographical change in dam site, muck disposal and quarry site will remain as the permanent change throughout the project life. As changes will be minor compared to the relief distribution in the area, there will not be a negative effect on the land relief pattern. The placement of the surface project structures such as powerhouse, switchyard and facilities in the area will also change the landscape of the site.

The magnitude of impact associated with changes in topography and landscape is low, extent is site specific and for long duration. The impact is direct in nature.

ii) Land Use

Land use changes involved in the implementation of the proposed project will basically be due to the permanent and temporary land acquisition for the project structures and facilities. The project will affect 51.74 ha (35.54 ha permanent and 16.2 ha temporary) land for the placement of project structures and facilities including land required for temporary facilities. Of the total affected land,

The likely increase in air pollution may affect human health particularly of construction site dwellers, travellers, and workers. Since construction work is mostly concentrated at left bank of Budhi Ganga River and some structures are underground the magnitude of impact is considered low. Furthermore, due to topography of the area the generated dust will be confined to the immediate vicinity of the proposed project construction area. The nature of impact is direct, extent is site specific and duration is short term.

Table 5-2: Types of land to be permanently acquired for the project

S.N.	Project Components	Land type (ha)													
		Forest						Cultivated		Barren		River and Flood Plain (Forest land)	Built up/ Residential		Total area
		Gvt	CF	LHF	Rel	Pvt	Govt. ऐलानी)	Pvt.	Gvt	Pvt			Public	Pvt	
1	Reservoir		6.51					1.57				5.35			13.43
2	Dam		0.07									0.43			0.5
	Stilling basin											0.265			0.265
	Settling basin		1.25												1.25
3	Adit		2.47												2.47
4	Powerhouse and tailrace area							3.16							3.16
5	Project component road														0
5.1	Road to headworks		0.35					0.73							1.08
5.2	Road to adit		1.5					4.05							5.55
5.3	Road to powerhouse							2.02							2.015
5.4	Road to surge shaft							2.33							2.325
6	Owners /engineers camp							2.82							2.82
7	Office and camp							0.68							0.68
	Total area		12.15					17.34				6.045			35.545

Table 5-3: Types of land to be temporarily acquired for the project

S.N.	Project Components	Land type (ha)												
		Forest					Cultivated		Barren		River & Flood Plain (Gov.land)	Built up /Residential		Total area
		Gvt.	CF	LHF	Rel.	Pvt.	Gvt. PInfgL	Pvt.	Gvt	Pvt.		Public	Pvt.	

The major impact on the water quality arises when the muck is disposed along the river bank. Three muck disposal sites are proposed at abandoned river terraces at right bank of Budhi Ganga River. Of which two are located between headworks to Ardoli Gad and one is between Ardoli Gad to powerhouse site.

The muck which will essentially come from the underground powerhouse, adit, tunnelling and other excavation works will contribute in increasing the pollution in river water. However, these impacts are temporary in nature and have no permanent effect on surface water. The potential for adverse impacts are nevertheless direct in nature, extent is site specific, moderate magnitude and duration is short term. The river water quality will be affected by any increased total suspended solid (TSS) concentrations and turbidity due to increased erosion and sediment loads into the river system. A decrease in quality and availability of light due to increase in TSS and turbidity is expected particularly at the construction site close to river bank.

Another impact on the water quality will be discharge from the tunnel construction. Tunnel blasting uses large amount of ammonium-nitrate, and if concrete (particularly spray concrete) is used for tunnel tightening, the runoff becomes very alkaline, and react with ammonium to create free ammonia, which is very toxic to fish and other aquatic animals. Runoff from tunnels and spoil rock deposits can thus cause fish kills in periods with low flow.

vi) Land degradation, land stability, landslides and soil erosion

Land degradation is expected at the sites used for temporary facilities such as camp and storage area. Altogether 3.5 ha area of private cultivated land will be taken on lease for construction yards, contractor camps and labor camps. The project will acquire 17.34 ha land for the placement of project structures. The permanent and temporary acquisition of land will affect 62520m³ topsoil.

Furthermore, fuel and lubricants required for various light and heavy vehicles throughout the construction phase will be stored in construction yards taken on lease. There is possibility of leakage of chemicals, fuels and lubricants around the construction and storage areas which will pollute soil thus declining its productivity.

Landslides are not observed at project structures sites. The access road to headworks, powerhouse, surge shaft and adit will require completely new earth works. These activities will produce soil erosion and land instabilities. Impacts in the form of landslides and erosion may occur due to cutting and excavation of the roadbed, on the upslope from barren rock or loosely held conglomerate materials that are variably stable during construction and must be removed sufficiently to provide clear space for the roadbed and working shoulders and to assure stability over the long term period of use. The operation of the quarry and access road particularly during clearing, drilling and preparation of benches may cause suspended particulates consisting primarily of eroded soils from denuded area of the quarry and fine rock particles from the drilling.

Soil erosion may also be accelerated due to use of heavy construction equipment and machinery employed for haphazard slope cutting and toe removal of hills at places where the hill has high slope gradient. Increased load of sediment in downstream rivers and waterways are other consequences of soil erosion during construction. The nature of impact is direct, low magnitude, site specific extent and for short duration.

Leftover construction material such as cement bags, iron bars, used drums containing petroleum products, used tires, refrigerators, air conditioners etc. are the waste that are generated in the project area. Besides these some liquid waste can be produced from constant use of oils, grease, lubricants, paints, cleaning chemicals and other aqueous and oil based materials. The improper disposal of solid and liquid waste may degrade water and soil condition of the area. The impact is direct in nature with low magnitude, site specific extent and for short duration.

x) Quarrying activities

Five Potential quarry sites have been identified that are near the project site. These sites have massive deposition of rock and are characterised by nearly flat surface and gentle stable slopes. The sites are sufficiently far from forests and settlements as well. Budhabagar ($35 \times 10^3 \text{ m}^3$), Ardoli gad ($100 \times 10^3 \text{ m}^3$) Budhi Ganga River Bank ($90 \times 10^3 \text{ m}^3$) Bhimkoti Khola ($80 \times 10^3 \text{ m}^3$) Ikri Gad ($150 \times 10^3 \text{ m}^3$) are the potential quantities available from the quarries. The removal of quarry material will disturb about 2.2 ha river flood plain. The excessive use of sand and boulders may affect the river flow regime and increase flood risk. Since only small quantity of aggregate will be extracted from the proposed quarry sites the likely impacts due to quarrying is low, site specific and for short duration.

xi) River morphology and drainage system

The temporary diversion of river for the construction of intake may affect river morphology in small stretch. Also some aggregate material will be excavated from the Budhi Ganga River. The excessive use of sand and boulders may affect the river flow regime and may have long term impact. The construction of project component road and other surface structures and facilities will affect natural drainage of the area. The magnitude of impact is low, extent is local and short term.

5.3.1.3 Operation Phase

i) Climate and meteorology

The concern regarding the impacts of dams and reservoirs projects on local climate is microclimate changes. The significance of this change is related to the surface area and volume of the reservoir and to the prevailing climatic conditions in the area. As the storage capacity of the reservoir is 1.05 Mm^3 and the surface area is only 13.34 ha the impact on micro climate will be low and it will not lead to a significant change in the climate of the area or the region.

But there might be slight increase in the ambient temperature due to the reduced flow in the 6.87 km stretch between dam and powerhouse tailrace during the operation phase. Since two major tributaries are joining Budhi Ganga River and reservoir is small and daily fluctuation in water level the impact on climate due to the operation of the project will be low in magnitude, local and for long duration.

ii) Hydrology

The reservoir levels for normal operation of the Dam were established considering storage requirements for 6 hours' daily peaking in the dry months. The full supply level (FSL) and the minimum operating level (MOL) of the reservoir are fixed at 718 masl and 712 masl, respectively. These levels will result in an active pondage volume of 1.05 Mm^3 for daily plant peaking. The

downstream. The magnitude of impact on hydrology and sedimentation is moderate, local in extent and long duration. The nature of impact is direct.

iii) Water quality

The chemical, thermal and physical changes which flowing water undergoes when it is stilled can contaminate a reservoir and the river downstream. The extent of deterioration in water quality is in general related to the retention time of the reservoir and its storage capacity in relation to the amount of water flowing into it. During the first years after a reservoir is filled the decomposition of submerged vegetation and soils can deplete the level of oxygen in the water. Rotting organic matter can also lead to releases of greenhouse gases methane and carbon dioxide.

The BHP project is envisaged as a peaking run of the river scheme, with significant diurnal variations in reservoir water level. In such a scenario, significant re-aeration from natural atmosphere takes place, which maintains Dissolved Oxygen in the water body. Thus, in the proposed project, the reduction in DO level in reservoir water is at minimum level.

The project will have a small impoundment resulting in low potential of thermal stratification and loss of dissolved oxygen. Fertilizer use in the project area is negligible, hence, the runoff at present does not contain significant amounts of nutrients. Even in the post-project phase, use of fertilizers in the project catchment area is not expected to rise significantly. Another factor to be considered that the proposed project is envisaged as a peaking run off the river scheme, with significant diurnal variations in reservoir water level. Thus, in project operation phase, problems of eutrophication are considered to be low in magnitude, site specific and for long duration.

However, there might be slight increase in river water temperature in reduced flow stretch due to the decrease in water volume. The impact is direct in nature with low magnitude, site specific extent and for long duration.

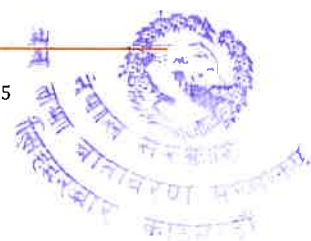
iv) Waste disposal

The waste generated from the operation and maintenance of the power plant will be mostly domestic waste along with little maintenance waste. Inappropriate disposal of degradable (food items and other organic material) and non-degradable (Glass, plastics, rubber, metals) solid waste may create eyesore and pollute air, water and soil quality of the area.

Since the number of employees during operation phase is limited (45) and maintenance work have limited waste material the magnitude of impact due to waste disposal is low, direct in nature, extent is site specific and of long duration.

v) River morphology and drainage pattern

The operation of Budhi Ganga Hydropower Project will divert on average 92.23 % water for 7 months and 34.55 % water in five monsoon months (June – October). The diversion of water will change the flow regime of Budhi Ganga River between headworks and powerhouse, a distance of 6.87km. The diverted water will be release at powerhouse tailrace which will change the flow pattern of the river further downstream. The sediment deposited in settling basin will be flushed annually which will also affect the flow pattern downstream of the weir. The placement of surface project structure and facilities and project road will have long term impact on natural drainage pattern. The magnitude of impact is low extent, site specific and for the long duration.



5.3 Adverse Impacts

The issues related to construction and operation of the project, as identified in ToR, were assessed extensively during the EIA. Based on the analysis of collected qualitative and quantitative data and expert's judgment, the following impacts are identified for the physical, biological, socio-economic and cultural environments of the project.

5.3.1 Physical Environment

5.3.1.1 Pre-Construction Phase

The impacts of construction activities and its related impacts as identified by the study are as follows:

i) Re-Location of foot trails

The cremation sites are located downstream of the dam close to proposed construction yards and contractors camp. Further access trail at right bank will be also affected due to construction of desander basin. The construction of alternatives foot trails will disturb the land use of the particular site. Since the land proposed for construction of new foot trails is within the boundary of project-acquired land, the magnitude of the impact is considered low, site specific and short term.

ii). Increase in air and noise pollution

No significant impact is expected since construction equipment's are not used at this stage. The construction of foot trail will be conducted using local human resources and materials.

5.3.1.2 Construction Phase

i) Topography and Landscape

The topography of the project component site has steep to moderate slope. The construction of the project component roads involves excavation, slope cutting and grading which leads to changes in local topography and disturbs the fragile slopes. Topographical changes are also expected in dam site, settling basin, penstock, quarry and disposal sites. In headworks site earth excavation will be conducted for the foundation works. The topographical change in dam site, muck disposal and quarry site will remain as the permanent change throughout the project life. As changes will be minor compared to the relief distribution in the area, there will not be a negative effect on the land relief pattern. The placement of the surface project structures such as powerhouse, switchyard and facilities in the area will also change the landscape of the site.

The magnitude of impact associated with changes in topography and landscape is low, extent is site specific and for long duration. The impact is direct in nature.

ii) Land Use

Land use changes involved in the implementation of the proposed project will basically be due to the permanent and temporary land acquisition for the project structures and facilities. The project will affect 51.74 ha (35.54 ha permanent and 16.2 ha temporary) land for the placement of project structures and facilities including land required for temporary facilities. Of the total affected land,

20.84 ha (40.28%) is cultivated, 12.15 ha (23.49%) is forest, 5 ha (9.66%) is barren land and river and flood plain is 13.75ha (26.57%).

The project will permanently acquire 35.54 ha land for the placement of project structures and permanent facilities such as reservoir, dam, powerhouse, owners and engineers camp, project component road and adit area. Besides this, 16.2 ha land will be taken on lease for temporary facilities such as construction yards, temporary camps, spoil deposits, quarry areas and crushing plant site. The construction of surface project structures and permanent facilities such as dam, reservoir, powerhouse, owners and engineers camp, project component road and adit area will change the existing land use condition of the affected site forever. It includes 12.15ha forest area and 17.34 ha cultivated land (Table 6-2). The reservoir pondage will cover an area of 13.43 ha mainly consisting of forest land (6.51ha) river and flood plain (5.35ha) and cultivated land (1.57 ha). The agricultural and forest land area occupied permanently (29.49 ha) will have a permanent land use change. These areas will be converted into structural sites and water body. The permanent land use changes will result in permanent loss of production resource base particularly of cultivated land and forest.

Land use will also be temporarily affected (16.2 ha) for the construction of project facilities such as contractor camps, construction yards, and disposal area (Table 6-2). Land use change is not expected in quarry site and crushing plant site. The magnitude of impact is moderate, extent is site specific and duration is long term. The impact is direct in nature.

iii) Changes in Air Quality

The impact on ambient air quality will be generated from activities such as blasting, quarrying, excavation, site clearance especially at the project component road, headworks, powerhouse, camps, muck disposal and emissions from vehicles, construction equipment, crushing plant and generators.

Dust levels may slightly increase during construction of project components. Emission levels of pollutants like SPM, SO₂ and NO_x etc. may temporarily rise due to increased vehicular movement, and operation of construction machinery. The operation of various construction equipment requires combustion of fuel. Normally, diesel is used in such equipment. The major pollutant which gets emitted because of combustion of diesel is SO₂.

The operation of the crusher during the construction phase is likely to generate fugitive emissions, which can move even up to 1 km in predominant wind direction. During crushing operations, fugitive emissions comprising mainly the suspended particulate will be generated. The Budhabagar and Thapagaun settlements located close to headworks and powerhouse area will be affected by the construction activities.

The movement of wheel loaders, trippers, trucks and light vehicles will be high between headworks to powerhouse site. Similarly, there will be increased traffic movement because of disposal of muck or construction waste at the dumping site. Large quantity of dust is likely to be entrained due to the movement of trucks and other heavy vehicles and construction equipment. Due to the continual movement of vehicles marginal increase in hydrocarbons, SO₂ and NO_x levels are anticipated for a short duration.



The other potential impact on air quality is unpleasant odour due to improper management of sewerage and solid waste and indoor smoke pollution due to cooking activities. The fugitive dust pollution will be more acute during the dry season compared to the wet months during the construction phase.

The likely increase in air pollution may affect human health particularly of construction site dwellers, travellers, and workers. Since construction work is mostly concentrated at left bank of Budhi Ganga River and some structures are underground the magnitude of impact is considered low. Furthermore, due to topography of the area the generated dust will be confined to the immediate vicinity of the proposed project construction area. The nature of impact is direct, extent is site specific and duration is short term.

Table 5-2: Types of land to be permanently acquired for the project

S.N.	Project Components	Land type (ha)												
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		Gvt	CF	LHF	Rel	Pvt	Govt. (ऐलानी)	Pvt.	Gvt	Pvt		Public	Pvt	
1	Reservoir		6.51					1.57			5.35			13.43
2	Dam		0.07								0.43			0.5
	Stilling basin										0.265			0.265
	Settling basin		1.25											1.25
3	Adit		2.47											2.47
4	Powerhouse and tailrace area							3.16						3.16
5	Project component road													0
5.1	Road to headworks		0.35					0.73						1.08
5.2	Road to adit		1.5					4.05						5.55
5.3	Road to powerhouse							2.02						2.015
5.4	Road to surge shaft							2.33						2.325
6	Owners /engineers camp							2.82						2.82
7	Office and camp							0.68						0.68
	Total area		12.15					17.34			6.045			35.545

Table 5-3: Types of land to be temporarily acquired for the project

S.N.	Project Components	Land type (ha)												
		Forest					Cultivated		Barren		River & Flood Plain (Gov.land)	Built up /Residential		Total area
		Gvt.	CF	LHF	Rel.	Pvt.	Govt. P]nfgL_	Pvt.	Gvt	Pvt.		Public	Pvt.	

1	Construction yard						1.5		0.5				2
2	Disposal area							0.5	2	5.5			8
3	Quarry area									2.2			2.2
4	Contractor and labor camps						2						2
5	Crushing plant								2				2
	Total area						3.5	0.5	4.5	7.7			16.2

iv) Noise and vibration

Tunnel drilling, blasting, vehicular traffic, crushing plants, operation of various machinery and diesel engines and generators are the primary sources of noise generation in the project construction sites. The probable noise level due to accumulated effect of noise generating sources at the project construction sites will range between 70 dB(A) to 85 dB(A). The noise impact is temporary in nature and will quickly dissipate.

The impact due to blasting will be felt especially by the local inhabitants of Budhabagar settlement located close to headworks and Thapagaun settlement close to powerhouse and associated structures. The overall impact due to blasting operations will be restricted well below the surface and no major impacts are envisaged at the ground level.

Noise levels in the construction area from machinery and vehicles are estimated to be from 80 to 95 dB (A) at a distance of 15 m from the project site, which is higher than the WHO Standards of 75 dB (A). The effect of high noise levels on the operating personnel must be considered as this may be particularly harmful. It is known that continuous exposures to high noise levels above 90 dB (A) affects the hearing acuity of the workers/operators and hence, should be avoided. The increase in ambient noise levels will have pronounced impacts on Budhabagar settlement located close to headworks and Thapagaun settlements located near noise sources. Noise generated by blasting is instantaneous, site specific and depends on type, quantity of explosives, dimension of drill hole, degree of compaction of explosives in the hole and rock. It has been observed and recorded from various construction sites in Nepal that noise level due to blasting period (peak) are expected to be of the order of 100 – 140 dB(A). As the blasting is likely to last for 4 to 5 seconds depending on the charge, noise levels over this time would be instantaneous and short in duration. Hence, the impact of noise level due to blasting and operation of equipment's will be low in magnitude, site specific and short term.

v) Water quality

During the construction phase, surface water may get polluted due to the generation of waste water (sewage) coming from office, sanitary effluents from the construction worker's camp, oil and chemical spills, dynamite residue and leaching of ammonia and nitrogen from the tunnel blasting and spoil rock deposits, and inflow of large quantities of suspended particulate matter from excavated soil, stone crusher sites and construction material if left unchecked. Potential uncontrolled spillage of petrochemicals, oils, paints, cement slurry and hazardous substances may have adverse impacts on the river water quality which will increase during the dry season. There will be a temporary increase in the turbidity and sediment content of the river due to unavoidable disturbance of river beds and banks and likely accidental spills of sediment producing material in the river. The impacts will be felt more during the dry season.

The major impact on the water quality arises when the muck is disposed along the river bank. Three muck disposal sites are proposed at abandoned river terraces at right bank of Budhi Ganga River. Of which two are located between headworks to Ardoli Gad and one is between Ardoli Gad to powerhouse site.

The muck which will essentially come from the underground powerhouse, adit, tunnelling and other excavation works will contribute in increasing the pollution in river water. However, these impacts are temporary in nature and have no permanent effect on surface water. The potential for adverse impacts are nevertheless direct in nature, extent is site specific, moderate magnitude and duration is short term. The river water quality will be affected by any increased total suspended solid (TSS) concentrations and turbidity due to increased erosion and sediment loads into the river system. A decrease in quality and availability of light due to increase in TSS and turbidity is expected particularly at the construction site close to river bank.

Another impact on the water quality will be discharge from the tunnel construction. Tunnel blasting uses large amount of ammonium-nitrate, and if concrete (particularly spray concrete) is used for tunnel tightening, the runoff becomes very alkaline, and react with ammonium to create free ammonia, which is very toxic to fish and other aquatic animals. Runoff from tunnels and spoil rock deposits can thus cause fish kills in periods with low flow.

vi) Land degradation, land stability, landslides and soil erosion

Land degradation is expected at the sites used for temporary facilities such as camp and storage area. Altogether 3.5 ha area of private cultivated land will be taken on lease for construction yards, contractor camps and labor camps. The project will acquire 17.34 ha land for the placement of project structures. The permanent and temporary acquisition of land will affect 62520m³ topsoil.

Furthermore, fuel and lubricants required for various light and heavy vehicles throughout the construction phase will be stored in construction yards taken on lease. There is possibility of leakage of chemicals, fuels and lubricants around the construction and storage areas which will pollute soil thus declining its productivity.

Landslides are not observed at project structures sites. The access road to headworks, powerhouse, surge shaft and adit will require completely new earth works. These activities will produce soil erosion and land instabilities. Impacts in the form of landslides and erosion may occur due to cutting and excavation of the roadbed, on the upslope from barren rock or loosely held conglomerate materials that are variably stable during construction and must be removed sufficiently to provide clear space for the roadbed and working shoulders and to assure stability over the long term period of use. The operation of the quarry and access road particularly during clearing, drilling and preparation of benches may cause suspended particulates consisting primarily of eroded soils from denuded area of the quarry and fine rock particles from the drilling.

Soil erosion may also be accelerated due to use of heavy construction equipment and machinery employed for haphazard slope cutting and toe removal of hills at places where the hill has high slope gradient. Increased load of sediment in downstream rivers and waterways are other consequences of soil erosion during construction. The nature of impact is direct, low magnitude, site specific extent and for short duration.

vii) Construction material and camp sites

The construction materials which include concrete, cement, sand, steel reinforcement bars, brick and electrical and mechanical equipment that shall be stored for timely completion of the project. The project will also store blasting materials and petrochemicals consisting of lubricating oil, engine oil and diesel required for the project construction. These materials will be stored in the temporary land taken on lease for the storage facilities.

Some of the above-mentioned materials such as cement and petrochemicals if not managed and stored properly will have detrimental effect on water and land. The project dynamite may use for fishing and other illegal activities if not properly controlled and managed.

The construction material required for project component road construction is generally stock piled near by construction sites. Stock piling of these materials is likely to occupy the land throughout the construction period. The common problems from inappropriate stockpiling of construction materials are contamination of water bodies, gully formation and erosion, especially when combined with unmanaged surface water runoff. Disruption of natural drainage pattern can cause scouring, erosion and landslides. It will also increase air pollution if uncovered. The impact is both direct and indirect in nature with low magnitude, site specific extent and for short duration.

viii) Spoil disposal

Excavation work for dam, desander, headrace tunnel, surge shaft, vertical shaft and underground powerhouse would generate spoil material (4, 54,500 m³ spoil material). Out of this, 30% (1,36,350 m³) will be used as aggregate and remaining 318,150 m³ spoil material will be disposed off at pre-identified, designated three muck disposal areas located at right bank of Budhi Ganga River.

The main potential impacts associated with spoil disposal are increase in the turbidity and sediment of river water. As the topography of the project site is narrow and steep there is a possibility of washing away of loose muck into the main river. Furthermore, most of the dumping sites are located along the banks of the river which further increases the possibility of washing away of loose muck into the main river, which may cause adverse impacts on the aquatic ecosystem and water quality of the river.

The impact due to spoil disposal will be both direct and indirect in nature, moderate in magnitude, site specific and short termed in duration.

ix) Disposal of solid waste

Two types of solid waste that will be generated by the project is domestic waste and construction waste. The amount of domestic waste generated will depend on the number of people working in the project and more important the number of people who temporarily migrate to the project area during construction including construction crew and members of their families. The project will require 300 personnel during peak construction period. Considering 50% work force outside the area, 150 kg (assuming 1kg waste per person for 150 people) of waste per day will be produced during construction period. The domestic waste will primarily consist of organic food and biodegradable if properly managed.

Leftover construction material such as cement bags, iron bars, used drums containing petroleum products, used tires, refrigerators, air conditioners etc. are the waste that are generated in the project area. Besides these some liquid waste can be produced from constant use of oils, grease, lubricants, paints, cleaning chemicals and other aqueous and oil based materials. The improper disposal of solid and liquid waste may degrade water and soil condition of the area. The impact is direct in nature with low magnitude, site specific extent and for short duration.

x) Quarrying activities

Five Potential quarry sites have been identified that are near the project site. These sites have massive deposition of rock and are characterised by nearly flat surface and gentle stable slopes. The sites are sufficiently far from forests and settlements as well. Budhabagar ($35 \times 10^3 \text{ m}^3$), Ardoli gad ($100 \times 10^3 \text{ m}^3$) Budhi Ganga River Bank ($90 \times 10^3 \text{ m}^3$) Bhimkoti Khola ($80 \times 10^3 \text{ m}^3$) Ikri Gad ($150 \times 10^3 \text{ m}^3$) are the potential quantities available from the quarries. The removal of quarry material will disturb about 2.2 ha river flood plain. The excessive use of sand and boulders may affect the river flow regime and increase flood risk. Since only small quantity of aggregate will be extracted from the proposed quarry sites the likely impacts due to quarrying is low, site specific and for short duration.

xi) River morphology and drainage system

The temporary diversion of river for the construction of intake may affect river morphology in small stretch. Also some aggregate material will be excavated from the Budhi Ganga River. The excessive use of sand and boulders may affect the river flow regime and may have long term impact. The construction of project component road and other surface structures and facilities will affect natural drainage of the area. The magnitude of impact is low, extent is local and short term.

5.3.1.3 Operation Phase

i) Climate and meteorology

The concern regarding the impacts of dams and reservoirs projects on local climate is microclimate changes. The significance of this change is related to the surface area and volume of the reservoir and to the prevailing climatic conditions in the area. As the storage capacity of the reservoir is 1.05 Mm^3 and the surface area is only 13.34 ha the impact on micro climate will be low and it will not lead to a significant change in the climate of the area or the region.

But there might be slight increase in the ambient temperature due to the reduced flow in the 6.87 km stretch between dam and powerhouse tailrace during the operation phase. Since two major tributaries are joining Budhi Ganga River and reservoir is small and daily fluctuation in water level the impact on climate due to the operation of the project will be low in magnitude, local and for long duration.

ii) Hydrology

The reservoir levels for normal operation of the Dam were established considering storage requirements for 6 hours' daily peaking in the dry months. The full supply level (FSL) and the minimum operating level (MOL) of the reservoir are fixed at 718 masl and 712 masl, respectively. These levels will result in an active pondage volume of 1.05 Mm^3 for daily plant peaking. The

pondage will extend up to 2.06 km upstream of the dam axis and will cover an area of 13.43ha. Due to the formation of pondage shoreline erosion and bank cutting due to seepage can be anticipated along the river. The lower terraces land located upstream of the dam on the right bank of Budhi Ganga River will be affected by the submergence. The maximum 6m daily fluctuation of the water level will trigger erosion activities in fragile and unstable areas. The impact is direct in nature with low magnitude, site specific extent and for long duration.

The creation of a reservoir will bring alterations in physical, abiotic and biotic parameters both upstream and downstream of the proposed dam site. The construction of dam will permanently change fast flowing river habitat to a lake environment.

The power plant will be operated in the following mode: 6 hours daily peaking during dry season and 24 hours operation at full capacity in wet season (June – October). Peaking will cause daily fluctuations in flow and water levels in the river downstream of the power station outlet. The magnitude of water level fluctuations will vary along the river, depending on the actual cross-sections at different locations. In addition, the daily water level variations will depend on the size of the turbine flow each day, and to some extent on the general flow situation in the river. The impact on river hydrology has been discussed below considering the dry and wet season.

Non-peaking Operation

During the dry season, flow in the Budhi Ganga River downstream of the dam will change from the natural minimum monthly flow (January) of 9.9 m³/s to 0.99 m³/s along with contribution of downstream tributaries during non-peaking hours. Around 0.51 m³/s water will be contributed during dry period from the downstream tributaries between headworks and powerhouse site.

The reduction in flow rate of river especially during lean period is likely to increase turbidity levels downstream of the dam. Further reduction in rate of flow may even create condition of semi-desiccation in certain stretches of the river. This will have adverse impact especially on the benthic ecosystem.

The rapid variation of flow in the river section from peaking hours (26 m³/s plus 1.5 m³/s) to off-peaking hours (0.99 m³/s in 3 km and 1.5 m³/s 3.8km section) during the dry season will have adverse impacts on river hydrology. During the low flow period the flow variations will become significant, becoming even more so within months when the plant may be operated only during peak hours.

Peaking Operation

The flow downstream of the tailrace outlet will fluctuate in a manner dictated by the daily pondage filling and peaking operations. The turbines will be operated at full capacity only during peak hours (6hours) and will release 26 m³/s downstream to tailrace during peaking hours in driest month. During the dry period the pre-project flow at powerhouse is 10.41 m³/s (January) and will increase to 27.5 m³/s during peaking hours. While during the monsoon there will be no changes in flow pattern at powerhouse tailrace. However, the flow will be reduced in 6.8 km river section after diversion of the river water for power generation.

The scouring of the river banks to some extent is expected immediately after the tailrace due to flow of sediment free high velocity discharge. The effect of scouring will gradually diminish



downstream. The magnitude of impact on hydrology and sedimentation is moderate, local in extent and long duration. The nature of impact is direct.

iii) Water quality

The chemical, thermal and physical changes which flowing water undergoes when it is stilled can contaminate a reservoir and the river downstream. The extent of deterioration in water quality is in general related to the retention time of the reservoir and its storage capacity in relation to the amount of water flowing into it. During the first years after a reservoir is filled the decomposition of submerged vegetation and soils can deplete the level of oxygen in the water. Rotting organic matter can also lead to releases of greenhouse gases methane and carbon dioxide.

The BHP project is envisaged as a peaking run of the river scheme, with significant diurnal variations in reservoir water level. In such a scenario, significant re-aeration from natural atmosphere takes place, which maintains Dissolved Oxygen in the water body. Thus, in the proposed project, the reduction in DO level in reservoir water is at minimum level.

The project will have a small impoundment resulting in low potential of thermal stratification and loss of dissolved oxygen. Fertilizer use in the project area is negligible, hence, the runoff at present does not contain significant amounts of nutrients. Even in the post-project phase, use of fertilizers in the project catchment area is not expected to rise significantly. Another factor to be considered that the proposed project is envisaged as a peaking run off the river scheme, with significant diurnal variations in reservoir water level. Thus, in project operation phase, problems of eutrophication are considered to be low in magnitude, site specific and for long duration.

However, there might be slight increase in river water temperature in reduced flow stretch due to the decrease in water volume. The impact is direct in nature with low magnitude, site specific extent and for long duration.

iv) Waste disposal

The waste generated from the operation and maintenance of the power plant will be mostly domestic waste along with little maintenance waste. Inappropriate disposal of degradable (food items and other organic material) and non-degradable (Glass, plastics, rubber, metals) solid waste may create eyesore and pollute air, water and soil quality of the area.

Since the number of employees during operation phase is limited (45) and maintenance work have limited waste material the magnitude of impact due to waste disposal is low, direct in nature, extent is site specific and of long duration.

v) River morphology and drainage pattern

The operation of Budhi Ganga Hydropower Project will divert on average 92.23 % water for 7 months and 34.55 % water in five monsoon months (June – October). The diversion of water will change the flow regime of Budhi Ganga River between headworks and powerhouse, a distance of 6.87km. The diverted water will be release at powerhouse tailrace which will change the flow pattern of the river further downstream. The sediment deposited in settling basin will be flushed annually which will also affect the flow pattern downstream of the weir. The placement of surface project structure and facilities and project road will have long term impact on natural drainage pattern. The magnitude of impact is low extent, site specific and for the long duration.



vi) Seismicity

Nepal has experienced several large earthquakes over the past several years, which has caused substantial damage to property and life. As a result all hydropower projects in Nepal are in general vulnerable to some degree of seismic risk. However, considering that the project is a peaking run - of - river type of project with low height dam the impact due to seismicity is considered to be low in magnitude, local and for long term.

vii) Dam failure and associated hazards

There isn't any structure that is fully protected against all types of adversaries. Any structure is potentially at risk of failure. Such failures are more potent in case of water resource management related structures because water resource projects are always based on probability based calculations as in the present case.

The failure of Dam will result in downstream flooding and the magnitude of flood shall depend upon the type of dam failure and time of the year. A sudden dam outbreak will result in a heavy flash flood while a relatively slower failure of dam will result into a moderate to low downstream flood.

Similarly, a failure at a time when the water in dam is in its full capacity (crest level) i.e. around the end of monsoon will result in heavier flood while a failure at a time when there is water level in the dam is about in lowest level i.e. during the time of onset of monsoon, shall result almost no flood downstream.

In worst case, if the dam fails suddenly while the water in the dam is in its crest level, the impact shall be highest. Since settlements like Thapaguan, Budhbagar and Sanfebagar are at lower altitude the impacts of dam break on the human life and property are expected to be high long term and regional.

Table 5-4: Prioritized value and significance of physical environment impacts

S.N.	Activities/Resources	Impacts	Nature of Impact		Weightingfor Prioritization of Impacts										Scoring Criteria for Significance Value			Significance of Impacts	Prioritized Impacts
					Magnitude			Extent			Duration			Total Prioritized Value	Importance of Impacts				
			D	I	H	M	L	R	L	S	LT	MT	ST		H	M	L		
5.3.1 Physical Environment																			
5.3.1.1 Pre- Construction Phase																			
I	Relocation of foot trail	Disturbance to foot trails at headworks area due to construction of desander and road to dam	D				10			10	20			40			1	40	L
5.3.1.2 Construction Phase																			
I	Topography and landscape	Excavation grading and filling activities will affect topography of the area especially the dam, desander basin, penstock area etc.	D				10			10	20			40			1	40	L
II	Land use pattern	Changes in 51.74 ha land use	D			20				10	20			50		2		100	M
III	Air quality	Likely increase in concentration of pollutants such as SO2and NO2	D				10			10			5	25			1	25	L
IV	Noise and vibration	Likely increase in ambient noise level and vibration	D				10			10			5	25			1	25	L
V	Water quality	Likely increase in river turbidity, sedimentation and pollution by petrochemicals, cement washed out and spoil disposal	D			20				10			5	35	3			105	M
VI	Land degradation, land stability, landslide and soil erosion	Degradation in quality of land especially the land used for concrete batching plant, storage, crushing plant and disposal sitesincrease in landslides and surface erosion especially on the fragile and critical areas.	D				10			10			5	25			1	25	L
VII	Construction material and camp	The storage of petrochemical, cement may affect land and water quality. Dynamite may be used for fishing and other illegal activities if not properly managed	D	I			10			10			5	25			1	25	L
VIII	Spoil disposal	Destruction of productive land and increase in river turbidity	D	I		20				10			5	35	3			105	M
IX	Waste disposal	Deterioration of water quality, unpleasant odor and visual impact	D	I		20				10			5	35		2		70	L
X	Quarry site and burrow area	Likely impact on river flow regime, increase in flood risk.	D	I			10			10			5	25			1	25	L
XI	River morphology	Temporary diversion of river, removal of boulders for quarry and construction of surface structure may change the river flow regime and natural drainage	D	I			10			10	20			40			1	40	L
5.3.1.3 Operation Phase																			
I	Climate and meteorology	Likely increase in water temperature in 6.8 km reduced flow stretch and impact associated with reservoir fluctuation		I			10		20		20			50			1	50	L
II	Hydrology	Flow variation in peaking and non peaking operation and changes in flow regime below powerhouse tailrace	D			20				10	20			50		2		100	M
III	Water quality	Changes in water quality parameters in reservoir and reduced flow area	D				10			10	20			40		2		80	L
IV	Waste disposal	Disposal of degradable and non-degradable waste may create eyesore and pollute air, water and soil.	D				10			10	20			40			1	40	L
V	River morphology and drainage pattern	Operation of Project will divert in average 92.23 % water for 7 months and 34.55 % water in five monsoon months which will change the flow regime of River. Flushing of desander will also affect the river morphology and construction of surface structure may affect the drainage pattern of the area.	D				10			10	20			40			1	40	L
VI	Seismicity	Seismic risk to dam		I			10	60			20			90		2		180	M
VII	Dam failure	Likely impact on dam and other project structures due to earthquakes, high flood etc.			60			60			20			140	3			420	H

Note: Magnitude Weighting

Extent (Weighting)

Duration

5.3.2 Biological Environment

5.3.2.1 Terrestrial Environment

1. Vegetation/Forest Resources

A. Pre-Construction Phase

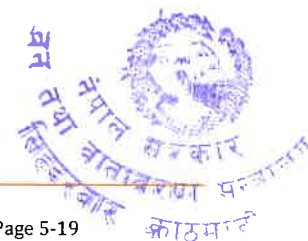
i) Acquisition of forest land

The forest area is calculated only for the surface structures since no impact is expected from underground structures. The project will acquire 18.20 ha forest land consisting 12.15 ha forest cover with tree and bushes belonging to community forest and 6.05 ha river and flood plain connected with forest (Table 5-5). The nature of impact is direct, moderate magnitude, site specific and long term.

Table 5-5: Forest area acquired by the project

SN	Project Component	Types of Forest Area (as per Forest Act)	Forest Area (ha)	Loss of vegetation			Crown Cover (%)	Basal Area (%)	Vegetation Type
				Seedling / ha.	Saplings / ha.	No. of trees >10cm DBH /ha			
1	Reservoir	Juke and Rakshe CF of Achham and Jukeban Lamkana CF of Bajura district	6.51	930	583	591.3	5-45	0.023 - 0.3988	Sal, Malato, Mauwa, Sindure Khirro, Kokkade, Badkaulo, Bhalayo, Daar, Amala, Saaj
2	Headworks								
a	Dam	Rakshe CF and Juke CF	0.07	280	150	25	20	0.015	Malato, Khirro,
b	Settling Basin	Juke CF	1.25	117	16	216.66	20	0.0265	Khirro, Pahadi Mauwa, Faledo, Malato, Rohini, Ghangharu
c	Road to headworks	Rakshe CF	0.35	467	117	150	25	0.0676	Kalo Siris, Khirro, Kokkade, Sindure
3	Adit	Imiltukra CF	2.47	303	469	1089.66	5-40	0.14- 0.25	Saal, Malato, Mayal, Khirro, Uttis
4	Road to adit	Imiltukra CF and Sukethana	1.5	544	352	240	5	0.1073	Malato, Mayal, Uttis, Saal
	Total		12.15						

Source: Field survey 2018



ii) Loss of vegetation

The vegetation of the project site will be affected due to site clearance for the placement of project structures and facilities. Altogether 4,809 standing trees of 16 species (> 10 cm dbh) will be felled due to site clearance. Among them, pole size (10 – 30 cm dbh) and mature trees (> 30 cm dbh) are 4,481 and 328 respectively (Volume II, Appendix: D). There will be loss of 7948 seedlings and 5553 saplings due to implementation of the project. The total estimated loss of wood volume is 831.03m³. The estimated loss of fuel wood (Chatta) is 58.61 and loss of biomass (wet and dry) for standing tree is 648,203 kg. The loss of forest is comparatively more in reservoir area. The nature of impact is direct, moderate magnitude, site specific and long term.

iii) Loss of floral diversity

Altogether 16 species of plants will be affected by loss of vegetation due to site clearance for the placement of project structure and facilities (Table 5-6). Among them Sal is the highly affected species contributing 51.15% (2,460) of the total tree loss, followed by Sindure 11.08% (533) and Malato 6.34% (305). A total of 60 Simal trees of pole size will be felled due to implementation of the project. The nature of impact is direct, low magnitude, site specific and long term.

Table 5-6: Forest loss in terms of plant species

S.N.	Botanical Name	Local Name	Loss of Tree(Number)			
			Pole Class	Tree Class	Total	%
1	Macaranga pustulata	Malato	213	92	305	6.34
2	Englehardtia spicata	Pahadi Mauwa	237	0	237	4.93
3	Toona ciliata	Tooni	59	0	59	1.23
4	Mallotus philippinensis	Sindure	533	0	533	11.08
5	Sapium insigne	Khirro	296	0	296	6.16
6	Shorea robusta	Saal	2342	118	2460	51.15
7	Homalium nepalense	Kokkade	148	0	148	3.08
8	Rhus sp.	Bhalayo	30	0	30	0.62
9	Bombax ceiba	Simal	60	0	60	1.25
10	Boehmeria rugulosa	Daar	59	0	59	1.23
11	Garuga pinnata	Dabdbe	59	0	59	1.23
12	Erythrina sp.	Phaledo	30	0	30	0.62
13	Pyracantha crenulata	Ghangharu	30	0	30	0.62
14	Albizzia lebbeck	Siris	30	59	89	1.85
15	Pyrus pashia	Mayal	118	0	118	2.45
16	Alnus nepalensis	Uttis	237	59	296	6.16
			4481	328	4809	100

Source: Field Survey 2018

iv) Impact on rare, endangered and protected species

There are no species that are listed as threatened, endangered, vulnerable and protected plant category of Government of Nepal. Sal is highly affected species contributing 51.15% of the total tree loss. This species is banned for felling, transport and export for the commercial purpose. The nature of impact is direct, moderate magnitude, site specific and long term.



v) Reduction in available forest

The construction of dam and reservoir, adit, project component roads (headworks and adit site) will clear 12.15ha forest area for the implementation of the project. The loss of forest due to placement of project structures and facilities will reduce the available habitat and affect natural habitat of some wild mammals and birds. The reservoir will submerge 6.51 ha forested area. The submerge forest area will permanently change from forested habitat to aquatic habitat which will reduce the available habitat. Since forest area affected by the project is minimal in comparison to available forest area near the project site and the wildlife reported from the area are widely distributed in nearby forest areas, the impact on wildlife in terms of habitat loss is low. As mentioned in baseline description, project sites are not connected with dense forest and vegetation are found fragmented due to presence of settlements like Selgaun, Rithatoli, Paati, Toligaun, KunwarTole, Baddakhet, Moudali, Mathisiun, Talisiun and Thapagaun the impacts associated with discontinuation of habitat due to project activity is not expected. The nature of impact is direct, moderate magnitude, site specific and long term.

B. Construction Phase**i) Loss of vegetation**

The impact associated with acquisition of 12.15 ha forest land covered with tree and bushes, removal of 4809 standing trees of 16 species (> 10 cm dbh) consisting 4481 pole size (10-30 cm dbh) and 328 mature trees (> 30 cm dbh) loss of 831.03 m³ wood volume, 58.61 fuel wood Chatta and 648203 kg of biomass loss (wet and dry) for standing tree will be continued during construction phase also. Fodder and fruits (Jamun) are the direct products lost due to loss of vegetation. The nature of impact is direct, moderate magnitude, site specific and long term.

ii) Increased access to forests of the surrounding area and markets

Forests are the habitats and nutritional bases for many animals and birds. Such vegetated environment maintains the natural balance by checking soil erosion, reducing noise, regulating hydrological cycle, etc. Construction workers will have easier access to enter nearby forest and surrounding areas as they reside nearby. Increased easy access to the forests and vegetated area to the construction workers, staff and local residents may lead to the cutting and collection of firewood, increase the risk of forest fire, illegal trading of NTFPs, hunting and poaching of wild animals and birds and thus reduce the beneficial effects of the forest ecosystem.

The Sanfe-Martadi road is providing road access for the area which is not connected to the settlements located left side of Budhi Ganga River. The construction of access to headworks and powerhouse will link the settlements of left bank to road head and further to nearby market centers such as Budhabagar, Tansi Bazar, Thanti Bazar and Sanfebagar. The illegal harvest of Sal and other important wood may increase in immediate vicinity of the project. Since road access is limited to project component only the magnitude of impact is considered to be low; extent is site specific and long term in nature.

iii) Increased demand for firewood and timber

During the construction period there will be large numbers of laborers and other work forces and they need firewood in large quantities for cooking and heating purposes. Altogether 75 skilled, 150 semi skilled and 175 unskilled personnel will be involved in the construction of the project over 4 years. The unskilled personnel may use firewood for cooking. Considering 50% human

resources outside the area about 87 personnel may depend on forest resources. Assuming 5 kg of firewood per day for a group of 5 people for cooking purpose a total of 254.8 MT fire wood will be required annually if other alternative source of fuel wood is not provided. The likely increase in pressure to the forest resources will create adverse impact on local forests. Large and small size timber may also be needed for construction of temporary huts and shade houses. Such requirements may also be applicable to local residents who live in the vicinity of the project. These activities lead to the degradation of the forest and pressure will be high in surrounding forest. The nature of impact is indirect, low magnitude, site specific and short term.

iv) Impact due to harvesting of non-timber forest products

Forest products include medicinal and aromatic plants, NTFPs having economic values such as fiber bearing plants, religious plants, ornamental plants, etc. Unsustainable harvesting of these forest products may lead to depletion of natural resources and extinction in extreme cases. Overharvesting affects natural regeneration process as well. The implementation of the proposed project will remove 12 seedlings/ha and 2 samplings/ha of Dhaiyaro, 5 saplings/ha of Asuro and 10 saplings/ha of Sisno. Further 3 seedlings/ha and 1 sapling/ha of Amala and Jamun and 4 seedlings/ha of Aiselu will be lost due to the project. The project workers may be involved in harvesting and selling of non-timber forest product, found in the area. This impact is low, extent is site specific and duration is short term.

i) Shrinkage of Community forest and associated income loss

The total available forested area of 5 affected community forests is 256.85 ha. The project will acquire 12.15 ha community forest land from 5 community forests. The acquisition of the forest land will reduce the forested area of community forest by 4.73% in total. The impact is considered to be moderate on Imiltukra CF from where 18.85% of the total forest area will be acquired. The shrinkage of forest land may affect the fuel wood and fodder requirement of the community forest users which ultimately affect their income from the forest. This impact is low, extent is site specific and duration is long term.

Table 5-7: Loss of forest in different community forests

SN	Name of CFUG	Address	Total Forest Area (ha)	Forest Area to be Lost (ha)	Percentage Loss	Remarks
1	Shree Juka Ban CFUG	Kuskot - 4,5,6 (Now Mellekh Rural Municipality -8), Achham	65.43	4.54	6.94	Reservoir, dam, and settling basin
2	Shree Juka Ban Lamkana CFUG	Barhabis -4 (Now Budhiganga Municipality -10), Bajura	54	3	5.56	Reservoir
3	Shree Rakshe CFUG	Babala -3 (Now Sanfebagar Municipality -13), Achham	104.7	0.64	0.61	Reservoir, dam
4	Shree Imaltukra Betalmandu CFUG	Hatikot -8 (Now Mellekh Rural	14.43	2.72	18.85	Audit and road to adit

SN	Name of CFUG	Address	Total Forest Area (ha)	Forest Area to be Lost (ha)	Percentage Loss	Remarks
		Municipality -8), Achham				
5	Shree Sukethana CFUG	Hatikot - 3,7 (Now Mellekh Rural Municipality -8), Achham	18.29	1.25	6.83	Road to adit
	Total		256.85	12.15	4.73	

Source: Field Survey 2018

ii) Impact due to loss of agro-diversity

The possible sites for the loss of agro-diversity are agri-fields (Khet and Bari) that need to be acquired by the project for the installation of project structures and facilities. The agricultural products include cereals, pulses, vegetables, fruit trees, fodder plants and other plant species cultivated under agro-farming practices. Furthermore, due to increasing development activities, there might be diminishing trend of cultivation of traditionally grown and resistant varieties and thus social paradigm can be shifted to grow new and improved varieties which adversely impact upon the availability of traditionally conserved genetic resource.

C. Operation Phase

i) Increased access to forest

During the operation phase, especially the sites of immediate vicinity of project construction, will be impacted due to easy access that may attract the remaining project staff and local inhabitants for the unauthorized collection of timber, firewood and wildlife species.

2. Wildlife

A. Construction Phase

i) Loss of Natural Habitat

The construction of dam and reservoir, adit, project component roads (headworks and adit site) will clear 12.15ha forest area covered with trees and bushes. The loss of forest due to placement of project structures and facilities will affect natural habitat of some wild mammals and birds. Out of the total affected forest land (18.20 ha), 6.51 ha will be affected in reservoir area. The submerged forest area will permanently change from forest habitat to aquatic habitat which will reduce the available habitat. Since forest area affected by the project is minimal in comparison to available forest area near the project site and the wildlife reported from the area are widely distributed in nearby forested areas, the impact on wildlife in terms of habitat loss is low, site specific and of long duration.

As mentioned in environmental baseline description, project sites are not connected with dense forest and vegetation are found fragmented due to presence of settlements like Selgaun, Rithatoli, Paati, Toligaun, Kunwar Tole, Baddakhet, Moudali, Mathisiun, Talisiun and Thapagaun. Impacts associated with discontinuation of habitat due to project activity is not expected.

The project will not affect natural grazing land. The Budhi Ganga River is not serving as migratory route of water birds. Of the 47 recorded bird species from the project area only 8 species are aquatic birds. The nature of impact is direct, low magnitude, site specific and long term.

ii) Construction Disturbances

Construction disturbances resulting from blasting, drilling, vehicle movement and other related activities would interrupt normal movement, feeding and other activities of mammals. Construction activities may continue at night for the timely completion of project. The night blasting, electric light in an around the work site and human presence will affect wild animals grazing around the area, particularly in the headworks area and adit site and road to adit. Clearing, excavation, grading and filling activities will kill less mobile, frequently smaller species such as frogs, lizards and small mammals. Water pollution from the project activities (muck disposal, solid waste and accidental spill of oil and lubricants) may also affect local wild fauna and water birds most susceptible to water pollution. The nature of impact is indirect, low magnitude, site specific and short term.

iii) Movement of Labor Force

The movement of labor force at different construction sites will disturb the normal movement of wild fauna found in nearby areas. The local hunters or hunters among the workforce might be attracted to hunt barking deer, squirrels, birds and other wild animals for illegal trade and self-consumption. The possibilities of hunting and trapping by workers during construction period will have some adverse impact on local wild fauna. Since the project area is quite disturbed due to human activities and the movement of wild animal is occasionally reported in the area, the nature of impact is indirect, low magnitude, site specific and short term.

iv) Impact on Endangered and Threatened Species

Of the 13 mammal species found in the project area, three species fall under Appendix-I, one under Appendix-II and two under Appendix-III of CITES. Similarly 8 species of mammal falls in least concern category of IUCN where as 3 species falls in nearly threatened category. Out of the 47 bird species species recorded from the project area 31 are categorized in least concern of IUCN and 1 species falls in endangered category. *Columba livia* is included in CITES Appendix-III. Among the reptiles and amphibians *Ptyas mucosus* and *Rana sp.* are listed in CITES-II and CITES-I category respectively. Of the total recorded species 3 species of reptiles and 2 species of amphebians are categorized in least concern category. The impact on listed species will be similar to the other species and no specific impact is expected. The nature of impact is indirect, low magnitude, site specific and short term.

v) Terrestrial and Aquatic Biodiversity

The project area is rich in plant biodiversity and altogether 165 species of plants were identified from the project area. Similarly, twelve species of mammals, 47 species of birds, 6 species of reptiles and 2 species of amphibians were recorded from the project area. Among the aquatic biodiversity, 33 species of phytoplanktons, 17 species of zooplankton and 23 species of aquatic insects were found in Budhi Ganga River. The river is also rich in fish diversity and 25 species of fish were recorded from the river. The implementation of the project will result in the loss of 4,809 standing trees of 16 species from the placement of project structures and facilities. The mammals and birds found in the project area will be affected due to loss of habitat and



construction activities. The possibility of illegal hunting, risk of forest fire, excessive fuel wood collection by work force and new migrants will also add pressure on biodiversity.

The aquatic biodiversity will be affected due to reduction in river flow and blockage of fish migration and changes in riverine habitat. The nature of impact is indirect, low magnitude, site specific and short term.

B. Operation Phase

i) Habitat Destruction and Movement of Wildlife

The placement of surface project structures and facilities such as dam, reservoir, project component road, powerhouse, switchyard and camp will permanently change the land use of the area. The electric light arrangement at dam and powerhouse area may disturb the wildlife movement in surrounding areas. This impact is low since the dam site is located close to Sanfe-Martadi Road and powerhouse is located on private cultivated land. Eight species of aquatic birds were found in project area which are common and widely distributed in different parts of Nepal. The Budhi Ganga River is not providing migratory routes to birds. The extent of impact is site specific and duration is long term.

ii) Rare, Endangered and Threatened Species of Fauna

No significant impact on protected species is expected since species found in core project site is widely distributed in project area as well as other parts of Nepal.

5.3.2.2 Aquatic Environment

1) Fish and Aquaticlife

A. Construction Phase

i) Temporary Diversion of River

The river water will be temporarily diverted for the construction of dam. The river stretch in diverted section will be dry and the fish found in this section will either die or be captured by project workers. Furthermore, the diversion works also affect water quality of the river which affects downstream fish and aquatic life. Experience with other projects shows that large quantities of fish will be captured during diversion if not properly managed. The magnitude of impact is low, extent is site specific and of short duration.

ii) Habitat Destruction and Loss of Spawning Ground

The construction disturbances such as river diversion, excavation and concreting works, movement of vehicles and other direct and indirect activities will affect the aquatic habitat at dam site and immediately downstream of the dam. Three spoil disposal sites are proposed between the dam and powerhouse along the river bank. The construction activities will affect the spawning and rearing ground found close to construction areas such as Ikri Gad confluence, Ardoli Gad and Bhimkoti Gad area. Further the spawning and rearing ground found between dam and Ardoli Gad will also be affected. The magnitude of impact is low, extent is site specific and duration is short term.

iii) Water Quality

Various activities like earthwork, excavation, grading, filling, disposal of construction spoils, waste water and effluent disposal of oils and grease, are the primary sources of water pollution. The wastewater may discharge into the river without treatment and it will affect the quality of water. These wastewaters have high pollution potential and contain cement as well as suspended and colloidal particles. The changes in water quality may affect the fish habitat and respiratory system causing fatalities to some fish. The magnitude of impact is low, extent is site specific and duration is short term.

iv) Fish Exploitation/Increase Fishing Activity

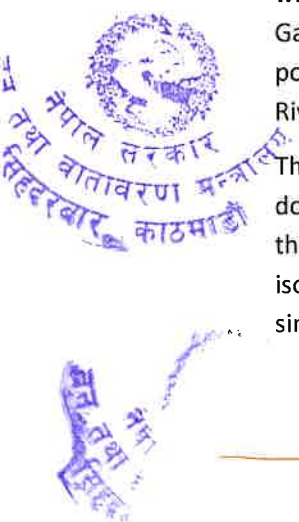
Fishing activities in the project area may increase throughout the duration of the project construction due to the influx of people. The labor force and their dependents may be involved in fishing activities. Harvesting by using simple techniques may not affect the fish population significantly. However, destructive techniques such as the use of dynamite, herbicides and electric rod will have an adverse impact on the local fish population. The use of dynamite, poison and electric rod not only kills fish fry, fingerlings and adults, it also destroys the habitat.

The construction crew will provide ready market for harvested fish and demand may increase. Local people may get benefits due to possible increase in fish price during project construction, which leads to more fishing. This impact is considered significant in confluence of Bhimkoti Gad to Jijadi Gad area where fishing pressure is already high. The magnitude of impact is low, extent is site specific and duration is short term.

B. Operation Phase**i) Fish Migration**

Barrier effect is expected on long distance and midrange migrant species due to construction of 40 m high dam. The presence of long distance migratory species such as Sahar, Gouch, Jalkapoor and Eel are reported from Budhi Ganga River especially in high water phase. Out of the above mentioned migratory species, Sahar and Eel were collected during the field survey. The confluence with Budhi Ganga River and 1km upstream area of Ikri Gad and Sarane Gad with Budhi Ganga River confluence area are suitable spawning site for Mahseer, River Rohu and Copper Mahseer. Further, the migration range of these long distance migratory species is reported by local people up to the Mala Gad area near Bamka Bazar in upstream and Seti River in downstream and Karnali River further downstream. The construction of dam in Budhi Ganga River will eliminate access to some upstream spawning areas for the migratory fishes. The migratory species which occupies a long migration range for spawning, rearing and feeding in upstream of Budhi Ganga River will be significantly affected by the construction of dam. The construction of dam will pose significant impact to the migration of collected/reported migratory species of Budhi Ganga River. Mahseer, Eel, Gouch and Jalkapoor are the prime concern.

The Coper Mahseer, River Rohu, and Snow Trout which occupies distribution range both up and downstream of Budhi Ganga River will be isolated by construction of dam. The fish species utilizing the upstream and downstream tributaries for feeding, spawning and rearing will be affected. The isolation impact is considered more in dry months (November – December and January – May) since downstream migration is allowed in wet season as dam gates are open.



Barrier impact is also considered to the resident species but the magnitude is low because these species occupies a small range of distribution and can survive in the limited available habitat. Torrent Minnows, Catfish and Stone Carp are the species likely to be affected by the construction of dam. The overall magnitude of impact is considered high, local extent and of long duration.

ii) Water Diversion

Budhi Ganga Hydropower Project is proposed to divert on average 92.23 % (90-95%) water for 7 months and 34.55% (13.20 – 68.42%) water in five monsoon months (June – October). The reduction in river flow and possible changes in water quality is considered significant adverse impacts on fish and aquatic life. The low flow will also affect the fish population as the local people can easily exploit more fish in these areas. The main parameters affecting the fishes are;

- Reduction in water flow
- Changes in water quality
- Water fluctuation impact

iii) Reduction in Water Flow

The flow in 3km river section between dam and Ardoli Gad will be substantially reduced after diversion of Budhi Ganga River for power generation. Since no tributaries are joining in this stretch there will be no flow in 7 months except the riparian release of 0.99 m³/s.

Ten species of fish were collected in this river section during the field survey. This represents 20% of the total catch in totality. The catch per unit effort is 0.16 fish and 1 fish is caught at 6 attempts. In dry month April when flow is low, 8 species of fish were collected from this stretch of river. Among the collected species *Tor putitora* is the long distance migrant whereas *Schizothorax progastus*, *Schizothorax plagiosomus*, *Bangana dero* and *Neolissochilus hexagonolepis* are mid-range migrant species with high food value. The maximum size fish (*Schizothorax plagiosomus*) recorded in this stretch of river is 22.5 cm long and weighs 90gm. In dry period Snow Trout contributes 53% of the total catch.

Due to reduction in river flow these species will not survive in run and riffle habitat and migrate downstream areas below Ardoli Gad and preferably further downstream to tailrace. However, their juveniles will sustain in pools found in this stretch of river. The magnitude of impact is high, extent is site specific and duration is long term.

Diversion of water to the tunnel will also reduce the flow in the Budhi Ganga River particularly in the 3.8 km stretch of river between the Ardoli Gad and Budhi Ganga River confluence to powerhouse tailrace. There might be no effect of reduction of water during the monsoon, but during the dry season, the flow in the river stretch in this stretch will be reduced for seven months between January-May and November-December.

The hill stream fish species, which are ecologically adapted to fast flow conditions, will be adversely affected by water diversion. The impact will be significant to resident and mid range migratory fish species since long distance migratory species are very low in catch and mostly seen during monsoon. Mid range migratory fish, living their adult life in central or lower parts of Budhi Ganga River and spawn in upper parts will be affected mainly by reduced area for spawning and growth of fry. Among the mid-range migrant species, the Snow Trout which is found throughout the year will be highly affected by the diversion of water. The adult Snow Trout requires more water because of low flows they could move out of the area (6.8 Km) and into the deeper water.



The impact will be considered particularly high in March – April when the popular Snow Trout breed. In the worst-case scenario, there could be a species change to Catfish, Rock Carp and Loaches which are adaptable to low flow conditions. However, the juveniles of Snow Trout will survive well in pools found in this stretch of river.

The other mid-range migrant such as River Rohu, Copper Mahseer and Minor carps although collected during dry period, are widely distributed and breed in June-July when water is sufficient in this stretch. They will be moderately affected by flow reduction.

The resident fish species recorded in this stretch such as *Pseudorasbora parva*, *Garra gotyla* and *Glyptothorax cavia* will be affected at all life stages. As these fishes are small size and comparatively tough in nature and can survive with limited water and changed condition hence not expected to be highly affected by the flow reduction.

Five tributaries namely Rakse Khola, Saine Khola, Ardoli Gad, Lata Khola and Angali Khola join Budhi Ganga in this stretch. Ardoli Gad joins from the right bank of river at about 3km from downstream of dam site and Angali Khola joining from the left bank of river are perennial in nature and the rest are seasonal and have flow in wet season only. The contribution of downstream tributaries between dam to powerhouse is 0.51m³/s in critical dry months January to March (Ardoli Gad=0.43m³/sec and Angali Khola=0.08 m³/sec).

Considering the good contribution of downstream tributaries, availability of spawning and rearing ground below tailrace and wide distributional range of fish species found in Budhi Ganga River the overall impact of flow reduction is moderate. The extent is site specific and duration is long term.

iv) Water Quality Changes

The construction of dam in Budhi Ganga River will create a 13.43 ha reservoir extended up to 2.06 km upstream of the dam axis. Due to the formation of the reservoir the river velocity in reservoir stretch will be substantially reduced. All rapids and stretches of broken water (run and riffle) will be changed. The confluence with Budhi Ganga River and 1 km upstream area of Ikri Gad and Sarane Gad with Budhi Ganga River confluence area which are suitable spawning site for Mahseer, River Rohu and Copper Mahseer will be submerged. This stretch of river is dominated by Snow Trout which represents 77.26% of the total catch in dry period and 53.85% of the total catch at this river section in wet season. Snow Trout require flowing water and cannot survive in reservoir condition and possibly may be eliminated from the area in long run.

After construction of dam 2.06 km river stretch will be changed from lotic ecosystem to lentic ecosystem in dry period. However, there will probably be normal flow in wet season. Since reservoir is small and there will be maximum fluctuation of 6m in dry period and probably no or minimum in wet season the likely changes in other parameters except water temperature is not expected.

Besides adverse impact, the reservoir will also provide opportunity for the growth of some other kind of species such as Copper Mahseer, River Rohu and Mahseer. At present these species contribute 18.19% of the total catch in dry period and 30.77% in wet season.

Due to substantial reduction in river flow between dam and powerhouse tailrace the water temperature will be increased. After diversion in reduced flow area (Ardoli Gad to powerhouse tailrace) quality of water remaining in the Budhi Ganga River will be more influenced by the

qualities of incoming tributaries downstream (Ardoli Gad and AngaliKhola). Differences might be observed in temperature, conductivity as well as for concentrations of various major ions. The differences of water quality might influence the fish and aquatic life of Budhi Ganga River. Any change in water quality will affect the spawning and nursery ground more severely than the adult fish.

The water diversion at dam will increase the water temperature of Budhi Ganga River in reduced flow (intake to powerhouse stretch) section. The likely increase in temperature above 25°C will be fatal for Snow Trout and many other species. The magnitude of impact is moderate, extent is local and duration is long term.

v) Water Fluctuation Impact

The power plant will operate in the following mode: 6 hours daily peaking during dry season and 24 hour operation in wet season (June – October). Since there is only 6 m daily fluctuation of reservoir level in dry period the impacts on aquatic life associated with water quality changes are low.

During peak operation (dry period) the river flow below the powerhouse tailrace will be 26m³/s including the riparian flow and contribution of downstream tributaries (0.51m³/s). In non-peak the flow of river will be limited to downstream release and contribution of downstream tributaries.

Experience with other hydro-electric projects shows that immediately downstream of tailrace fish especially fry and fingerlings and small size resident species feeding and rearing at natural condition will not adjust themselves immediately as reservoir operation level change and remain at the bank of river. The local fishermen take this opportunity catch the fish by hand.

Similar type impact is likely to be expected in proposed Budhi Ganga HPP. The magnitude of impact is low, extent is site specific and duration is long term.

vi) Flushing of Desanding Basin

The sedimentation load in Budhi Ganga River is high and river water will pass through surface de-sanding basin where coarse silt particles will be settled out of water before entering the tunnel. The settled sediments will be periodically flushed in to the river below the Dam. The approximate 3 km river section below the dam (up to Ardoli Gad) will be affected. The deposition of sediment may reduce or eliminate the habitat in which fish spawn and invertebrates live. This impact is high if the desander is flushed in dry period especially in March-April which is the spawning season of Snow Trout. The overall magnitude of impact is moderate, extent is site specific and duration is long term.

vii) Fish Entrainment

The operation of Budhi Ganga Hydropower Project will divert on average 92.23 % water for 7 months and 34.55 % water in five monsoon months (June – October). The diversion of the river water in to the headrace tunnel is expected even to divert the fishes (migrant and resident) through the intake structure to de-sanding basin and subsequently to the penstock and turbine. Given the amount of head and pressure in the penstock (Bell 1990) hardly any of these fish passing through turbine will survive. The loss of fish due to entrainment is site specific and species specific and not known for the species found at site as well as in Nepal. The magnitude of entrainment is expected to be low, extent is site specific and duration is long term.

viii) Local Fishermen/Riverside villagers

Since full time and part time fishermen are not found in project area the reduction in fish catch will have no significant impact with regards to livelihood of river side villagers. However, the reduction in fish catch has low impact on protein consumption of river side villagers who are occasionally involved in fishing and fish is major source of their protein. The magnitude of impact is expected to be low, extent is site specific and duration is long term.

ix) Terrestrial and Aquatic Biodiversity

The operation phase staffs are limited and office quarter is available for the staff hence consumption of fuel wood and illegal hunting is not expected during this phase. The other impact like disturbances of electric light, vehicle movement at night are discussed above. In operation phase the project activities are reduced hence new migrants are limited or negligible. Flood is natural phenomenon in hill streams. The dam and reservoir will reduce the impact of flood to some extent. Road to adit and headworks may trigger landslide which may affect some trees in border line of RoW of road.



Table 5-8: Prioritized value and significance of terrestrial and aquatic environmental impacts

Table 5-3: Prioritized Value and Significance of Terrestrial and Aquatic Environmental Impacts																				
S.N.	Activities/Resources	Impacts	Nature of Impact		Weighting for Prioritization of Impacts										Scoring Criteria for Significance Value					Prioritized Impacts
					Magnitude			Extent			Duration			Total Prioritized Value	Importance of Impacts			Significance of Impacts		
5.3.2 Biological Environment 5.3.2.1 Terrestrial Environment			D	I	H	M	L	R	L	S	LT	MT	ST		H	M	L			
5.3.2.1.1 Vegetation/Forest Resources																				
I. Pre- Construction																				
i	Acquisition of forest land	Acquisition of 18.20 ha forest land consisting 12.15 ha forest area and 6.05 ha river flood plain connected with forest.	D			20				10	20			50		2		100	M	
ii	Loss of Vegetation	Removal of 4809 trees (4481 pole, 328 tree)	D			20				10	20			50		2		100	M	
iii	Floral diversity	Loss of 16 species of plants	D				10			10	20			40			1	40	L	
iv	Protected species	Loss of 2342 pole size and 118 tree of Sal which is banned for felling, transport and export for commercial purpose.	D			20		60			20			100		2		200	M	
v	Reduction in forest area	Acquisition of 12.15 ha forest area belonging to community forest	D			20				10	20			50		2		100	M	
II. Construction Phase																				
i	Loss of Vegetation	Removal of 4,809 trees, 831m³wood volume,58.61 fuel wood Chatta and 648,203 kg of biomass loss	D			20				10	20			50		2		100	M	
ii	Access to forest	Increased access to other bank of forest may add pressure to valuable sal forest		I			10			10	20			40			1	40	L	
iii	Firewood and timber	Approximately 254.8 MT firewood will be required for the workforce annually					10			10			5	25			1	25	L	
iv	Non-timber forest products	Likely increase in collection of non-timber forest products					10			10			5	25			1	25	L	
v	Shrinkage of CF area	The area of affected CF will be reduced by 4.73%					10			10	20			40		2		80	L	
vi	Loss of Agro biodiversity	Possibilities of shifting social paradigm to grow new and improved varieties					10			10			5	25			1	25	L	
III. Operation Phase																				
	Access to forest	Continuation of impacts of easy access to forest					10			10	20			40			1	40	L	
5.3.2.1.2Wildlife																				
I. Construction Phase																				
i	Loss of natural habitat	Loss of 12.15 ha forest area covered with trees and bushes	D				10			10	20			40		2		80	L	
ii	Construction disturbance	Impact on feeding and normal movement of wild animals due to drilling, blasting and other construction activities		I			10			10			5	25			1	25	L	
iii	Hunting and poaching	Likely increase in hunting and poaching especially by the workforce	D				10			10			5	25			1	25	L	
iv	Endangered and threatened species	Likely impact on endangered and threatened species found in project area	D				10			10			5	25	3			75	L	



v	Loss of biodiversity	Impact and terrestrial and aquatic biodiversity due to implementation of the project	D				10			10			5	25			1	25	L
II. Operation Phase																			
i	Habitat destruction and wildlife movement	Loss of wildlife habitat, movement of wild animals etc.	D				10			10	20			40			1	40	L
5.3.2.2 Aquatic Environment																			
I. Construction Phase																			
i	Temporary diversion of river	Impact on fish and water quality in diverted section	D				10			10			5	25		2		50	L
ii	Habitat destruction	River diversion, excavation and concreting works will affect the aquatic habitat	D				10			10			5	25		2		50	L
iii	Water quality	Earthwork, excavation, grading, filling, disposal of construction spoils, waste water and effluent will affect water quality and fish habitat	D				10			10			5	25			1	25	L
iv	Fish exploitation	Increased fishing activity may affect fish of different life stages and habitat	D				10			10			5	25			1	25	L
II. Operation Phase																			
i	Fish movement	Blockage of fish migration	D		60				20		20			100	3			300	H
ii	River diversion	Substantial reduction of river flow in 3km river stretch	D		60					10	20			90	3			270	H
iii	River diversion	Reduction of flow in 3.87 km river stretch	D			20				10	20			50	3			150	M
iv	River diversion	Water quality in 6.87 km stretch will be influence by the tributaries water and increase in temperature above 25°C will be fatal for the fish	D			20				10	20			50		2		100	M
v	Reservoir operation	Changes in water quality of reservoir and colonization of slow water loving species in reservoir area. Water level fluctuation impact due to peaking.	D			20				10	20			50		2		100	M
vi	Project operation	Water level fluctuation downstream tailrace will affect the fish especially the fry and fingerlings	D				10			10	20			40			1	40	L
vii	Flushing of desanding basin	Increase sediment in downstream		I		20				10	20			50		2		100	M
viii	River diversion	Likely impact due to fish entrainment	D				10			10	20			40			1	40	L
ix	Fish catch	Impact to local fishermen/river side villagers due to reduction in fish catch		I			10			10	20			40			1	40	L
x	Loss of biodiversity	Project road may trigger landslide which will affect the local biodiversity	D				10			10	20			40			1	40	L

Note: Magnitude Weighting

H= High (60)

M = Medium (20)

L =Low (10)

Extent (Weighting)

R= Regional (60)

L= Local (20)

S= Site specific (10)

Duration

LT= Long Term -20 20 years and above)

MT= Medium Term -10 (5-10 years)

ST= Short Term -5 (up to 5 years)

Prioritization of Impacts

H= Significance value above 200

M= Significance value above 100 to up to 200

L= Significance value below 100

5.3.3 Socio-economic and Cultural Environment

Based on the findings of the baseline condition and project activities the adverse impact of the project are broadly categorized as loss of private land and assets, displacement of people, unplanned development of market/growth centers, encroachment of public land, impact on historical, cultural and religious sites, law and order situation, occupational health and safety, social problems (gambling, prostitution, violence, alcoholism, discrimination etc.), indigenous and vulnerable people, social, cultural and religious practices. The issue of share is not discussed since DoED is the proponent of the project and as per prevailing legal provisions government institutions could not provide public share.

5.3.3.1 Pre-construction Phase

A. Land Acquisition

The project needs 17.34 ha private land permanently for the placement of project structures and facilities. Most of the land required for the project has already been acquired and some are in the process of acquisition. In addition 8 ha of private land will be taken on lease for the placement of temporary facilities (Table 5-9).

Table 5-9: Acquisition of private land by type and project structures

Structures/ facilities	Private land to be acquired by land type/ha				Total
	Permanent		Temporary		
	Land Type	Area (ha)	Land Type	Area (ha)	
Reservoir	Khet	1.57		0	1.57
Powerhouse and tailrace area	Khet	3.15		0	3.15
Road to headworks	Khet	0.73		0	0.73
Road to adit	Khet	4.05		0	4.05
Road to powerhouse	Khet	2.015		0	2.015
Road to surge shaft	Khet	2.325		0	2.325
Owners/engineers camp	Khet	2.82		0	2.82
Office and camp	Khet	0.68		0	0.68
Construction yard		0	Khet and barren land	2	2
Disposal area		0	Barren land	2	2
Contractor and labor camps		0	Barren land	2	2
Crushing plant		0	Barren land	2	2
Total		17.34		8	25.34

Source: Field survey, 2018

Altogether 80 families/households were identified as project affected families/households due to acquisition of their land and house. Of the total affected households, 46.25.0% households of Mellekh Rural Municipality ward no. 8 will lose 7.902 ha land. The average loss of land is high (0.314 ha) in Mellekh Rural Municipality ward 4 and low in Sanfebagar Municipality ward no. 4 (0.125 ha). The average loss of land of the affected household is 0.217ha per households (Table 5-10).

Table 5-10: Distribution of households losing land

Municipality/Rural Municipality/ Ward	Households Losing Land		Total Area (ha)	Avg./HH (ha)
	No. of HHs	%		
Bajura district				
Budhiganga Mun.-10	5	6.25	1.057	0.211
Achham district				
Sanfebagar Mun.-4	4	5.0	0.499	0.125
Sanfebagar Mun.-10	16	20.0	3.329	0.208
Sanfebagar Mun.-13	10	12.5	2.042	0.204
Mellekh R. Mun.-4	8	10.0	2.51	0.314
Mellekh R. Mun.-8	37	46.25	7.902	0.214
Total	80	100	17.339	0.217

Source: Field survey, 2018

An assessment of percentage of land loss from total land holding of the affected HHs is made. Of the affected HHs, 13.75% HHs will lose less than 10.0% of land from their total holding, 31.25% HHs will lose 10-25% land from their total land holding, 27.5 % HHs will lose 25-50% of land from their total land holding. Similarly, 15% HHs will lose 50 - 75% land and 12.5% HHs will lose 75-100% of land from their total land holding.

In accordance with current practices and guidelines, families who are physically displaced from their residences or commercial establishments and those who are severely affected through loss of agricultural land are classified as severely project affected families (SPAFs). The households losing more than 10% of their total land and or losing residential structures are considered under this category. Therefore, of the total HHs affected by land acquisition 86.25% HHs are SPAFs (Table 5-11).

Table 5-11: Affected households by percentage loss of land

Municipality/Rural Municipality/ Ward	Loss of Total Landholding (Percent)									
	< 10%		10 – 25%		25 – 50%		50 - 75%		75-100%	
	HHs	%	HHs	%	HHs	%	HHs	%	HHs	%
Bajura										
Budhiganga Mun.-10	1	20	2		2	40				
Achham										
Sanfebagar Mun.-4	1	25	3	75						
Sanfebagar Mun.-10	2	12.5	5	31.3	3	18.8	2	13	4	25
Sanfebagar Mun.-13	3	30	1	10	3	30	3	30		
Mellekh R. Mun.-4			4	50	1	12.5	1	13	2	25
Mellekh R. Mun.-8	4	10.8	10	27	13	35.1	6	16	4	11
Total	11	13.75	25	31.25	22	27.5	12	15	10	12.5

Source: Field survey, 2018

Of the affected households, 95% belong to Chhetri caste/ethnic group and their total land loss is 16.57 ha and 5% HHs are Dalit (Lohar) and their total land loss is 0.77 ha. The average land loss of Chhetri HHs is 0.133 whereas it is high (0.145 ha) of the Dalit HHs. This indicates that the average land loss of Dalit is high compared to the Chhetri HHs. The mean land loss of the affected HHs is 0.217ha (Table 5-12).



Table 5-12: Distribution of households losing land by caste/ethnicity

Caste/Ethnic Group	Households Losing Land		Total Area (ha)	Avg/HH (ha)
	No. of HHs	%		
Chhetri	76	95	16.57	0.133
Dalit (Lohar)	4	5	0.77	0.145
Total	80	100	17.34	0.217

Source: Field survey, 2018

Of the 80 household who will lose their land, 5 are female headed and 75 are male headed. The female headed HHs will lose 0.62 ha land in total whereas male HHs will lose 16.72 ha land (Table 5-13).

Table 5-13: Distribution of households losing land by sex

Sex of Land Owner	No. of Households Losing Land	Total Area (ha)	Avg/HH
Male	75	16.72	0.133
Female	5	0.62	0.145
Total:	80	17.34	0.217

Source: Field survey, 2018

Agriculture is main source of livelihood of almost all the affected HHs. The acquisition of fertile agricultural land (Khet) for the project is likely to have impact on their livelihood. The nature of the impact is direct, high magnitude, site specific and long term.

Name of the affected HHs due to acquisition of land, residential structure and cowshed along with details on the area to be acquired is given in Volume II, Appendix D.

B. Acquisition of House and Cowshed

Construction of the proposed project will acquire 6 Kachi residential houses and 5 cowsheds for the placement of project structures/facilities and project component road. Of the total affected HHs, 12.5% will lose their residential structures and cowsheds (Table 5-14).

Table 5-14: Distribution of households losing structures

Municipality/Rural Municipality/ Ward	Total Surveyed Households	Households Losing Structures	(%)	No. of Loosing Structures by Type	
				House	Cowsheds
Bajura district					
Budhiganga Mun.-10	5				
Achham district					
Sanfebagar Mun.-4	4	1	25%	1	1
Sanfebagar Mun.-10	16				
Sanfebagar Mun.-13	10	1	10%		1
Mellekh R. Mun.-4	8				
Mellekh R. Mun.-8	37	8	21.60%	5	3
Total	80	10	12.50%	6	5

Source: Field Survey, 2018 * Note: Kachi = Mud/stone wall with thatch/ slate /zinc sheet roof.

Of the 10 affected HHs losing structures, 75.0% are Dalit and 9.21% are Chhetri. As the Dalit are poor and depressed groups they are more affected due to acquisition of residential structure (Table 5-15).

Table 5-15: Distribution of households losing structures by caste/ethnicity

Caste/Ethnic Group	Total Surveyed Households	Households Losing Structures	(%)	No. of Loosing Structures by Type	
				House	Cowsheds
Chhetri	76	7	9.21%	3	5
Dalit (BK)	4	3	75.00%	3	-
Total	80	10	12.50%	6	5

Source: Field survey, 2018

The total plinth area of the affected residential structure is 4716 sq. ft. and cowshed is 898 sq. ft. Similarly, the average area of the residential structure is 786 sq. ft. and cowshed is 179.6 sq. ft. Of the residential structures, 50.0% are single floored with < 300 sq. ft. of plinth area (Table 5-16). The nature of impact is direct, high in magnitude, site specific and long term.

Table 5-16: Area of affected house/structure

Area	No. of Affected Houses	Houses (Sq.ft.)		Cowsheds (Sq.ft.)	
		Kachi	Avg	No.	Area
Single Floor					
<300 Sq.ft.	3	686	229	5	898
300-500 Sq.ft.	1	436	436		
500-1000 Sq.ft.					
>1000 Sq.ft.	2	3594	1797		
Total	6	4716	786	5	179.6

Source: Field Survey, 2018

C. Explosives

Explosives required for the construction of project will be procured through designed process of government of Nepal and stored in proposed bunker house. If the explosives are not transported, stored and managed properly it will have detrimental impact on social as well as aquatic environment. The nature of impact is direct, low magnitude, site specific and short term.

D. Loss of Private Fruit/Fodder Trees

The project will acquire 50 private trees which consists of 20 fruit trees, 30 timber and fodder trees due to site clearance and other activities. The fruit trees are mostly mango, guava and orange. The loss of private tree will mostly occur along the road to adit site. The nature of impact is direct, low magnitude, site specific and short term.

5.3.3.2 Construction Phase

A. Loss of Crops

Since land is acquired during pre- construction, loss of standing crop is not expected during construction phase. The land acquired during pre-construction phase will have permanent loss of agriculture production during construction phase also. The estimated annual production loss of cereal crops and cash crops for permanently acquired land is 47.02 MT from 17.34 ha of permanently acquired Khet land (Table 5-17). Out of the total production loss 87.32% is cereal crops and 12.68% cash crops. Among the cereal crop paddy (50.05%) is the major crop whereas

in cash crop, potato (78.52%) will be the major crop lost by the acquisition of land. The magnitude of impact is moderate, extent is site specific and duration is short term

Table 5-17: Permanent agricultural production loss

Type of Crops	Production Loss (MT)	%
Cereal Crops		
Paddy	20.55	50.05
Wheat	10.06	24.5
Maize	5.77	14.05
Millet	4.68	11.4
Total	41.06	100
Cash Crops		
Potato	4.68	78.52
Pulses	1.28	21.48
Total	5.96	100
Grand Total	47.02	

Source: Field Survey 2018

i) Livelihood

Agriculture is main source of livelihood of almost all the affected households. The acquisition of agricultural land, houses and cowsheds for the project is likely to have impact on their livelihood. The magnitude of impact is moderate, extent is site specific and of long duration.

B. Health and Sanitation

The likely increase in population of the area during construction may add further stress on local water supply and health and sanitation situation of the area. Furthermore, due to the influx of work force during the construction phase, the existing water supply system will not be sufficient. The lack of proper sanitary measures in temporary camps and increase in waste and water pollution can lead to the outbreak of epidemics, water born diseases like Jaundice, Typhoid etc. Migrant workers may bring different vulnerable diseases, which are not prevalent in the area, and this will have adverse impact on the health of local people. The nature of impact is indirect, low magnitude, site specific and short term.

C. Occupational Health and Safety

Due to unsafe construction practices, the construction related accidents are common in Nepal. Construction activities such as blasting, use of heavy equipment, working in dangerous areas like tunnel and on steep slopes, and traffic flow due to increased movement of vehicles may cause accidents and injuries. Health hazard is also expected due to gaseous emission from tunnel. Work related injuries and vehicle accidents are the likely impact expected due to implementation of the proposed project. The nature of impact is direct, high magnitude, site specific and short term.

D. Conflicts of Interest and Law and Order

Due to the influx of workforce from different places and diverse ethnic groups there will be possibilities of conflict of interest between the workers and project management and among the workers and local community. Local employment, information disclosure, wages rate and working hours are areas of potential conflict. The employment in project varies based on the need of construction and workers will be terminated once their services are not required for the project.



The termination of any employee may create conflict of interest and affect law and order situation of the area.

Similarly, misbehave by the project workers particularly from the international contractors with local people may create conflicts with local community that could affect law and order situation. As reported by local people, such situation emerged in similar hydropower projects in Nepal. The nature of impact is indirect, low magnitude, site specific and short term.

E. Increased Economic Activities

Due to increase in economic activities there might be increase in price of local consumable goods. The influx of workers will lead to a changed demand and supply situation. Wage labours will have more to spend and therefore prices within the impact area will inflate. The inflation in the market price of consumable goods may affect the local economy. During the construction period, agricultural labour may be diverted at the peak season towards the project and away from agriculture, which may cause high demand of labourers in agriculture, which will bring inflation in agriculture sector. The nature of impact is indirect, low magnitude, site specific and short term.

F. Sanfe- Martadi Road

Sanfe - Martadi Road will provide road access to headworks and powerhouse area from where the project will construct small access roads to headworks and powerhouse site. The traffic volume will significantly increase in this road from Thanti Bazar to Budhabagar. The traffic will also increase in other sections but to a lesser degree. The increase in traffic flow will add pressure on safety of road side settlement such as Thanti Bazar, Tansi Bazar, Sanfebagar and Budhabagar and there will be increased chances of accidents. Further the road condition may deteriorate due to increase in road traffic. The nature of impact is indirect, low magnitude, local and short term.

G. Impact on Community Infrastructures/Facility, Services and Resources

Community infrastructure and resources such as health, education and drinking water will face increased pressure due to demand for social service/facilities from the work force concentrated in the project site particularly in the market areas such as Budhabagar, Tashi Bazar and Thanti Bazar areas. Drinking water and health facilities are likely to be affected more. Similarly, influx of population due to the project activities (labour and other people) will also increase pressure on local forest resources due to increased demand for forest products like timber and fuel wood. The nature of impact is direct, low magnitude, site specific and long term.

H. Impact on Gender and Vulnerable Groups

Daily wage labourers will be required for different construction activities of the project. The contractor especially the sub-contractors may employ non-local people due to cheap wage, requirement of large number and commitment/dedication of workers. However, it could discriminate against local labourers for employment. Similarly, there could be discrimination by the employers among the local men, women and vulnerable group while hiring them as wage labours. In general, the employment opportunity will be more to men and advanced groups in comparison to women and vulnerable groups as usual in other development projects of Nepal and this trend may occur in this project too.

The impact of the project construction is also expected on the poor and disadvantage people who might be directly not affected by the project but affected in other ways such as price in



commodities, shortage of consumable goods, social inferiority and less opportunity of employment and other project related benefits. The nature of impact is indirect, low magnitude, site specific and short term.

I. Blasting and Tunneling on Houses and other Infrastructure

The construction of tunnel will use minimum blasting in small slot hence no impact is expected on the house and structures due to blasting and tunnelling activities. Furthermore, no settlements are found in nearby areas of interconnection point, adit portal and surge shaft area hence no impact is considered for the other sites.

The information available from other similar projects suggests that sources of drinking water and irrigation schemes may be affected due to tunnelling in long run, although the exact reasons for this are unknown. The nature of impact is indirect, low magnitude, site specific and long-term.

J. Disturbance to Cremation, Cultural and Religious Sites

Cremation sites are found along both banks of the river just below the dam and these will be disturbed due to construction activities. The existing foot trail at right and left banks will be affected due to construction of access road and desanderbasin. The project will not affect cultural and religious sites. The nature of impact is both direct and indirect in nature, low magnitude, site specific and long-term.

K. Life Style/ Behavior of the People

The interaction among different people and ethnic group may attract the rural people towards more advanced society. Experience in other similar projects shows that sudden cash flow in the project area and cash earning by workers led to spending on unproductive and luxurious items. The availability of cash and alcohol may encourage the workers and local people towards gambling, more alcohol consumption and even for prostitution. There may be cause of absconding women from the villages, prevalence of communicable disease like STD and HIV/AIDS although the prevalence of STD and HIV/AIDS is high in the area due to India migrant workers. Therefore, it will create social problem and promote conflict since such activities are unacceptable in the society. The nature of impact is indirect, low magnitude, site specific and of short term.

L. Domestic Violence and Polygamy

The availability of cash and alcohol may encourage the workers and local people towards gambling and more alcohol consumption. The over consumption of alcohol may lead domestic violence and polygamy. The nature of impact is indirect, low magnitude, site specific and of short term.

M. Social Cultural and Religious Practice

The Tithana shrine will be affected by project reservoir and needs to be relocated in consultation with local people. The project area is dominated by Chhetri and Dalits, who have their own social status and culture. Due to the project activities, project workers and other people will migrate in the area for business. The migrants and local people will interact with each other and influence each other's social and cultural norms, and religion. The nature of impact is both direct and indirect, low magnitude, site specific and of short-term.

N. Price Hike

There might be increase in market price of local consumable goods. The influx of workers will lead to a changed demand and supply situation that will affect the local market and the project area. Wage labourers will have more to spend and therefore prices of the consumable goods and other items in the market places will inflate. The inflation in the rate of consumable goods may affect the local economy and market places. However, based on the experience of other hydropower projects it is not expected that it will significantly influence the local market as workers are confined in camps and they are more work oriented. The nature of impact is both indirect, low magnitude, site specific and of short term.

O. Fire Hazards

Construction materials such as explosive for blasting and fuel and lubricants will be stored in large quantities for construction of the project. If storage areas are not properly fenced and necessary precaution for the storage and handling of the petrochemicals and explosive are not followed there will be increased risk of fire hazards. The nature of impact is direct, moderate magnitude, site specific and short term.

P. Disturbance to Domestic Animals Especially the Naumuthe Cow

Budhabagar, Tansi Bazar, Thanti Bazar and Thapagaun are the nearest settlements to construction sites. Of these, Budhabagar, Tansi Bazar and Thanti Bazar are the rural market areas where domestic animals including Naumuthe cow are not found. In Thapagaun which is small settlement close to powerhouse area some domestic animals are found but the presence of Naumuthe cow is not found in this settlement. The other settlements where domestic livestock are found are located on hill tops, far from the construction site hence no significant impact is expected to domestic animals due to project construction.

Q. Disturbance to Foot Trails

Construction of the project will affect existing foot trail along the right and left river banks just downstream of the dam site due to construction of access road to headwork and desanding basin. The foot trails of the powerhouse and surge shaft area will also be affected due to construction activities. The disturbance and damage of foot trails will affect movement of people and transportation of goods. The nature of impact is direct, low magnitude, site specific and short term.

R. Financial burden to local people

The construction work will require semi skilled and unskilled laborers. Most of the unskilled human resources required for the project will be hired at local level. The engagement of local laborers for the project will add pressure on availability of local laborer which ultimately will add burden to local people. The price of local consumable goods may also increase due to increase in demand of local products which further adds pressure on financial condition of local people. The nature of impact is indirect, low magnitude, site specific and short term.



5.3.3.3 Operation Phase

A. Loss of Agriculture Production

The annual production loss of cereal crops and cash crop from permanently acquired land is 47.02 MT. Out of the total production loss 87.32% is cereal crops and 12.68% cash crops. The loss of production will reduce income of local people and further increase the food deficit problem thus affecting livelihood. The magnitude of impact is moderate extent is site specific and duration is long term.

B. Withdrawal of Economic Opportunity

The reduction in economic activities and associated income loss after project construction is completed will have some impact on local people. The withdrawal or decrease in economic activity during operation and maintenance may affect the life style of the local people. As the consumption/expenditure habits of local people changed due increased income from construction phase. Therefore, the local people will face difficulties to manage their lifestyles once the economic activities will reduce and earning will significantly decline. This impact is felt more by vulnerable groups and women.

The magnitude of impact is low because the economic activities are limited and some might be continued during operation phase also. The extent is site specific and duration is medium term and indirect in nature.

C. Sudden Release of Water Downstream

As the project is PROR type, the reservoir will cover 13.43 ha area for water storage. Considering the large quantity of stored water in the reservoir sudden release of water from the reservoir will impact the downstream environment including human lives and livestock. Since settlements like Budhabagar, Tansi Bazar and Thanti Bazar are at road side and quite high altitude from the river bed the sudden release of water will have minimal impact. The magnitude of impact is low, extent is site specific and duration is long term and indirect in nature.

D. Occupational Health and Safety Hazard

Operation of the power plant also requires safety gears. Lack of training, operation and maintenance skill and unavailability of the necessary safety equipment may add further risk regarding safety. The nature of impact is direct, moderate magnitude, site specific and long term.

E. Changes in Aesthetic and Natural Beauty

The 2.06 km section of flowing river upstream of the dam will be changed in to a reservoir and forested and cultivated area will be changed to concrete structure which will change the aesthetic and natural beauty of the site forever. Since some of the project structures are underground and the coverage area of the project is very small in comparison to available natural area this impact is not considered significant.

F. Increase in Price of Consumable Goods

During operation phase only limited operation and maintenance staff (around 45 persons) will work in the power plant. The boom of construction will be settled down and there will be limited movement of outsiders. Hence this impact is not considered significant during project operation.

G. Water Uses

Water Mills

Altogether seven water mills are in operation from Budhi Ganga River and Ikri Gad confluence to Angali Gad confluence. As mentioned in baseline description, these water mills (Ghattas) are in operation by using the water of tributaries like Ikri Gad(1 water mill), Ardoli Gad (4 water mills) and Angali Gad (2 water mills) hence diversion of water for power generation will have no significant impacts to the water mill operated using water of Ikri Gad and Ardoli Gad. The water mill operating at the confluence area of Angali Gad with Budhi Ganga River is reported to use water of Budhi Ganga River in driest months. These two water mills need to be relocated in critical dry months below the Budhiganga Ardoli Gad confluence. The magnitude of impact is moderate, site specific and long term.

Cremation sites

Three cremation sites are found along the confluence of Budhi Ganga River with its tributaries between headworks to powerhouse site. As mentioned in baseline cremation site of Budhabagar Ghat is using water of Budhi Ganga River and others are using water of tributaries. Since Budhabagar Ghat is within 500m downstream of the dam the proposed riparian release of 0.99m³/s will be sufficient enough to meet the local requirement hence no significant impact is expected with respect to water diversion.

Irrigation

Budhi Ganga River is used for irrigation of 5 ha area at Thapagaun located between Angali Gad confluence and powerhouse tailrace. The estimated total water requirement is 10 liters/s. The diversion of water for power generation will affect the existing irrigation and drinking water requirement of the people of Thapagaun settlement in critical dry months. The nature of impact is direct, low magnitude, site specific and long term.

H. Disturbance to Domestic Animals

Movement of domestic animals along the flood plain area is noted in section of Ardoli Gad to powerhouse and further downstream of powerhouse tailrace. The domestic animals moving around may be affected by increase of sudden river flow. The reservoir is in a narrow gorge with steep slopes and the topography of the area is not suitable for rearing of domestic animals including Naumute cow hence this impact is not considered for the reservoir area.

I. Disturbance to Foot Trails

No significant impact is expected on foot trails and movement of local people and goods during project operation.

J. Livelihood

The project will acquire 17.34 ha private land for the placement of project structures and facilities. The acquisition of land will reduce food grains and cash crop production. The loss of production will reduce income of local people and further increase the food deficit problem thus affecting local livelihoods. Since fulltime fisherman are not found in project area and people involved in fishing mostly live in downstream of the project the likely reduction in fish catch will not have significant impact to people involved in occasional fishing. However, the reduction in fish catch

has low impact on protein consumption of river side villagers who are occasionally involved in fishing and fish is a source of their protein. The magnitude of impact is moderate, extent is site specific and of long duration.



Table 5-18: Prioritized value and significance of socio-economic and cultural impacts

SN	Activities/Resources	Impacts	Nature of Impacts		Weighting for Prioritized Impacts										Scoring Criteria for Significance Value				Prioritized Impacts	
					Magnitude			Extent			Duration			Total Prioritized Value	Importance of Impacts					Significance of Impacts
					H	M	L	R	L	S	LT	MT	ST		H	M	L			
			D	I	H	M	L	R	L	S	LT	MT	ST		H	M	L			
5.3.3.1 Pre- Construction Phase																				
i	Land	Acquisition of 17.34 ha private land for permanent structures and leasing of 8 ha private land for temporary facilities	D		60					10	20			90	3			270	H	
ii	House	Acquisition of 6 Kachi residential houses and 5 cowsheds	D		60					10	20			90	3			270	H	
iii	Explosive	Detrimental impact if not properly stored and managed	D				10			10			5	25		2		50	L	
iv	Private trees	Removal of 50 private trees including 20 fruit and 30 timber	D			20				10	20			50			1	50	L	
5.3.3.2 Construction Phase																				
i	Loss of crop	Annual loss of 30.27MT food crops	D			20					20			40	3			120	M	
ii	Livelihood	Acquisition of agricultural land, houses and cowsheds will affect livelihood of the people	D			20				10	20			50		2		100	M	
iii	Health and sanitation	Increase in waste and water pollution may leads to water borne disease	D			20				10			5	35		2		70	L	
iv	Occupational health and safety	Likely increase in construction related accidents, health hazards due to gaseous emission	D		60					10			5	75	3			225	H	
v	Law and order	Likely impact due to conflicts of interest between project and workers		I			10			10			5	25			1	25	L	
vi	Increased Economic activities	Impact due to increase in wages rate for agriculture labor, price hike of consumable goods		I			10			10			5	25			1	25	L	
vii	Sanfe- Martadi Road	Increase in traffic flow will add pressure on safety of road side settlement such as Thanti Bazar, Tansi Bazar, Sanfebagar and Budhabagar		I			10		20				5	35		2		70	L	
viii	Community infrastructure and services	Likely increase in pressure on drinking water, school, health post and local forest resources	D			20				10			5	35		2		70	L	
ix	Gender and vulnerable group	Likely discrimination of the women and vulnerable group while hiring the workers, employment to non local		I			10			10			5	25			1	25	L	
x	Blasting and tunneling	Likely impact on irrigation and water supply scheme in long run		I		20				10	20			50			1	50	L	
xi	Cremation, cultural and religious sites	Cremation site found at both bank below dam and access trail will be disturbed and submergence of Tithana shrine	D	I		20				10			5	35		2		70	L	
xii	Behavior of public	The available of cash may divert the workers towards gambling and more alcohol consumption		I			10			10			5	25			1	25	L	
xiii	Domestic violence and polygamy	Availability of cash may encourage the workers and local people towards gambling, more alcohol consumption which leads domestic violence and polygamy.		I			10			10			5	25			1	25	L	
xiv	Social and cultural practices	Likely disturbance in traditional cultural ways		I			10			10			5	25			1	25	L	
xv	Price hike	Likely inflation of prices of consumable goods		I		20				10			5	35			1	35	L	
xvi	Fire hazards	Risk of fire hazards at the explosive and petrochemical storage site	D		60					10			5	75		2		150	M	
xvii	Disturbance to foot trail	Foot trail below dam site at both banks , powerhouse and surge shaft area will be disturbed	D				10			10			5	25		2		50	L	

xviii	Financial burden to local people			I			10			10			5	25			1	25	L
5.3.3.3 Operation Phase																			
i	Loss of crop	Annual production loss of 47.02MT cereal crops and cash crop	D			20				10	20			50		2		100	M
ii	Withdrawal of economic opportunity	People will face difficulty to manage life style once the economic activities will reduce and earning drastically declined.		I			10			10		10		30			1	30	L
iii	Peoples safety due to sudden release	Likely increase in accidents due to variation in flow	D	I			10			10	20			40			1	40	L
iv	Health and safety	Safety risk due to unavailability of safety gears or not properly used by the employees	D		60					10	20			90		2		180	M
v	Water Uses	Impact on existing irrigation system at Thapagaun and 2 water mills located near Angali Gad confluence	D				10			10	20			40			1	40	L
vi	Livelihood	Acquisition of agricultural land, houses and cowsheds will affect livelihood of the people	D			20				10	20			50		2		100	M

Note: **Magnitude Weighting**
H= High (60)
M = Medium (20)
L =Low (10)

Extent (Weighting)
R= Regional (60)
L= Local (20)
S= Site specific (10)



Duration
LT= Long Term -20 (20 years and above)
MT= Medium Term- 10 (5-10 years)
ST= Short Term -5 (up to 5 years)

Prioritization of Impacts
H= Significance value 200 and above
M= Significance value 100 to below 200
L= Significance value below 100

5.4 Cumulative Impacts

The cumulative impact assessment has shown that a several impacts from the implementation of Budhi Ganga Hydropower Project are unavoidable, but their significance can be reduced by appropriate mitigation measures. The major cumulative impact will be on the river hydrology, which cannot be mitigated. The hydrology of the river will change considerably due to the diversion of the river water. There will be a decrease in water level between the dam to the powerhouse.

Altogether there are three hydropower schemes upstream and downstream of proposed in Budhi Ganga River. Out of them one is in detailed design stage (Budhi Ganga Khola Small HPP, 10.85 MW) and two projects are at feasibility level (Middle Budhi Ganga HPP 13 MW, and Seti River-6 (SR-6) Storage Project (301 MW).

The Budhi Ganga Khola Small Hydropower project is located about 14 km southwest of Martadi the district headquarter of Bajura district. The project is simple run of river scheme located far upstream of the Budhi Ganga Hydropower Project. The Middle Budhi Ganga Hydroelectric Project is about 3km upstream of the Budhi Ganga Hydropower Project. This project is also run of river scheme. The Budhi Ganga Hydropower Porject (20MW) is pondage run of river scheme whereas Seti River-6 (SR-6) is a Storage Project. SR-6 Storage Project is located 30 km downstream of the proposed Budhi Ganga Hydropower Project in West Seti River. Construction of BHP does not affect any of these three projects directly in terms of water diversion, physical project boundary etc.

The implementation of above mentioned project will divert the river flow for power generation thus reduced the river flow between the headworks to powerhouse stretch of the particular project. The reduction in river will affect aquatic fauna of the river. Further storage of water for power generation in Budhi Ganga HPP(daily peaking) and SR-6 Storage Project will affect the fish diversity in reservoir area by changing the river flow and water quality. The implementation of all 4 four project will affect forest land and private land for the placement of project structures and facilities. The loss of forest will further contribute towards declining of forest resources, reduction in wildlife habitat and disturbances to local fauna. The acquisition of land in proposed hydropower projects will affect the livelihood of the affected households. The magnitude of cumulative impact is low, extent is local and duration is long term.



6. ALTERNATIVE ANALYSIS

Alternative analysis of the project was carried out during the Feasibility Study in 1998 by METCON Consultant Pvt. Ltd. The current Detailed Engineering Design has been carried out on the recommended best alternative from the Feasibility Study as per the consultancy contract agreement. The description of the alternative analysis has been described in the following section based on the Feasibility Study.

Three more alternatives were identified as having possibly better potential than the site identified by MHSP during the Screening and Ranking Study. Available head, discharge, power generation, annual average energy and length of the tunnel for each of the alternatives were determined from the available maps and the sites were inspected during the site visit carried out prior to the preparation of the Inception Report.

6.1 Design Alternative

6.1.1 Alternative Project Layouts

The descriptions of all four options identified during the desk study are described below and presented in Figure 6-1.

6.1.1.1 Option 1

The Headwork is located about 300 m north-east of Rakshe in the central part of a 400 m long gorge in the Budhi Ganga River valley.

The proposed intake site lies at the downstream of the confluence of the Budhi Ganga River and Ikri Gad, which is a major tributary of the Budhi Ganga River. To reach the intake site, it is about four hours' trek from Sanfebagar. Construction of a district road is presently being undertaken along the right bank of the Budhi Ganga. The preliminary excavation of the road is almost complete up to the intake site making the site accessible during dry weather. The intake site is in a narrow gorge with near vertical rock cliffs 100 - 150 m high on both banks. The surrounding area is forest covered.

At the intake axis the river width is about 20 m with vertical 100-150 m high rocky cliffs on both banks.

The rock is thickly bedded massive granitic gneiss with individual bed thickness ranging from 1 to 3m.

The tunnel alignment passes through the left bank of the Budhi Ganga River in coincidence with the general strike of the bedrock and parallel to the hill slope. Hence it will pass through mostly granitic gneiss and augen gneiss with lesser amounts of feldspathic schist. These rocks can be categorized as 'fair' to 'good'. A number of small and large landslides are noted along the alignment, which will have no effect on tunnelling. The tunnel length along this alignment is estimated as 5,450 m.

The Powerhouse site lies near Thapagaun on the left bank of the Budhi Ganga River. The Powerhouse is located on flat agricultural cultivated terrace. Considering the space available at the end of the penstock alignment, a surface Powerhouse can be conveniently located near the

confluence of the Budhi Ganga River and Bimkoti Khola. Geologically this area is quite good, as the rock in the area comprises thickly bedded massive granitic gneiss with some augen gneiss. The general attitude of the bedrock is 25 Degrees' strike and 7-10 degrees' dip towards the East. Colluvial overburden cover is thin with vegetation cover consisting of grass and bushes. The estimated gross head available for power generation is 107 m. The access road length is approximately 15 km and construction of three permanent bridges will be required for this option.

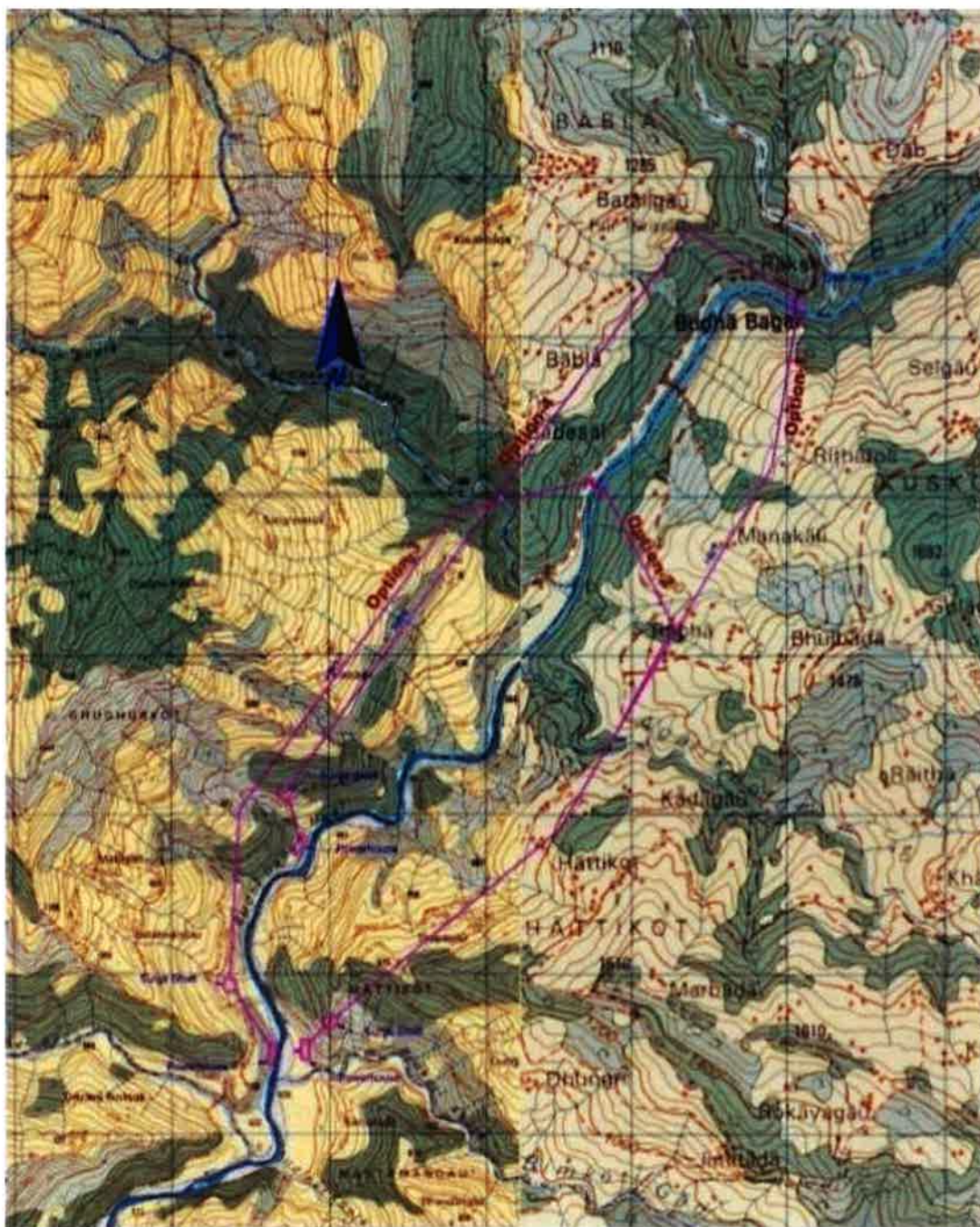


Figure 6-1: Layout of different alternatives

6.1.1.2 Option 2

The location of the Weir for this alternative is about 1800 m downstream of the Weir axis of option 1 and about 700 m south of Budha Bagar. The area is covered with thin forest with agricultural land along the river banks. The width of the river at the Weir axis is about 110 m. Because of the wide river valley at this location, there is ample space to store water for daily pondage. Some agricultural land will be submerged by the creation of the daily pondage reservoir. Bedrock at the Weir site is exposed on both banks of the river and is coarse grained massive, thickly bedded granitic gneiss with an attitude of 110° dip direction and 20 degrees' dip. Poor geological conditions at this site and the submergence of agricultural land are the major drawbacks for this option.

Intake and Desanding basins will be located on the left bank. A surface Desanding basin can be constructed because of the wide river valley.

The Powerhouse for this alternative will be near Thapagaun, at the same location as proposed for Option 1. Gross head available is 98 m.

Bedrock at the Weir site is exposed on both banks of the river and is coarse grained massive, thickly bedded granitic gneiss with an attitude of 11° dip direction and 20° dip.

The diversion tunnel will pass through the left bank and will more or less follow the same alignment as that of option 1. The estimated length of the tunnel is 4,140 m. The access road length is approximately 12 km and three permanent bridges will be required for this option.

6.1.1.3 Option 3

The location of the Weir site for this alternative is at the same site as proposed for Option 2 that is 700 m downstream of the Budha Bagar village. For this alternative all project structures will be on the right bank of the Budhi Ganga River.

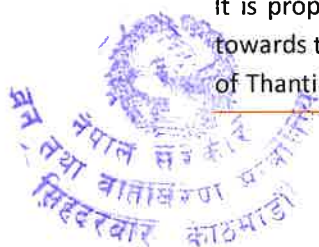
The Headrace tunnel alignment is in a north-westerly direction for a few hundred meters and then turns to the Southwest along the right bank. The Tunnel alignment will cross Ardoli Gad a major tributary of the Budhi Ganga River. To maintain cover over the Headrace tunnel it will be necessary to locate it in steeper topography. This result in a longer tunnel which is reflected in the cost of the project. This alignment will also cross a several large and small active landslides developed on the hill slopes. The tunnel length for this option is 4,570 m.

The Powerhouse site is located close to Thanti Bazar and will be an underground structure because there is insufficient space for construction of a surface Powerhouse. Use of heavy machinery and blasting for construction of the underground structures could possibly affect the settlements above. Total head available for power generation is 98 m. The access road length is approximately 12 km and construction of three permanent bridges will be required.

6.1.1.4 Option 4

The Weir site for this alternative is same as that proposed for Option 1 downstream of the confluence of Budhi Ganga River with Ikri Gad.

It is proposed to route the Headrace tunnel through the right bank of the Budhi Ganga River towards the northwest for a few hundred meters and then Southwest to a Powerhouse site north of Thanti Bazar. This side of the river has many large and small active landslides as the hill slope



and dip direction of the bedrock are in the same direction. The tunnel alignment crosses the Ardoli Gad and several other dip-cutting streams and gorges. This will necessitate locating of the major part of the tunnel alignment further to the NW, which will add to the project cost. The tunnel length is estimated as 4,500 m.

The Powerhouse site for this alternative lies a few hundred metres north of Thanti Bazar. At this location the hill slope is 40-50 degrees towards the South-west. The bedrock exposed in the vicinity is granite gneiss. There is not sufficient space for locating a surface powerhouse and therefore the structure needs to be placed underground. The advantage of this layout is accessibility because of the proximity of the road along the right bank. The head available is 100 m. The access road length is approximately 15 km and three new permanent bridges will need to be built.

Except for Option 2 where the Desander is on the surface, the Desanders for all other options are underground.

An economic comparison of the various options was also carried out using the parameters developed for the Screening and Ranking Studies. The results are tabulated in Table 6-1.

6.1.2 Recommended Option for Study

A consultant's team visited the project site and conducted a field study. Based on the study, all four options were evaluated on their geological, environmental and economic considerations. A comparison of all four options is presented in Table 6-1.

Table 6-1: Comparison of salient features of the four options

Description	Option-1	Option-2	Option-3	Option-4
Discharge (m ³ /sec)	22.3	22.3	22.3	22.3
Head (m)	107	98	98	100
Length of Weir (m)	55	110	110	55
Power Output (MW)	22	18	18	19
Annual Energy (GWh)	153.1	126.1	126.1	133.2
Access Road (Km)	15	12	12	15
Bridges (no.)	3	3	2	2
Tunnel Length (Km)	5.45	4.14	4.57	4.5
Project Cost (USD)	50073105	47402976	47526021	44753393
Annual Cost (USD)	5551104	5255094	5268735	4961361
Generation Cost (USD)/KW/h	0.036	0.042	0.042	0.037

Options 2 and 3 were dropped from further consideration because of poor geological and morphological conditions prevailing at the site, environmental concerns and the high cost of unit energy generation.

The energy generation cost for Options 1 and 4 are around the same value (US\$ 3.6/Kwh) but the average energy output for Option 1 is higher (153 Gwh for Option 1 compared to 133 Gwh for Option 4). Based on the optimisation studies as well as from a geological and environmental perspective, Option 1 was selected for further design.

6.2 Construction Method Alternatives

Construction methodology will be based on intensive technologies of construction equipment and maximum utilization of local resources to the extent possible. This is to ensure lowest possible cost for project development and ensure quality in the works undertaken. Due priority will be given for the recruitment of local people which will minimize the requirement of temporary camps, reduce fuel wood and timber requirement, enhance local skills and economy and develop better relationships between the project and local people. The surface construction work will be scheduled in daylight and night construction will be limited to underground work. Controlled blasting will be practiced always while excavating the underground area to have a minimum vibration impact on house structures located close to the tunnel alignment. This will minimize the impact on local topography, structural damages in nearby settlement and unnecessary disturbances to local community. Drilling work site will be selected away from the settlement whereas movement of vehicle in construction areas will be controlled to minimize likely damage.

The implementation of the project will require sand and aggregate which will be used from the proposed quarry sites and crushing the excavated materials from tunnel construction.

6.3 Project Alternatives

Such alternatives consider other modes of electricity supply to fulfil similar requirements for the regional development as would be achieved by installation of hydropower. The people within the zone of influence require safe, efficient, cheap and reliable energy for daily lighting and cooking activities. At the same time, there is an urgent need to conserve the environment in terms of physical, biological, social and cultural aspects. Possible alternative options to achieve above-said prospect would include solar power, wind power, thermal power, fossil fuel and firewood. Power import from neighbouring countries is another option.

Solar and wind power are also sources of clean energy which create or produce very less environmental degradation. However, the potential of both solar and wind power on large extent depends on the sunshine hour and wind velocity which may not be available all the time. Besides, there are problems associated with these sources. Some household in the project affected area have small solar panels for lightning purposes that are not sufficient as they need more power for cooking, lightning, heating, running electronic and electrical equipment's and others.

Related problems in the operation of wind power are lack of time series data of wind, and trained human resources and intricate design of wind turbines. Thus, the solar and wind power could not be an appropriate alternate for this size project.

Thermal power plant is associated with serious environmental problems like air pollution due to CO₂ emission, sludge handling, high noise, high temperature and fire hazard. Besides, petroleum products are imported from abroad, price is continuously increasing, and there is a problem of spare parts and their high cost. Nepal is surrounded by India in the south, east and west and China to the north. Nepal has been importing power from India where the power is already in acute shortage. Various problems have arisen during its import such as lack of high voltage transmission line, low voltage at certain time of the day and irregular supply schedule. High mountain barrier has made power import inaccessible and costly from China. Thus, it is an optimum necessity to seek out the permanent source of electricity within Nepal for the continuous supply of electricity.

For these reasons, power import from neighbouring countries are not currently a sustainable solution for Nepal.

Considering the above alternatives, hydropower can be the best option to serve the purpose of electricity requirement of the country.

6.4 Construction Material Alternatives

Physical resources are consumed for the construction of proposed project. The materials to be used are boulders (stones) for gabion and walls, gabion wires, masonry wall, brick or concrete block, aggregates for concreting. Other local resources will be quarry and borrow areas used from the area. Reinforcement bars and cement will also need to be transported from other places of the country or outside of country. Electro-mechanical equipment needs to be imported from overseas manufacturers. There are no other cost-effective alternatives for the above materials in construction works of the project.

The construction is intended to be carried out by conventional method, whereas earthwork, construction of simple structure such as drains, gabion walls, bio-engineering works etc. will be carried out manually.

6.5 Construction Schedule Alternatives

The estimated project construction period is 4 years from the date of commencement of the work. The construction works are mainly of two types - surface construction works and underground construction works. The surface construction works will be carried out only in dry season. But the underground structures such as desander, tunnel, surge shaft and other structures can be constructed throughout the year irrespective of weather and climatic conditions. All the surface work will be scheduled in day light.

6.6 No Forest Option

The no forest option helps to conserve and protect some forest land (18.20 ha) for optimal option selected for the project. It will obviously provide ecosystem services, soil and nutrient conservation, habitat for wildlife, source of fuel wood, forage and fodder to local people and other forest based raw materials but it will seriously undermine the development of proposed option that is renewable and clean source of energy. The long-term operation of the project far outweighs the ecosystem and economic services provided by the forest under project effect. The project will provide continuous source of clean energy that will displace existing use of fossils fuels and fuel woods, help to conserve more forest area that will be degraded in the future that has negative impact on forest and human health in the long run.

The project's layout option is such that minimal forest area is required. Except for forest land required by reservoir, project component roads and adit the other structures and facilities are either underground or on private land hence forest requirement is limited which will be compensated as per the Guideline for the Allocation of Forest Land for National Priority Project 2074 and other mitigation programs as proposed in Chapter 7.

6.7 No Project Alternative

This alternative prevents the implementation of the Proposal, and will therefore forfeit the beneficial impacts identified in Chapter 6. This Proposal aims to provide electricity to remote rural areas of Achham and Bajura districts and providing reliable power to the national power grid. Similarly, limitation exists to access clean energy in rural areas. This situation calls for rapid expansion of power projects. Furthermore, electricity is synonymous with development. Household amenities, commerce and industry all depend on the reliable power supply. Thus, the project is a necessity of the country.

The total installed capacity of Nepal is 972.49 MW of which 918.98 MW is hydropower, 53.41 MW thermal and 0.1 MW solar energy (NEA 2017). The demand of electricity in the country is increasing day by day and the existing power deficit has been managed by NEA by scheduling electricity supply and import from India. The National Water Plan 2007 – 2027 (NWP) was prepared to implement the Water Sector Strategy of Nepal. The Plan targets an increase in Nepal's hydropower generation from 600 MW in 2007 to 4,000 MW by 2027. If hydropower generation is not continued, power shortage will continue and hamper the overall socio-economic development of the country.

Electricity consumption is one of the parameters to assess the prosperity of the people. Activities like running rice mill, flour mill, saw mill, oil mill, nursing home operation (x-ray, pathology, operation), photo processing, secretarial services (computer typing, printing, e-mail and internet operation, sending and receiving fax) these all and other activities depend on electricity. In fact, the demand for electricity is increasing and there are difficulties in meeting the requirement. Access to power is an increasing necessity of life. In this age of information technology, the power availability must be increased. Therefore, absence of the proposed project would result in a significant loss of social wellbeings.

Similarly, no project alternative means the non-use of potential power generation, loss of job opportunity, continuation on power shortage, and also depriving of the other economic benefit due to project implementation. In a country where unemployment is very high and clean energy is in shortage, a do nothing scenario is a regressive approach and is very difficult to accept.

The do-nothing situation will prevent some of the environmental adverse impacts at the cost of isolation, difficulty in access, remoteness, malnutrition and increasing poverty. In balancing the trade-offs with the No-action option, this alternative is regarded as not acceptable in the interest of national development.

6.8 Operation Procedure

Operation of the project comprises of semi automatic control system. A team of qualified staff will run the project and no adverse impact is anticipated to the local population or environment. It would rather benefit the local community through increased employment opportunities, communication facilities and supply for rural electricity. The project will be operated as per requirement of INPS.



6.9 Design of Fish Pass

A fish pass is designed on the right bank of Budhi Ganga River across the Dam of Budhi Ganga Hydropower Project to facilitate migration of fish. Fish passes usually consist of a sloping channel partitioned by weirs, baffles, or vanes with openings for fish to swim through. The in-channel devices act hydraulically together to produce flow conditions that fish can navigate. Several types of fish passes have been developed and are usually distinguished by the arrangement of in-channel devices. Although several variations of each fish pass type exist, fish passes are classified into vertical slot, Denil, weir and culvert fish passes. Excavated channels utilizing rocks, sills or weirs are also used as fish passes. The different physical and hydraulic characteristics of each fish pass type may make them suitable for some fish species and not suitable for others. Several types of fish passes have been developed and the most common are described below. An effective fish pass attracts fish readily and allows them to enter, pass through, and exit safely with minimum cost to the fish in time and energy.

6.9.1 Vertical slot fish pass

In vertical slot fish pass, vertical baffles are installed at regular interval to create pools. Vertical slots in alternate position are provided for easy travel of fish between pools. Water velocity in the slot is maintained constant from top to bottom in the slot. This type of pass can work for variable head between pools. In general the head difference between successive pools is maintained between 200 to 300 mm. A longitudinal slope of less than 10% is recommended.

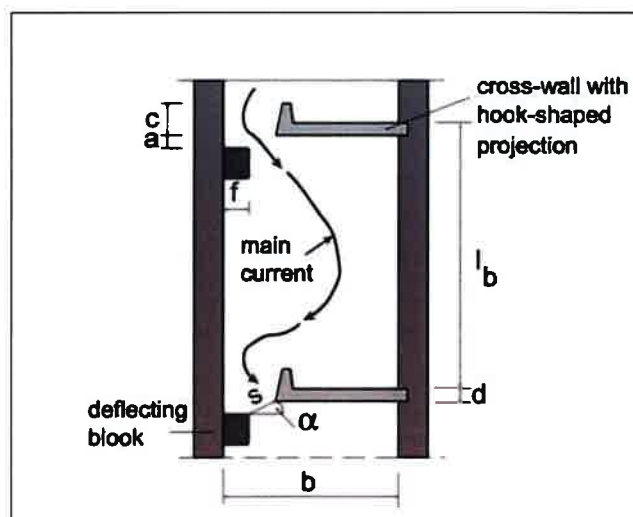


Figure 6-2: Vertical slot fish pass

6.9.2 Denil Fish Pass

Denil fish pass is named after its inventor, Denil, a Belgian Engineer who developed this in the early 20th century. Denil fish pass consists of a rectangular chute with closely spaced baffles along the side and bottom of the channel. Flow through Denil pass is highly turbulent with large momentum exchange and high energy dissipation. This reduces the deposition of sediment in the chute and provides attraction for few species. Resting pools need to be provided at every 10 to 15m for salmon and 5 to 10 m for other species. Slopes for Denil fish-ways usually range from 10% to 15% for adult freshwater fish and 15% to 25% for adult salmon.

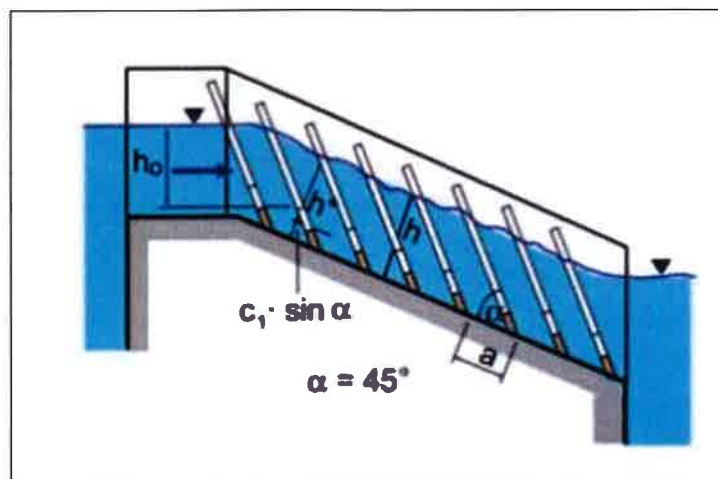


Figure 6-3: Denil fish pass

6.9.3 Weir and Pool Fish Pass

The weir and pool fish pass consists of a number of pools arranged in a stepped pattern separated by weirs, each of which is slightly higher than the one immediately downstream. The fish, attracted by the flowing water, move from pool to pool by jumping or swimming (depending on the water depth) until they have cleared the obstruction. Movement between pools usually involves burst speeds. Fish can rest in the pools, if necessary as they move through the fish pass.

Out of 17 species found in the Budhi Ganga River, major dominant migratory fish species are of jumping and bottom to middle depth dwelling. It is found that 3 species are jumping and 3 species are swimming in the middle depth of channel during migration. Since their migration takes place from downstream to upstream, water fall movement of Weir and pool fish pass is considerably attractive. Weir and pool fish pass with bottom orifice may cater the migratory needs of both jumping and swimming type species, hence it is selected for Budhi Ganga dam to allow free movement of the diverse species of fish found in the river.



7. MITIGATION AND ENHANCEMENT MEASURES

7.1 General

The development of hydropower projects has both positive and adverse impact on the existing environment and similar impact is expected due to implementation of BHP. The impacts are direct and indirect at household and community levels.

7.2 Enhancement Measures for the Positive Impacts

In this section the following mitigation and enhancement measures are proposed to minimize the adverse impacts of the project and enhance the positive impacts that are identified during the EIA at different stages of project implementation. In addition community support programs are proposed as a part of corporate social responsibility. BHP as the project proponent will implement the proposed enhancement measures as a prime responsibility.

7.2.1 Construction Phase

7.2.1.1 Priority for Employment to Local People

Priority for employment will be given to local people in construction and other project activities as per their skills and qualifications. Priority will be given for employment to the project affected families and vulnerable groups particularly Dalits and women. The project will require about 75 skilled, 150 semi-skilled and 175 unskilled people during its construction period of 4 years. Out of this required workforce unskilled workers will be hired from the project area as available. Similarly, due priority will be given for hiring skilled and semi-skilled persons available in the project area and the districts. The proponent will give employment priority in following order. This will be ensured by incorporating relevant clause in tender document. The list of the PAFs along with preferential hiring will be provided to contractors and consultants. The following preferential criteria should be followed by contractors and consultants while hiring required workforce for the project.

- Severely Project Affected Families (SPAfs)
- Marginally Project Affected Families (MPAFs)
- Women, disadvantage group and Dalit
- People of project affected municipality/rural municipality
- People of Achham and Bajura districts
- Nepali citizens
- Foreigners as required

7.2.1.2 Promotion of Enterprise Development and Commercialization

During the construction period, different types of commercial activities (existing or new ones) such as shops, groceries, hotel/lodges, restaurants, stationery shops, medical halls, cyber cafe etc. will come into operation to meet the demand of the project workers and others. This will increase demand for local products such as milk, meat, eggs, fresh vegetables and fruits which will help to promote agricultural production of the area, generate employment and boost the local economy.



The project will help entrepreneurship development and commercialization in the project area by providing opportunities for the local entrepreneurs/cooperatives for providing required goods and services for the project personnel. Agreements will be made with interested suppliers and local cooperatives for supply of daily consumption goods and agricultural products for the project people. The project affected families will be encouraged to undertake such entrepreneurship development activities.

7.2.2 Operation Phase

7.2.2.1 Employment for Local People

Supporting staff for operation of the project will be hired from local area to the extent possible. Priority will be given for employment to the SPAFs and vulnerable groups.

7.3 Mitigation and Enhancement Measures

The project proponent will implement the proposed mitigation and enhancement measures as a prime responsibility. The adverse and beneficial impacts that are not identified during the study, if later discovered during the construction and operation phases will be mitigated by the proponent at its own cost. The project proponent will compensate the affected parties for losses of livelihoods or properties due to implementation of the project as per the prevailing law. The preventive, avoidance and mitigation measures proposed under the contractor's responsibility will be ensured by incorporation of appropriate tender clauses in tender documents. The major items proposed to be implemented by contractor is given below. The compliance of these measures will be ensured by compliance monitoring system proposed in the EMP. Budhi Ganga Environment Monitoring Unit and Safeguard Implementation and Grievance Management Unit has been proposed for the environmental management of the project. The project will coordinate and inform the stakeholder about the construction schedule prior to start of the work. Likewise transparency will be maintained in project construction works and implementation of mitigation measures including determination and distribution of the compensation.

7.3.1 Physical Environment

7.3.1.1 Pre-Construction Phase

i) Foot Trails

New foot trail to the cremation site located just below the dam along both banks of river will be constructed to provide easy access for the local people. The site located just below the dam along both river banks will be allowed for the use of local people. Attempt will be made to relocate the cremation sites further downstream in consultation with local people.

7.3.1.2 Construction Phase

i) Topography and Landscape

Preventive Measures

Controlled blasting will be practiced always while excavating the surface or underground area to have a minimum vibration impact in the surrounding areas. This will be ensured by incorporating relevant clauses in the tender document.



Mitigation Measures

Slope of the cutting areas especially in project component road will be maintained. The excavated areas will be treated by applying proper bio-engineering measures including shotcrete. Appropriate drainage structure will be made to minimize the soil erosion problem. Landscaping will be done in required sites.

ii) Land Use and Land Take

Avoidance Measures

Lower value production land (un-irrigated) has been proposed for temporary facilities. As fertile agricultural land is very limited in the core project, effort has been made to minimize the permanent and temporary land take in project design. To minimize the impact of land use changes some of the project structures are designed underground.

Avoiding land use changes completely is not possible, the selection of lower pondage FSL has already minimized the forest land and productive land take and land use changes to some extent. Likewise, selection of dam at upstream reaches with no settlement has minimized the productive land take and land use changes.

Mitigation Measures

Land affected by the temporary facilities will be reclaimed and existing land slopes will be properly maintained. Slope of the cutting areas will be maintained. The quarry sites and spoil deposit area along the river banks will be profiled and planted such that it has a similar landscape to equivalent areas prior to construction, and blends in with the profile of undisturbed areas. The top soil will be scraped off while preparing project areas (including during scaling and planning of surfaces) and stored for re-use in rehabilitating temporary acquired land and spoil areas.

Bio-engineering in combination with civil structures to prevent erosion and landslides will be adopted especially at project component roads. The land use on forest will be mitigated by implementing compensatory plantation in nearby area.

iii) Air Quality

Preventive and Avoidance Measures

Crusher plant is proposed away from settlement, school and sensitive areas. Open storage and heaping of loose soil in and around construction sites will be prohibited. All vehicles belonging to the project i.e. consultants, owner, contractors, will comply with the national emission standards and regular (monthly) check-up, for maintenance of all vehicles will be made mandatory. Use of breathing mask by construction workers in dust-prone areas such as crushing plant, batching plant, rock drilling areas, and tunnel will be compulsory. Visitors and other workers not related to muck work will be prohibited to enter the tunnel after blasting operation and mucking operations. These actions will be ensured by incorporating relevant clauses in tender document.

Mitigation Measures

To mitigate dust problems in the project area water will be sprayed on the roads and construction sites, during hot and dry periods at least twice a day. All trucks with construction material will be covered and the traffic on access and service road will be regulated, to minimize air pollution. Powerful ventilators will be provisioned for ventilating the tunnel area.

Engineering measures and biological and bio-technology measures followed by plantation at all the spoil disposal areas will be adopted to further ameliorate air pollution.

Regular maintenance of diesel generator sets, construction machinery and vehicles will be done. Construction vehicles complying with GoN emission standards will be used. Mufflers to all vehicles will be provided. Batching plants, crushing plants and the diesel generators will be provided with controlled stacks. Installation of cyclones in the stone crushers will be made mandatory. During tunnelling operations, dust will be generated during blasting. Blowers will be provided with dust handling system to capture generated dust especially during the tunnelling and blasting operations. Respirators to the laborers working close to the construction sites will be provided. Other mitigation measures proposed to minimize the impacts are timely removal of debris and its disposal in designated Muck Disposal Areas. These actions will be ensured by incorporating relevant clauses in tender document.

iv) Water Quality

Preventive measures

Disposal of muck, sludge, and other wastes directly into water bodies will be prohibited. An appropriate sewage and waste treatment plant will be constructed for solid waste disposal in the project area. This will be ensured by incorporating relevant clause in tender document.

Mitigation Measures

- The waste generated from batching plants, truck wash down, run-offs will be diverted to settling tanks before disposal.
- The runoff from the tunnel will be monitored and passed through a sedimentation basin where neutralization could be performed if extremely high pH values are observed.
- As much of the greenhouse gas emissions derive from anaerobic decomposition of organic matter from the inundated areas, clearance of the reservoir area for forest, trees and bushes, prior to filling is proposed.
- Berme will be made around storage tanks to control spillage of oil and fuel on to the ground and into water resources.
- Spent oils will be collected and stored in suitable storage tanks and disposed through incineration.
- Toilets with septic tanks in all camps will be provided at the rate of 1 toilet for 7 workers.
- Garbage and solid wastes generated by the workforce will be dumped safely away from water bodies.
- Construction and solid waste will be treated as per prevailing standards so that treated wastes will be harmless before they are disposed to water bodies

v) Land Degradation, Land Instability, Landslides and Soil Erosion

Bio-engineering will be carried out in disturbed areas and waste disposal sites will be compacted and re-vegetated. Slope protection structures such as revetment walls, retaining walls benches or terraces, riprap and spurs will be made to retain unstable soil masses. Appropriate catch drains to collect sub-surface water and to divert surface water to stabilize gullies in the possible landslide prone areas will be made.

The slopes will be treated properly by means of cutting the slope in gentle fashion following the benching method along with the construction of berms at certain interval for the accumulation of



gullies. The vulnerable slopes formed during construction could be protected with the help of wire-mesh and shotcrete along with the application of bioengineering.

Borrowing areas, quarrying sites, land occupied for contractors and workers' temporary camps, concrete batching plants, storage area etc. will be restored to its natural conditions with proper landscaping. Topsoil will be placed in cultivated areas and farmers will be paid for the land development cost in case of cultivated land. The private land used for temporary facilities will be taken on lease and compensated at the current market price based on production loss. The top soil will be placed at safe location for covering the disposal area after the completion of the construction works.

vi) Storage of Construction Materials and Construction Camps

Preventive and Avoidance Measures

The area used for the storage of construction material will be fenced off and entry of unauthorized person will be regulated with the help of security guards. Explosives will be obtained through designated process of Government of Nepal. Explosive material will be transported to the site by mobilizing Nepal Army as per existing practices in hydropower projects constructed so far in Nepal. The explosives will be stored in a separate building. Nepal police will be requested for the security of explosive materials and warning sign will be placed at the storage area. The electric detonators, detonating fuse, safety fuse, gelatin, battery, will also be stored close to explosive storage site.

Use of blasting material will be closely monitored and regulated. Construction materials will be stored within the area occupied by the project for such works. This will be ensured by incorporating relevant clause in tender document.

Mitigation Measures

Vehicles carrying construction materials will follow the weight limit prescribed by the Department of Road of Government of Nepal. Traffic regulation shall be followed and strictly monitored to avoid unnecessary damage. Vehicles operating within construction sites carrying spoil and other dust prone material shall be covered.

For the storage of petrochemicals, the floor will be concrete and berms will be constructed to avoid overflow impact. Precaution and warning signs and fire-fighting equipment will be placed at the storage areas. The private land to be used for the storage facilities will be compensated and rehabilitated to its natural condition prior to return to the respective land owners.

vii) Waste Disposal

Preventive Measures

A solid waste collection and storage system will be established in all the construction related camps and construction sites. This will be ensured by incorporating relevant clause in tender document.

Mitigation Measures

The collected waste will be segregated as to the property of the waste as degradable, glass, metals, plastics, cloths and leather etc. and will be stored in separate areas. These materials will be disposed off safely in landfill sites. The domestic waste will primarily consist of organic food

waste. Because this is easily biodegradable and non-hazardous it is proposed to dispose by burying and covering with soil. Waste generated from construction activities are usually inert material which are non-biodegradable e.g. empty cement bags and containers, rejected material, plastic, wooden planks, small structures etc. will be stored and kept separated instead of throwing haphazardly elsewhere.

viii) Spoil Disposal

Preventive and Avoidance Measures

Out of the total 454,500 m³ generated spoil material 30% (136,350 m³) will be used as aggregate and remaining will be disposed off at pre-identified, designated three muck disposal areas located at abandoned river terraces at right bank of Budhi Ganga River about 100 m downstream of the Sanfebagar settlement, private barren land and river terrace at about 1 km from the Sanfebagar, area near Kholsa. Attempt will be made to identify the other uses of spoil material such as land development.

Mitigation Measures

Muck disposal areas will be designed, developed and managed properly. The spoil will be disposed up to 2-4 m height depending on the topography of the site and fully compacted. Retaining structures will be constructed along with benching and drainage structures. Compensatory plantation will be done at the disposed site with suitable bioengineering measures. Top soil will be used at the top layer for better growth of plants.

ix) Contamination of Soil and Loss of Top Soil

Preventive and Avoidance Measures

Appropriate storage will be provided for storage of different kinds of material to prevent soil and water pollution.

Mitigation Measures

For the storage of petrochemicals, the floor will be concrete and berms will be constructed to avoid overflow impacts. Top soil will be scraped off while preparing project areas (including during scaling and planning of surfaces) and stored for re-use in rehabilitating temporary acquired land and spoil areas.

x) Noise and Vibration

Preventive and Avoidance Measures

Surface blasting activity will be limited or restricted during daytime only. Blasting operations will be conducted using limited detonators and in small lots. This will be incorporated in tender documents. Crusher plant, batching plant etc. will be established in isolation away from settlement, health post, school and sensitive ecological areas. Ear muffs will be provided to construction workers in noise-prone areas such as blasting for hard rock, excavation of tunnel and rock drilling. These actions will be ensured by incorporating relevant clauses in tender document.

Mitigation Measures

Workforce camps are proposed for construction sites to protect the people from noise and vibrations. All vehicles operating in the construction area will be maintained regularly as per the manufacturer's specifications. Special acoustic enclosures for diesel generators will be provided.



Noise barrier such as bund, thick plywood fence will be constructed at noise prone construction sites. Siren will be used to inform the settlements in the vicinity prior to blasting. Compensation will be given to house owners if structural damages occur as a direct result of project construction.

xi) Quarrying Activities

Preventive Measures

Five Potential quarry sites have been identified that are near the project site. These sites have massive deposition of rock and have nearly flat surface or gentle stable slopes. The removal of quarry will disturb about 2.2 ha river flood plain. Quarrying operations in the flood plain will be stripping operation rather than forming a big borrow pit at one location. The quarry operation will not excavate below the flowing water level of the river. Excavation of aggregates from the river wet channel will be prohibited.

xii) River Morphology and Drainage Pattern

Mitigation Measures

Quarrying operations in the flood plain will be stripping operation rather than forming a big borrow pit at one location. Appropriate river channel shall be made prior to diversion of the river.

7.3.1.3 Operation Phase

i) Microclimate

Mitigation Measures

The proposed environmental flow shall be released to maintain flow in the river and riverine ecosystem. The reservoir shall be operated in prescribed mode with maximum water level fluctuation of 6m daily.

ii) Hydrology and Sedimentation

Avoidance Measures

The minimum monthly flow for the driest month, January at the intake site is 9.9 m³/s. The project is designed considering 10% minimum dry period flow release from dam. The flushing of desander will be avoided during dry period.

Mitigation Measures

This compensation flow is estimate to maintain a continuum of the river, secure possibility for survival of aquatic life, secure drinking water for wildlife and domestic animals, and minimize adverse impacts associated with stagnant water. A flow 1.5 m³/s (0.99 m³/s riparian release and 0.51 m³/s contribution of tributaries) will be available up to 6.8 km downstream up to the powerhouse in driest month January. From the powerhouse, flow 26 m³/s along with contribution of tributaries and riparian release will be available during the peaking hours. However, during non peak hours only 1.5 m³/s will be available at tailrace outlet during driest month.

A warning system (Siren) will be installed at the riverbank downstream of tailrace to warn people about peaking releases. This warning system will cover at least the river downstream from the outlet of the power station to Sanfebagar the major nearest downstream settlement. In case of emergency, such as a sudden opening of the dam gates, warnings will be given with sirens along Budhi Ganga River from the dam. Residents will be educated on the functioning of the system.

To reduce the impact on water quality and river morphology downstream due to flushing from de-silting chambers, the flushing is to be done over longer period and during high flow periods during monsoon months.

iii) Water Quality

Preventive Measures

To avoid the death and decay of woody and leafy biomass in the reservoir area clearance of such vegetation from the inundation zone prior to filling of the reservoir will be carried out as well as weed control measures. The first flushing of the tunnel will be avoided in dry period. Necessary precaution shall be made to avoid contamination of water bodies with lubricants and toxic materials.

Mitigation Measures

Spoil disposal site will be managed to minimize or avoid water pollution during the dry period. Operation waste will be collected and managed to avoid soil and water resource contamination.

iv) Waste Disposal

Mitigation Measures

Operation waste mainly consists of waste generated from the human resources deployed for the operation of the power plant. Waste collection box will be placed at each residential building and offices which will be collected in containers and disposed by burying in pits and or burning.

v) River Morphology and Drainage Pattern

Preventive measures

Flushing and opening of gates will be done during high flow periods (monsoon) and over longer period.

Mitigation Measures

Necessary protection at left bank of powerhouse tailrace will be done if required to minimize erosion. Drainage structures constructed at temporary and permanent project sites will also reduce this impact. The use of boulders from powerhouse tailrace to Jijadi Gad Budhi Ganga confluence should be prohibited to prevent the risk of flood hazards. Flushing and opening of gates will be done in high flow periods (monsoon) and over longer period.

vi) Dam Safety and Seismic Hazards

Nepal has experienced several large earthquakes over the past several years, which has caused substantial damages to property and life. As a result, all hydropower projects in Nepal are in general vulnerable to some degree of seismic risk. For the present level study, the design seismic coefficients for the project components were estimated from relevant Nepali and Indian codes of practice.

Preventive and Avoidance measures

Considering the size of the structures of Budhi Ganga HPP and the minimal downstream risks of loss of life and property associated with their failure, a peak ground acceleration of 0.26g is used for the project. Project engineering design includes calculations of dynamic and seismic loads



during both construction and operation phases. The structural design of project component meets all the engineering standards.

The dam has been designed to withstand a 1,000 year flood surge. A siren warning will be established along the Budhi Ganga River downstream of the dam to ensure that the risk of loss of life and properties is minimized.

vii) Catchment Protection Program

Awareness program about the reduction in soil erosion by applying modern cultivation techniques, construction of check dams in tributaries, protection of water sources, plantation in barren land are the activities proposed to manage and conserve the immediate catchment of the project.

7.3.1.4 Cost

The estimated cost for the catchment protection works is NRs. 3.97 million. The items mentioned below are included in project design and will be incorporated in tender document as the part of civil work. These costs are tie up with other activities and included in total project cost. The cost for spoil disposal and siren warning system including others are part of civil work and included in total project cost. The contractor will implement above mentioned programs on behalf of the proponent. However, overall responsibilities for carrying out these mitigation measures lies with the developer.

- Cost required for rehabilitation work.
- Measures for slope failure and erosion control.
- Bioengineering works.
- Spoil disposal.
- Air, noise and water quality protection measures.
- Construction of adequate number of toilets at work sites and camp areas.
- Camp with adequate facilities such as good aeration and sanitation condition, kitchen facilities for group, toilet facilities with adequate water and drinking water supply shall be provided for project workers.
- Fencing of construction sites and other work related facilities.
- Stockpiling of construction materials.
- Placement of information and warning signs related to safety.
- Establishment and operation of solid waste collection and storage system in all the construction related camps and construction sites.
- Provision of alternative fuel for labor force/central dining facility.
- Proper storage of petrochemicals and placement of adequate precaution and warning signs and firefighting at storage areas.
- Availability of construction related safety equipment such as hard hats, safety boots, eye protection, masks, earmuffs etc.
- Establishment and operation of dispensary and availability of first aid kit at all work sites.
- Establishment of siren warning system

7.3.2 Biological Environment

7.3.2.1 Terrestrial Environment

1. Vegetation/Forest Resources

A. Pre-construction Phase

i) Forest Land

Land for land compensation

As per the provision of Guideline for the allocation of forest land for national priority project 2076 and Forest Act 2076 the proponent will purchase 18.20 ha land for replacement of forest land acquired for the project and handed to concerned division forest office. Such land will be provided in adjoining forest area with similar topography. Alternatively, the project can deposit cash in Forest Development Fund as per the provision made in Article 42 (5&7) of Forest Act 2076 .

Compensatory Plantation

Trees that are likely to be removed will be counted, marked and harvested with the proper forest techniques by involving technical staffs from the Division Forest Office of the project districts. Wood and other forest products extracted as part of the site clearance from the forest will be utilized as per the Forestry Regulations. The cost required for counting, cutting, stockpiling and transportation of the felled trees will be provided to related institutions and stakeholders. This cost is included in civil cost hence separate estimate is not included in this report.

The project will plant 10 saplings for each loss of tree. The proponent will plant and manage the planted site for 5 years or necessary cost for the plantation and management will be deposited in Forest Development Fund as per the provision made in Article 42(6) of the Forest Act and Guidelines for the Allocation of Forest Land for National Priority Project (2076).

Altogether 48,090 saplings will be planted by the project for the loss of 4809 trees (4481 poles and 328 trees) to fulfil the requirement of GoN. In addition, 29,120 saplings will be planted for the replacement of 18.20 ha land at 1,600 saplings/ha. The selection of plant species for afforestation program will be based on the species that are available as indigenous tree species in the natural surroundings. Due emphasis will be given towards planting of affected species, fodder trees and species commercially important. Malato, Tooni, Khirro, Kokkade, Pahadi Mahuwa, Amala, Simal, Siris and Uttisare the species proposed for plantation. The plant related agro-forestry will also be considered for plantation in area nearby farm land.

The proposed plantation sites are project road to surge shaft and adit, spoil disposal site and land purchased for land for land compensation of forest land. In addition, the area provided by the Division Forest Office, affected community forest users group will also be considered for plantation. Plantation program will be conducted in close coordination with the concerned Division Forest Office.

The cost required for the establishment and operation of forest nurseries, land clearance, fencing of the site, plantation and plantation site management (mulching, chipping, nurturing, caretaker Heralu and replacement cost) for 5 years is included under the cost estimate.



Preventive Measures

Mitigation Measures

For afforestation indigenous plants of protection category will be given priority and the program will be conducted in coordination with the CFUG and DFO of the concerned districts. In case of small life forms such as orchid spp. translocation of these plants will be made in adjacent forest area or nearest National Park.

Mitigation Measures

Degraded and unused natural habitats around the project site will be given priority for rehabilitation and thus alternate habitats will be developed. For maintaining agro-farming practices, forage development and plantation of fodder trees will be promoted. In temporary construction sites, rehabilitation works will be implemented after project construction completion.

B. Construction Phase

Preventive Measures

The long term effects of the environmental degradation could only be replenished from proper environmental protection measures. Project workers will be strictly banned from illegal harvesting of forest by incorporating appropriate clauses (heavy penalty to dismissal of job) in tender document and enforcing them.

Mitigation Measures

Forest conservation awareness programs will be conducted at 2 sites in project area covering the project workers, supervisors, representative of CFUGs and local people. The program aims to inform local people about the importance of forest conservation, existing rules and regulation regarding forest management and benefits of forest conservation including healthy ecosystem. Altogether 10 information boards consisting slogan related to forest conservation and warning sign will be placed in construction sites and public places in project area.

Preventive Measures

To minimize the need of forest products central dining facility for the work force is proposed. The sub contractor will run this and kerosene or LP gas will be used to meet its fuel requirements. During the construction of temporary and permanent housing facilities and other structures, the use of timber will be minimized and the use of other construction materials will be encouraged. Due priority will be given for the employment of local people to avoid building of more huts and

influx of labor force from outside. These actions will be ensured by incorporating relevant clauses in tender document.

iii) Harvesting of NTFP

Preventive Measures

The workforce will be prohibited from taking resources from the local forest. The project will prohibit the sale and purchase of NTFP in the camps. Informative and warning signs at centrally located construction site will be placed to create local awareness. These actions will be ensured by incorporating relevant clauses in tender document.

iv) Shrinkage of the Community Forest Area and Income Loss

Mitigation Measures

The compensatory plantation program will extend the forest area 4 times (48.25 ha) than the lost area (12.15 ha). The compensatory plantation program will be implemented on available barren land of the concerned community forest by involving them. This will provide direct financial benefits to them in addition to expansion of forest area.

v) Agro biodiversity

Mitigation Measures

Residents will be encouraged to grow traditionally cultivated agricultural crops as far as practicable. Agricultural Service Centers will be consulted for providing seeds and necessary technical support. Collection, drying and burning practices of invasive plants such as *Ageratina adenophora*, and *Lantana camara* will control such phenomenon.

C. Operation Phase

i) Access to Forests

Mitigation Measures

Forest conservation awareness program will be continued during the first year of project operation at 2 sites in project area covering project operation staff, representatives of CFUGs and local people.

2. Wildlife

A. Construction Phase

i) Habitat Loss

Preventive Measures

The clearing of trees will be done manually without use of herbicides. This will be ensured by incorporating relevant clause in tender document.

Compensatory Measures

The proposed compensatory plantation program will extend the forest area 4 times than the lost area which will reduce the impact of habitat loss in the long run. Further awareness for forest conservation will help to minimize the impact of habitat loss also by creating local level awareness.



ii) Construction Disturbances*Preventive Measures*

As far as possible construction work will be labor based. The project proponent will be responsible to avoid the unnecessary machinery disturbances and lighting. Night time blasting will be controlled and limited to underground works only. These actions will be ensured by incorporating relevant clauses in tender document. Due emphasis will be given to protect listed species during construction phase.

iii) Restrict Hunting and Poaching*Preventive Measures*

Project workers will be strictly banned from hunting and poaching and any other kind of illegal activities related to hunting and poaching. This will be ensured by incorporating relevant clause in tender document.

Mitigation Measures

Awareness for wildlife conservation will be implemented to minimize the adverse impacts on wildlife. The conservation awareness training will be given to project laborers, supervisors and local people. Altogether 2 awareness training will be conducted in project area during construction phase. The conservation program includes the importance of wildlife conservation, wildlife occurrence in the project area, existing rules and regulation with respect to wildlife and benefits associated with wildlife conservation. Due emphasis will be given for the conservation awareness of protected species including their habitat, behaviour, protection status in CITES and IUCN redlist etc. The program will be implanted in close coordination with local NGOs and CBOs. Altogether 10 information boards consisting of slogans related to wildlife conservation and warning signs will be placed in the project area.

iv) Biodiversity

Laborers will be instructed to carry out their duties with due care and not to damage the plants and animals. They will also be taught through awareness program about the value of biodiversity and role of plants and animals in maintaining the environmental balance through awareness program. Further the forest and wildlife awareness program will also minimize the impact.

B. Operation Phase**i) Awareness Program***Mitigation Measures*

The awareness for wildlife conservation program will be also conducted during first year of project operation. Altogether 2 awareness trainings will be conducted in the project area during first year of operation phase. The objective of the program is to make environment friendly operation of the project and to avoid unnecessary disturbances to fauna such as that incurred by electric light and vehicle movements during night hours.

3. Enhancement Measures

i) Planting of Non-timber Forest Products

To increase the income level of the affected Community Forest Users Group 30,000 saplings of non-timber forest species will be planted in the area. The proponent will provide the saplings of the NTF species to concerned 5 affected CFUGs and provide assistance for plantation. The management of the planted site will be done by concerned CFUGs as a part of local contribution. The program will be conducted in close coordination with Division Forest Office.

ii) Forest Management Training

The representative of community forest user's group will be trained for record keeping, community forest management and income generation activities within the forest area. The duration of the training will be 7 days which includes 5 days of class and 2 day observation tour. Delivery of lecture, slide shows, distribution of reading material and group discussion will be the modalities of the program. The program will be conducted in close coordination with Division Forest Office.

4. Cost

The estimated cost for mitigation and enhancement measures for terrestrial environment is NRs 41.77 million which includes NRs 37.88 million for construction phase and NRs 3.89 million for operation phase (Table 7-1). The cost for compensatory plantation and management of planted site (purchase of seedling, plantation cost, chipping and nurturing) for five years, land for land compensation for the forest land, placement of information and warning signs related to forest, wild animal, NTFP program and forest management training to CFUGs. The other mitigation programs such as minimize need of timber products, restriction in hunting and poaching by the labour force will be included in Tender document and these programs will be implemented by the contractor(s). Land cost for the plantation site is not included in proposed estimate since barren land is available near the project area.

Table 7-1: Mitigation cost for terrestrial environment

S.N.	Mitigation Enhancement Measures	Unit	Rate	Amount NRs. (in million)		
A	Mitigation Measures			Construction Phase	Operation Phase	Total
1	Purchase of forest land occupied by the permanent structures	18.20 ha	1267875	23.08	0	23.08
2	Planting and management of planted site for 5 years	77210 saplings	70 for saplings and plantation and 40 for 5 year management	5.40	3.09	8.49
3	Fencing of the plantation sites	56 ha	LS	4	0	4.00

4	Forest conservation awareness program	4 nos	LS	0.4	0.4	0.80
5	Wild animal conservation awareness program	4 nos	LS	0.4	0.4	0.80
6	Placement of Information board consisting informative and warning sign	20 nos	30000	0.6	0	0.60
	Sub- total A			33.88	3.89	37.77
B	Enhancement Measures					
1	NTF species plantation (30000) in CF area	30000 nos	100	3	0	3
2	Forest management training to CFUGs	1no	LS	1	0	1
	Sub -total B			4	0	4
	Total			37.88	3.89	41.77

7.3.2.2 Aquatic Environment

1. Fish and Aquatic Life

Construction Phase

i) Habitat Management

Preventive Measures

Water quality protection measures will be applied during temporary diversion of river. Attempt will be made to conserve the spawning and rearing ground found in Ardoli Gad, Angali Khola and Bhimkoti Gad. This will be ensured by incorporating appropriate clause in tender documenting a compliance monitoring system and site specific impact monitoring.

Mitigation Measures

Attempts will be made to trap the fish and release them upstream during river diversion. This will be ensured by incorporating relevant clause in tender document. Information and warning sign will be placed at construction sites close to the river. Altogether 10 information boards will be placed in the project area focusing on river side settlements and construction sites. Since plenty of spawning sites are found along the Budhi Ganga River and its major tributaries creation of additional spawning ground is not proposed.

ii) Water Quality Protection Measures

Preventive Measures

To minimize the impact on water quality during dam foundation construction, the construction waste such as cement and concrete slurry will not be discharged to the river water. This will be ensured by incorporating appropriate clause in tender document and implementing compliance monitoring system.

Mitigation Measures

Arrangement will be made to collect the unused waste materials for disposal in the designated muck/spoil disposal sites. Tunnel seepage water discharges will be collected in settling tanks/ponds outside the portal areas in a suitable location for sedimentation and treatment. The water discharged from aggregate washing plant will be collected in settling tanks/ponds at a suitable location for sedimentation and treatment. The water will then be released to the nearest water body. All spent grease, oil and mobil and unused or date expired toxic chemicals will be collected separately in plastic drums and stored in a safe place under shade. The contractor will be made responsive for required treatment operation through contractual clause.

iii) Fish Exploitation Management

Preventive Measures

Project workers will be restrictedly banned from illegal fishing using pesticides, electrical gears and explosive for fish capture in all rivers and streams in the project area. The project will prohibit the sale and purchase of locally captured fishes in the camps. This will be ensured by incorporating relevant clause in tender document.

Mitigation Measures

Fish conservation awareness program is proposed to inform the local community, people involved in fishing and project workers about the importance of conservation of fish and aquatic habitat, existing rules and regulation regarding fish and aquatic life and agencies working on the conservation of fish. The mode of awareness program will be delivery of lecture and audio visual shows. Local and regional FM Radio will be used to create such an awareness program.

The project management will develop enforcement mechanism in association with local government (Municipality and Rural Municipality), local leaders and Fisheries Development Directorate (FDD) GoN and Nepal Fisheries Society (NEFIS) to banned illegal fishing in the project area. Information and warning signs will be placed at construction sites close to river and streams.

Operation Phase

i) Fish Pass

Mitigation Measures

A pool and weir type fish pass is proposed at dam to facilitate fish migration. The fish pass consists of a number of pools arranged in a stepped pattern separated by weirs, each of which is slightly higher than the one immediately downstream. The fish, attracted by the flowing water, move from pool to pool by jumping or swimming (depending on the water depth) until they have cleared the obstruction. Movement between pools usually involves burst speeds. Fish can rest in the pools, if necessary as they move through the fish pass. An orifice may also be added to the submerged portion of the weir allowing the fish to pass through the orifice rather than over the weir. While simple to construct, the pool and weir is sensitive to fluctuating water levels and requires adjustments. The water level difference between pools is usually set at 200 to 300 mm. Weir and pool fish passes usually have a slope of less than 10%.



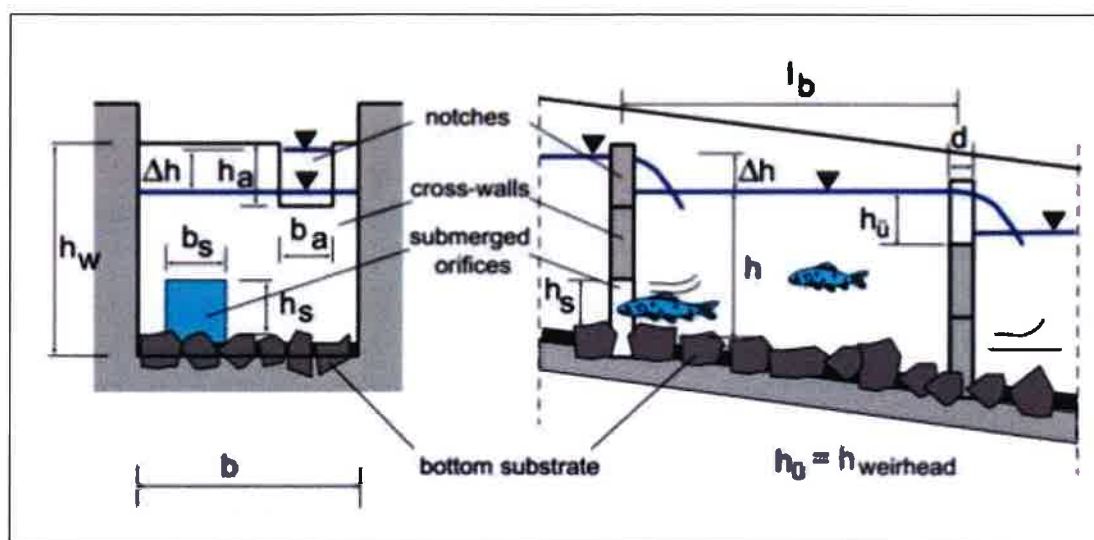


Figure 7-1: Weir and pool fish pass

Altogether 17 species of fish were collected from the Budhi Ganga River in the project area. Snow Trout contribute 54.57% of the total sampling catch. The contribution of River Rohu, Mahseer and Copper Mahseer is 10.09%, 9.15% and 7.57% respectively. Out of 17 species found in the Budhi Ganga River, major dominant migratory fish species are of jumping and bottom to middle depth dwelling. It is found that 3 species are jumping and 3 species are swimming in the middle depth of channel during migration. Since their migration takes place from downstream to upstream, water fall movement of Weir and pool fish pass is considerably attractive. Weir and pool fish pass with bottom orifice may cater the migratory needs of both jumping and swimming type species, hence it is selected for Budhi Ganga dam.

Hydraulic design of the above selected weir and pool fish pass has been carried out following FAO fish pass design guidelines. Parameters taken for the design are tabulated below.

Table 8-7-2: Input parameter for fish pass design

Parameter	Value	Unit	Remarks
Upstream reservoir level	712	masl	MOL
Downstream river level	694	masl	
Width of the pool	1.8	m	
Depth of the pool	1.3	m	
Energy dissipation for each pool	200	W/m ³	
Orifice width	0.4	m	
Orifice depth	0.4	m	

Table 8-7-3: Design Output for fish pass

Parameter	Value	Unit	Remarks
No of pool needed	89	No	
Length of pass	252.8	m	Minimum
Length of each pool	2.8	m	Outer
Thickness of baffle	150	mm	
Fish pass flow	0.68	m ³ /s	Total

Slope of the channel	7	%	
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A fish pass inlet i.e. dam outlet and fish pass outlet at the end of channel have been designed to maintain constant flow upstream and downstream to attract the movement of fish. Dam outlet has been designed for 10% extra discharge i.e. $0.75 \text{ m}^3/\text{s}$ as submerged orifice of size $1.2 \text{ m} \times 1.2 \text{ m}$ (b x h). Geometry of these structures are provided in drawings. Typical models of the channel and outlets for fish pass designed are presented below.

Considering the fish species, their migratory behavior, river hydrology, topography of the dam area and hydraulics, a weir and pool type fish pass is designed for Budhi Ganga Dam. Thus designed fish pass consists of 2.8 m long pools with 1.3 high weir with $0.4 \times 0.4 \text{ m}$ orifice at the bottom. This ensures maximum velocity through the orifice less than 2 m/s . To facilitate the movement of fish from the level of 694 masl to 712 masl, altogether 89 numbers of pools are provided. Longitudinal slope of 7% is provided for easy movement and to control the energy dissipation within each pool to the recommended value of 200 W/m^3 . Dam outlet of $1.2 \text{ m} \times 1.2 \text{ m}$ is provided as submerged orifice whereas fish pass outlet consists of a pool of size 3m width and 6.5 m length.

The proposed fish pass will allow the free migration of resident and migratory fishes such as Mahseer, Copper Mahseer, Eels, River Rohu, Snow Trout, Catfishes and Minor Carps. The objective of the pool and traverse fish way is to provide fish with a hydro-biological condition, which is optimal for leaping. The fish pass is designed in such a way to accommodate small fish (40 – 100 mm), as well as adult fish (300 – 450 mm) moving upstream.



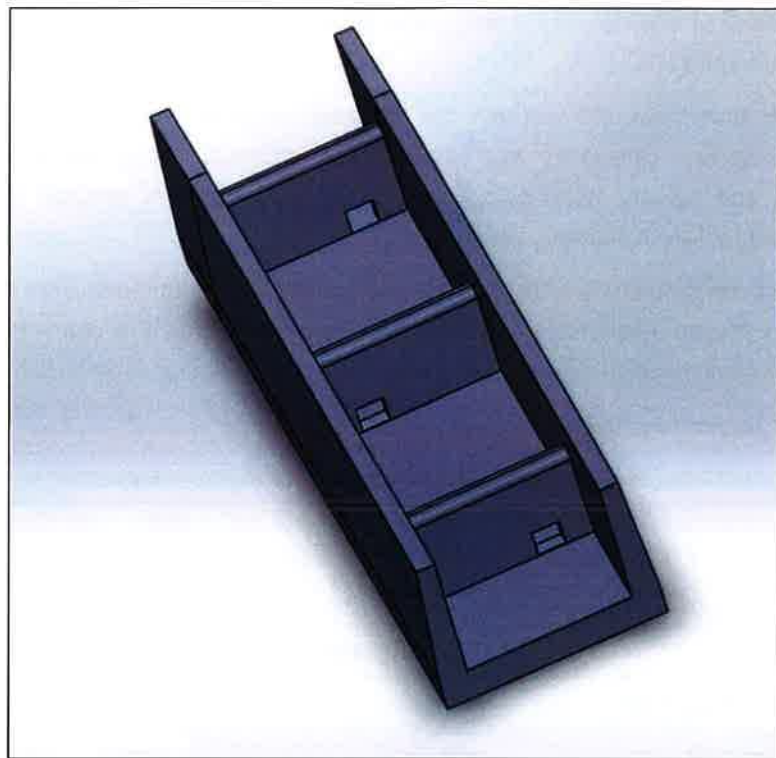


Figure 7-2: Typical weir and pool layout

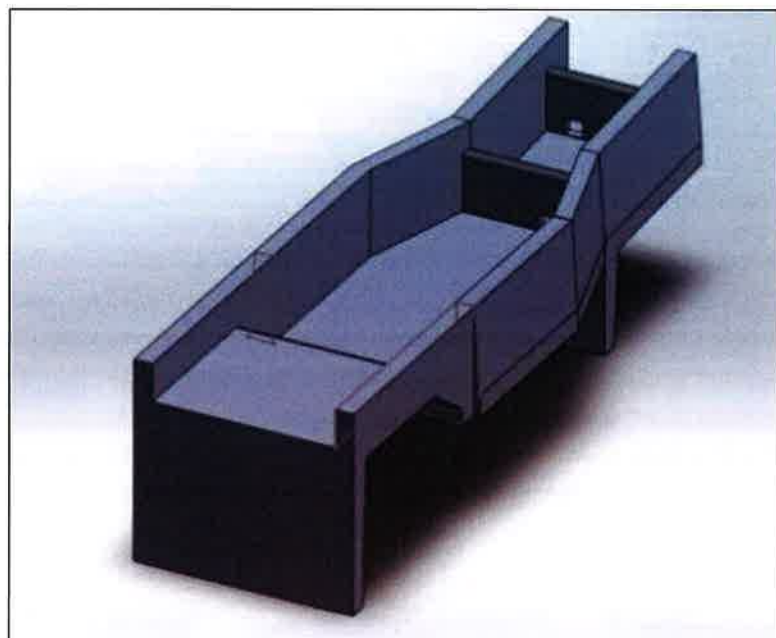


Figure 7-3: Fish pass outlet model

ii) Environmental Flow Release

Flow is a key feature in determining the complexity of aquatic habitats within the river's riffle, run and pool environment. In the above three environments of the river, the water flow velocity has a special relationship with the substrate that influences aquatic macro and micro invertebrates and algal growth, which are very important to riverine fish and river using predators. The proposed downstream flow will be released through the fish ladder. The proponent is responsible for the

management of downstream release and it will be ensured through the monitoring system proposed in the EMP.

There are more than 200 methods for the assessment of environmental flows which can be grouped into four categories: hydrological rules, hydraulic rating methods, habitat simulation methods, and holistic methodologies. Some of the important method for determination of environmental flow is discussed below.

In Nepal there is no study of minimum water requirements for survival of fish in nursery pools during dry season. Knowledge on the physical factors such as flow characteristics, temperature and water quality, which influences the migration and spawning of these fish species, is also poor.

Modified Tenant Method

To predict the impact of regulated flow hydrological methodology used by Montana or Tenant Method (Tenant 1976) used worldwide has been used in this study. Flow conditions with different regulated flows are evaluated during different months (Table 7-4).

Table 7-4: Flow regimens based on Tenant Method

Description	Monthly Average Flow (percent)	Rating or Score
Flushing or maximum	200	100
Optimum range	60 – 100	100
Outstanding	40 – 59	90
Excellent	30 – 39	80
Good	20 – 29	70
Fair	10 – 19	26 – 50
Minimum	10	25
Severe degradation	0 – 9	0 – 20

The study indicates that with the release of 0.99 m³/s of water the ecological condition of the river stretch between intake to Ardoli Gad will be severely degraded for 6 months (Table 7-5) and fish will mostly concentrate in pool section of the river. The fish composition data of Budhi Ganga River shows that Snow Trout (mid- range migrant) is dominant species found throughout the year. This fish spawns twice in a year, which consists March and April in dry period and September and October in wet season. The hydrological data shows that there will be maximum flow downstream in wet spawning months but in March and April, the habitat will be degraded as per Tenant method.

Table 7-5: Assessment based on 10% minimum mean monthly flow from intake

Month	Natural Flow	Proposed Diversion	Flow for Release/ proposed (10%)	Natural Flow (percent)	Modified Tenant Ranking Score
	Q (m ³ /s)				
January	9.9	8.91	0.99	10	Minimum
February	10.75	9.76	0.99	9.21	Severe degradation
March	11.89	10.9	0.99	8.33	Severe degradation
April	10.8	9.81	0.99	9.17	Severe degradation
May	14.83	13.84	0.99	6.68	Severe degradation
June	38	26	12	13.27	Fair
July	137.54	26	111.54	81.1	Optimum range

August	197.02	26	171.02	86.8	Optimum range
September	124.78	26	98.78	79.16	Optimum range
October	46.06	26	20.06	43.55	Outstanding
November	21.09	20.1	0.99	4.69	Severe degradation
December	13.77	12.78	0.99	7.19	Severe degradation

The data show that riverine condition of the above 6 months will improve only by the discharge of $2.11\text{m}^3/\text{s}$ in dry period which is 21.31% of the minimum mean monthly flow. This amount of release is not economically viable and such release of water will have serious implications on the hydropower output and to the economic cost benefit of the project. As mentioned in environmental baseline description, Snow Trout is the dominant species of Budhi Ganga River and represented 77.26% of the total sampling in dry period and 53.85% of the total catch in wet season. Snow Trout spawns twice in a year in the months of March and April and September-October. As shown in above table the riverine condition is optimum to outstanding in September-October and sufficient water is available for spawning and rearing but in March- April the proposed 10% release is not sufficient and needs to increase to improve the riverine condition to facilitate spawning and rearing of popular Snow Trout. The data shows that $1.2\text{m}^3/\text{s}$ is required to maintain minimum to fair habitat for this species. Hence $1.2\text{m}^3/\text{s}$ released is proposed for 2 months (March- April) during the breeding season and $0.99\text{m}^3/\text{s}$ in other months.

Furthermore, downstream tributaries contribute $0.51\text{m}^3/\text{s}$ (Ardoli Gad= $0.43\text{m}^3/\text{sec}$ and Angali Khola= $0.08\text{m}^3/\text{sec}$ in critical dry months (January-March) which are also considered a good contribution in terms of flow associated depth and velocity.

Therefore, considering the size, fish diversity, species type of Budhi Ganga River it is expected that the existing species will not be eliminated from the river but the population of Snow Trout, which is high value fish found throughout the year will decline to some extent. The population of Copper Mahseer, Mahseer and River Rohu will also be affected but comparatively less so since these fishes are mostly found in high water phases. The resident fish found in the River throughout the year are very small, of low food value and mostly prefer deep pool areas. Furthermore, Catfish is dominant among resident species which is tough in nature and can survive under worse conditions. Hence considering the above condition there will be minimum loss of these species in terms of diversity and composition. The proposed water release is considered appropriate for the survival of fish and aquatic life for 4 dry months except March and April.

iii) Restrict Fishing in Dewatered Zone

Fishing will be prohibited by project in 6.87 km reduced flow zone for about 7 dry months in coordination with local government. The project management will develop enforcement mechanism in association with local government, administration, local leaders and Nepal Fisheries Society (NEFIS) to ban illegal fishing in the project area. Project workers will be strictly prohibited from such kind of activities by incorporating appropriate clause in tender document. Two River guard will be appointed for 7 months in a year for 2 years from local communities to control such type of fishing activities. Information boards containing information and warnings regarding river pollution, use of fishing gears, dynamite, importance of fish conservation and habitat management will be placed at 1km intervals along the reduced flow zone and at public places close to Budhi Ganga River to inform people about restrictions to fishing.

2. Enhancement Measures

i) River Habitat Protection

Construction of 3 pools is proposed in reduced flow zone (Ardoli Budhi Ganga confluence to powerhouse tailrace). These pools will be created in such a way that there will be continuous flow between two pools. The size of pool will be 20 m × 5 m with depth ranges to 1 – 1.5 m. Different size of gavels and boulders will be deposited to increase fish spawning habitat. The boulder will be very useful to create depositional areas and generally create series of small artificial pool and increasing spawning opportunities. This is proposed for 2 years and will be extended if successful after evaluation.

ii) Aquaculture Promotion

The project will assist local people for aquaculture promotion in the area. This program will mainly focus on the study of the possibilities of aquaculture in the area, cage culture in the reservoir, training, distribution of fish fry and technical input to the local people.

3. Cost

The estimated cost of mitigation and enhancement measures for terrestrial environment is NRs 3.53 million for construction and operation phase (Table 7-6). This cost excludes construction and operation cost of fish ladder, water quality protection measures and other cost associated with civil works.

Table 7-6: Mitigation and enhancement measures cost for aquatic environment

SN	Mitigation Enhancement Measures	Quantity	Rate	Amount NRs. (in million)		
				Construction Phase	Operation Phase	Total
A	Mitigation Measures					
1	Placement of Hording boards for fish	10	30000	0.3	0	0.3
2	Fish conservation awareness program	4	200000	0.4	0.4	0.8
3	Restriction of fishing in reduced flow zone (6.8 km stretch)	28	10000	0	0.28	0.28
	Sub- total A			0.7	0.68	1.38
B	Enhancement Measures					
1	Aquatic Habitat management program	3	50000		0.15	0.15
2	Aquaculture promotion	LS			2	2
	Sub-total B			0	2.15	2.15
	Total			0.7	2.83	3.53



7.3.3.1 Pre- Construction Phase

Mitigation Measures

ii) Acquisition of Structures

Mitigation Measures

1. Kachi house with corrugated zinc sheet roof= NRs. 4,500/m²
2. Kachi house with stone roof= NRs. 5,000/m²
3. Kachi cowshed with corrugated zinc sheet roof= NRs. 1700/m²

Compensation for House and Cowshed

1. House: Total Area = 4,716 sqft= 438.13 sqm @ NRs 4750/m²= Total NRs. 2,081,118.
2. Cowshed: Total Area = 898 sqft= 83.43 sqm @ NRs 1700/m²= Total NRs. 141,831

Total cost for house and shed = NRs. 2,222,949 (2.222 million)

The total cost for acquisition of structure (house and cowshed) is estimated to be NRs. 2.22 million including NRs. 2.081 million for house and NRs. 0.142 million for cowshed. In addition land (5,614 sq ft) occupied by the house/cowshed will also be compensated and this cost is included under land acquisition cost. Owners will have the right to use salvage materials from the affected structures. The value of salvaged materials will not be deducted from the compensated amount. All 10 HHs affected by the acquisition of houses and cowshed have residential land in nearby areas hence resettlement is not required. However project will provide necessary assistance such as skill training, livelihood assistance, rehabilitation allowances and priority for employment to the affected households.

iii) Explosive Storage*Preventive and Avoidance Measures*

The area used for the storage of explosive material will be fenced off and entry of unauthorized person will be regulated with the help of security guards. The explosive will be stored in a separate building. Nepal police will be requested for the security of explosive materials and warning sign will be placed at the storage area. The electric detonators, detonating fuse, safety fuse, gelatin, battery, will also be stored close to explosive storage site.

Construction materials will be stored within the area occupied by the project for such works. This will be ensured by incorporating relevant clause in tender document.

Mitigation Measures

The storage and use of blasting material will be closely monitored and regulated. The storage site will be concrete. Precaution and warning signs and fire-fighting equipment will be placed at storage areas. Private land to be used for the storage facilities will be compensated and rehabilitated to its natural condition prior to return to the respective land owners.

iv) Loss of Fruit and Timber Trees*Mitigation Measures*

Compensation will be provided to the owner of trees to be felled by the project. Since the trees are pole size, the compensation is proposed based on the number of tree removed rather than lost wood volume. The rate given by the local people during the consultation meetings is considered for the estimate of the loss of private trees. The average rate taken for fodder and timber tree is NRs 12000/tree and 4500/tree for fruit trees. The estimated compensation cost for the private tree is N Rs 0.45 million.

7.3.3.2 Construction Phase**i) Loss of Crops, Agricultural Production and Livelihood***Mitigation Measures*

Compensation will be paid for the loss of standing crop at the prevailing market price. The amount will be paid immediately after the measurement of loss at site. The proposed enhancement measures will reduce this impact to an acceptable level.

ii) Leased Land*Mitigation Measures*

The project will require 8 ha khet land for temporary facilities of the project. The private land required for temporary facilities will be leased by negotiation with the landowners. A land lease agreement will be signed with the landowners for 4 years and payment will be given in advance for each calendar year. The 8 ha leased land will be handed over to concerned land owners after completion of the project construction in its original shape. Based on estimation of annual crop production per ha annual loss is NRs 30,177/year. Considering 4 year period for lease of land the estimated amount for 8 ha is NRs 0.97 million.

Rehabilitation Measures

The top soil removed from the leased land required for the permanent project facilities and temporary facilities will be stored at the proposed storage yards. The topsoil will be used for land reclamation and the temporarily leased reclaimed land will be provided to the owners. Excess top soil will be used at the top layer of spoil disposal site for the better growth of vegetation.

iii) Health and sanitation

Preventive Measures

Due priority will be given to the local people in project works to avoid the pressure on health and sanitation.

Mitigation Measures

Camp facilities will be provided for project workers. The campsites will have provision of basic infrastructure such as good aeration and sanitation conditions, kitchen facilities for group, toilet facilities with adequate water and drinking water supply. There will be enough space to accommodate the need of the workers and as per labor law standards. The temporary camps established by sub-contractor will have toilet and drinking water facilities. The drinking water sources will be tested prior to mobilization of the workers. Open defecation will be prohibited in and around construction sites, camp sites and in the river bank area. Information boards will be placed in construction camps and other important construction sites. A solid waste collection and storage system will be established in all construction related camps and construction sites. The collected waste will be segregated according to waste type degradable, glass, metals, plastics, cloths and leather etc. and all will be stored in separate allocated areas. Garbage containers of adequate size will be placed at critical places in the construction related camps and construction sites.

iv) Occupational Health and Safety Measures

Preventive Measures

The contractor shall develop a health and safety plan specifying construction safety, emergency evacuation plan, blasting plan. The plan shall be approved by the construction supervision Consultant and based on which construction work will be conducted and monitored. This will be ensured by including appropriate clause in tender document. Pre-information will be given to local people on the start date of project construction works and the range of activities to be undertaken. A guideline will be developed for construction vehicle operation (speed limits, use of horn, parking on the road and off the road etc.) and meet pollution criteria green stickers. Prior information will be given through sirens 10 minutes before blasting operations and 10 minutes after the blasting operation.

Mitigation Measures

The construction area will be declared as hard hat area and all the necessary precaution and warning sign will be placed at work site. Information boards and traffic signs will be placed at critical locations regarding traffic movement, speed limits, use of horns etc.

Hard hats, eye protection, safety boot, ear plugs, good electric light system, power-cutting devices, fire-fighting accessories, caution signals and other safety equipment as required at worksite will be provided. Toilet facilities, drinking water and use of mask are the other mitigation

measures proposed to minimize impacts associate with occupational safety. Proper adjustment of ventilators in tunnel will be made.

Dispensary with one medical doctor, Health Assistant and one nurse will be established at the main construction site (dam site). The Provision of first aid facilities will be made at all construction sites. One standby ambulance will be available to carry emergency cases (injury/serious cases) at the earliest to project site hospital and other referral hospitals. Provision of helipad for emergency evacuation of injured or other people will be made.

First aid kit and stabilizing equipment/facilities will be available to the injured people before he/she could be moved to the nearest hospital. Likewise, adequate medical stock will be kept for water borne diseases to tackle the epidemic in the camp or in the villages surrounding the project site. Fire-fighting equipment and trained personnel to fight fire hazards will be available in key areas to tackle the problem.

Regular training (at least once in three months) to the construction workers and health and safety issues of the construction works will be conducted. In addition, emergency preparedness training and on site exercise will be conducted every 6 months.

Workers assigned for tunnelling and other risky type of work will be insured against accidents. Similarly, the project proponent will compensate the affected parties for the loss of lives if any due to implementation of the project as per prevailing law of Nepal.

v) Law and Order

Preventive Measures

The project will develop a good coordination mechanism with local government and district level administration of GoN. Cordial relation will also be established with NGOs/CBOs, political parties, local people and project workers.

Mitigation Measures

Security personnel/guards will be hired from private firms or locally by the project. The security personal will be posted at the key entrance areas to provide security for people and equipment. Existing security facilities of GoN will also be used.

A project information center will be established in the project area to disseminate information related to project activities. This will help to minimize the misunderstanding with local people and provide platform for sharing/interaction. The information center will produce monthly bulletin in Nepali and conduct periodic consultation with concerned stakeholders. The cost required for the establishment and operation of information center is given in the chapter on Environment Management Plan.

vi) Community Awareness Programs

Mitigation Measures

Community awareness programs will be implemented by the project for the proper use of compensation amount, areas of employment and likely effect on people due to withdrawal of economic opportunity in the area. The awareness programs will also include problem associated with social and cultural decline, human trafficking, domestic violence, Chaupadi culture, STDs and HIV/AIDS. Methods of awareness program will include organization of lectures, distribution of



pamphlets, posters, audiovisuals and mobilization of local NGOs/CBOs. Local FM radio will also be used for supporting the awareness program.

vii) Sanfe-Martadi Road

Preventive Measures

Project vehicles operating on public roads will follow the norms of road department regarding carrying capacity. Any vehicle exceeding prescribed loads will be stopped and penalized immediately. The assistance of local traffic office located at Thanti Bazar will be taken regarding traffic management.

Mitigation Measures

The likely damage in Sanfe-Martadi Road between headworks and powerhouse site will be repaired by the project after construction completion.

viii) Community Infrastructure and Resources

Preventive Measures

The project will use existing drinking water source without disturbing the water need of local people. Provision will be made for a central dining facility for the project workers which will use LPG to minimize the impact on forest resources. This will be ensured by incorporating relevant clause in tender document.

Mitigation Measures

A dispensary will be established by the project which will provide health services to project workers. First Aid Kits will be available at all work sites to provide immediate primary treatment. The community support program mentioned below will also help to minimize the pressure on community infrastructure. The foot trail disturbed during construction will be renovated or new foot trail in nearby area will be constructed.

ix) Gender and vulnerable groups

Preventive Measures

The proponent will not discriminate based on gender, caste, color or place of origin while hiring the workforce for the project. The project will completely ban the use of child labor in accordance with Nepalese labor laws. This will be ensured by incorporating relevant clause in tender document.

Mitigation Measures

The rehabilitation measures such as skill training, agricultural assistance, and priority for employment is also applicable to vulnerable households. Due priority will be given to project related employment and other benefits to vulnerable groups and poor people in the immediate project area. Employment for women will be encouraged in the project and it shall be ensured that employment regulations shall not conflict with Nepalese law and international regulations and conventions signed by Nepal. No gender discrimination will be made regarding job facilities and incentives.

x) Blasting and Tunnelling*Preventive Measures*

Controlled blasting will be practiced at all times while excavating the underground area to have a minimum vibration impact on house structures located close to the tunnel alignment.

Mitigation Measures

All houses located in nearby settlement from the tunnel alignment will be surveyed prior to the start of construction works and the structural conditions of the houses and the cracks developed will be documented. This will form the basis for compensation if such damage is reported. The tunnel will be shotcrete and concrete lined as required for the protection and this will also minimize impacts on ground water.

xi) Fair Price Shop*Preventive Measures*

A fair price shop will be established at project site to provide consumable goods at a fair price to the project staff and workers. Project workers will be allotted a fixed quantity of consumable goods for their daily consumption. This fair price shop will be operated by a local sub-contractor. This will be ensured by incorporating relevant clause in tender document

xii) Fire Hazards*Preventive Measures*

The area used for the storage of petrochemicals and explosive materials will be properly fenced off. Necessary precaution and warning signs will be placed at the site and at least 500 m from the site to ensure adequate awareness.

Mitigation Measures

Fire-fighting equipment will be provided at all project sites and emergency evacuation plan shall be developed by the contractor. Security personnel will be deputed in such areas on 24 hour duty and entry of unauthorized person will be controlled.

xiii) Social and Cultural*Mitigation Measures*

The awareness program mentioned in section "Community Infrastructure and Resources" will minimize this impact. The project will assist local NGOs, clubs/cultural groups, women's group for the implementation of cultural program to preserve and promote their culture. Periodic cultural competition programs will be organized in which local schools, NGOs, clubs/cultural groups and women's group will be invited for performance and the best selected clubs/groups will be awarded. The cremation sites located downstream of the dam will be rehabilitated immediately or new site will be developed in consultation with local people. The Tithana shrine affected by the reservoir will be relocated and a new temple will be constructed in consultation with local people.



7.3.3.3 Operation Phase

i) Agricultural Production

Mitigation Measures

Impact due to loss of agricultural production will be minimized by providing training regarding improved farming and input support (small agriculture tools, hybrid seeds) for increasing agricultural production in their remaining land and livestock assistance. Furthermore, skill training, employment and other sources of income will also help to reduce this impact.

ii) Community Awareness Program

Mitigation Measures

An awareness program will be implemented for local people regarding proper use of compensation money, nature of job, project activity and its role in local economy etc. The enhancement measures implemented by the project will minimize this impact. The awareness program will also cover education to local people about the potential impacts on lives due to sudden release of water from the dam, causes and consequence of dam burst and precautionary measures in such situation. The siren warning system established at the dam site will also minimize this impact by providing early warning to local communities.

iii) Occupational Health and Safety

Mitigation Measures

Due attention will be given to safeguard occupational health and safety of project employees and local communities. The labor force deployed for the operation of the power plant will be properly trained. Safety gears will be provided in work areas. Toilets shall be maintained neat and clean and drinking water source will be tested periodically. The sickbay established during construction phase will be handed over to local community for operation or it will be given to local health institutions to provide better services to the local people.

iv) Livelihood

Mitigation Measures

Due priority will be given in the operation phase for employment of persons from households losing their entire land. The skill development training provided in construction phase will also minimize this impact.

v) Water Lifting

The water for the irrigation is sufficient from Agali Gad. However in case of insufficiency in dry months, the project will provide required water for irrigation by lifting river water from powerhouse tailrace. For this a water lifting pump and underground pipe will be laid. The entire cost of construction and operation of lift irrigation will be covered by the project. Similarly to fulfil the drinking water requirement of Thapagan settlement (8-10 households) drinking water facility will be provided from the owners camp.

vi) Relocation of water mill

The two water mills operated using the water of Budhi Ganga river located near Angara Khola and Budhi Ganga confluence area will be relocated about 300m downstream of Ardoli

Budhiganga confluence where required quantity of the water for water mill operation is available in critical dry months.

7.3.3.4 Enhancement Measures

i) Agricultural Assistance

Affected households (25) losing 10% to 25% of their total land will be provided agricultural assistance to increase their agricultural production. The assistance will include 7 days of livestock/agriculture training to one family member of each household and input support including hybrid seeds, small agriculture tools and small goat, pig, poultry based on their interest or demand. The estimated cost of for the training and assistance is NRs 1.75 million.

ii) Skill Training

One family member of each affected household (44HHs land +1 HH from structure) losing more than 25% of their total land will be provided skill training in the areas of driving, plumbing, house wiring, repair and maintenance of electrical appliances, plumbing, cooking as per their interest. The skill training will be given as per the curriculum of CTEVT and through its affiliated institutions. The duration of the training will be 390 hours as per the standard training course of CTEVT. The total cost for basic technical skill training is estimated NRs. 2.7 million.

iii) Livelihood Assistance

A total of 17.34 ha of cultivated land of 80 affected households will be permanently acquired and there will be permanent annual production loss worth NRs. 1.42 million and per household loss is NRs. 17,736. The project will provide cash compensation as a part of livelihood assistance of NRs. 35,473 to each affected household covering 2 years of crop loss. The total crop loss for two years is estimated to be NRs. 2.84 million (Table 7-7).

Table 7-7: Compensation for annual crop loss

Crop Type	Annual Production Loss (MT)	Total Annual Loss (NRs)	Average loss/ HH (NRs.)	Compensation for Crop Loss of Two Yrs. (NRs.)
Paddy	20.55	513750	6422	1027500
Wheat	10.06	352100	4401	704200
Millet	4.68	117000	1463	234000
Maize	5.77	144250	1803	288500
Potato	4.68	163800	2048	327600
Pulses	1.28	128000	1600	256000
Total	47.02	1418900	17736	2837800

Source: Field survey, 2018

iv) Rehabilitation Allowance

A onetime dislocation and transportation allowance of NRs. 25,000 including NRs. 15,000 as dislocation allowance and NRs. 10,000 as transportation allowance will be provided to the six affected HHs for demolition of the house/cowshed and transportation of goods and materials. The households will also be eligible to receive compensation and other benefits as mentioned above. The estimated cost for dislocation and transportation of the materials/goods is estimated at NRs. 0.15 million.



v) Rehabilitation Program for Women and Dalits

Three months weaving and cutting training along with sewing machine will be given to 5 women headed households affected by the project. Skill training based on their interest will be provided to 4 Dalit households affected by the project. The possible areas are plumbing, housewiring, cooking, driving and other training as per CTEVT course.

vi) Priority for Employment

Employment opportunity will be provided to 22 households who will lose more than 50-100% of their land. Priority will be given to the family members of the other affected women and vulnerable households for employment during project construction period. This will be ensured by incorporating appropriate clause in tender document. The list of the PAFs showing preferential hiring priority along with their skill and education will be given to Contractor to ensure employment.

vii) Modernization of Water Mills

The seven water mill found between dam to powerhouse tailrace will be modernized using recent techniques and equipments.

7.3.3.5 Cost

The estimated cost of mitigation and enhancement for socioeconomic and cultural environment is NRs 22.90 million which consists of 20.50 million for construction phase and 2.40 million for operation phase (Table 7-8). This cost is proposed for the implementation of mitigation and enhancement measures mentioned above. These programs are not related to the civil works and shall be implemented by the proponent. The land and structure compensation cost is not included in this cost estimate as these costs are associated with civil works. Additionally, this the cost for health and safety measures including health and sanitation, alternative fuel wood, first aid kits, recruitment of security personnel will be implemented by the civil contractor.

Table 7-8: Mitigation and enhancement cost for socio-economic and cultural environment

S.N.	Mitigation Enhancement Measures	Quantity	Rate (NR.)	Amount NRs. (in million)		
				Construction Phase	Operation Phase	Total
A	Mitigation Measures					
1	Loss of private trees	50	11000 for timber trees and 6000 for fruit trees	0.45	0.00	0.45
2	Leased land for 4 years (private land)	8 ha	30177/year/ha	0.97	0.00	0.97
3	Placement of Hording boards consisting informative and warning signs	15	30000	0.45	0.00	0.45
4	Health and safety training	4	300000	0.60	0.60	1.20



5	Emergency preparedness training	3	200000	0.40	0.20	0.60
6	Social awareness program	4	300000	0.60	0.60	1.20
7	Renovation/construction of new foot trail		Lump Sum	2.00	0.00	2.00
8	Renovation/construction of new cremation site		Lump Sum	1.55	0.00	1.55
9	Assistance for cultural program		Lump Sum	1.00	0.50	1.50
10	Shifting (relocation of 2 water mill found close to Angara Khola)		Lump Sum	0.30	0.00	0.30
11	Irrigation and drinking water		Lump Sum	0.50	0.50	1.00
12	Relocation of tithana shrine		Lump Sum	1.00	0.00	1.00
	Sub- total A			9.82	2.4	12.22
B	Enhancement Measures					
1	Agriculture and livestock training	25HHs	LS	1	0	1
2	Assistance for tools and kits	25HHs	30000	0.75	0	0.75
3	Skill training for 390 Hours (CTEVT) course	45 HHs	60000	2.7	0	2.7
4	Livelihood assistance for HHs losing more than 75% of their land	10 HHs	200000	2	0	2
5	Agriculture assistance to PAFs	80 HHs	35473	2.84	0	2.84
6	Rehabilitation allowance (Dislocation and Transportation allowance)	6HHs	25000	0.15	0	0.15
7	Training for women headed households and Dalit HHs	9 HHs	60000	0.54	0	0.54
8	Modernization of water mill		Lump Sum	0.7	0	0.7
	Sub-total B			10.68	0	10.68
	Total			20.50	2.40	22.90



7.4 Community Support Program

7.4.1 Pre-construction

The project has already started implementation of small scale community support program based on the request of local people and institutions through its site office as a part of corporate social responsibility. Small scale drinking water, irrigation and local school support are the few areas of assistance provided by the project.

7.4.2 Construction

7.4.2.1 Skill Training

The project will provide short-term technical training to 30 poor people of the area including 5 persons from each affected ward of the 3 project affected municipalities/rural municipality to enhance their income and livelihood in the areas of house wiring, plumbing, driving etc. based on their need. The skill training will be given as per curriculum of Council for Technical Education and Vocational Training (CTEVT) and preferably through institution affiliated with CTEVT. The duration of the training will be 390 hours as per the standard training course of CTEVT.

The participants for the training will be selected from vulnerable, indigenous and women headed households of the project area not directly affected by the project (non PAF). The candidates will be selected in consultation with municipal representatives and local stakeholders. The proponent will implement such type of training just before start of construction work so the trained person has opportunity for employment in project construction.

7.4.2.2 Infrastructure Support Program

Since the BHP is going to be implemented in their area it is natural that the local people will have certain expectation from the project. Therefore, to minimize the project impact on affected families, develop cordial relation with the local community and smooth implementation of the project activities, small scale community support programs will be implemented in the project area.

The community support programs will include assistance for operation and maintenance of existing drinking water and irrigation schemes, support to local schools for improvement in physical facility and improvement in health and sanitation of the local people (waste collection drum, training for waste management, toilet in schools, awareness raising). The project will also support cultural group to promote local socio-cultural activities unique to the area. Construction of compound wall in Kalika Higher Secondary school, Buda gad irrigation canal renovation, maintenance of health-post building are the few programs proposed for implementation in Mellekh Rural Municipality.

The basic principles of the community support programs will be transparency, community participation and local contribution.

7.4.2.3 Rural Electrification

As per the National Population and Housing Census 2011, only 18.95% of the project area is electrified. The project will assist for rural electrification in the project area by coordinating with the concerned authority.

7.4.2.4 Cost

The estimated cost for activities proposed under community support program is NRs. 40.88 millions consisting of NRs.31.80 million for construction phase of NRs. 9.08 million for the operation phase (Table 7-9). Since the activities to be conducted are not spelled out in details which will be done during project construction in consultation with local stakeholders a lump sum cost is proposed in major tasks.

Table 7-9: Community support program

S.N.	Proposed Activities	Location	Required Support	Cost (Million NRs)		
				Construction	Operation	Total
1	School support program	Government schools of the project affected wards	Assistance for playground construction, class rooms toilet, drinking water, teaching materials, library, and training/awareness activities regarding health and sanitation, personal hygiene, waste management etc.	4.00	1.00	5.00
2	Small scale irrigation support program	Existing irrigation schemes of project affected wards and irrigation schemes in operation using water of Budhi Ganga River	Improvement/construction of canal and intake	6.00	1.00	7.00
3	Support program for construction/operation of small scale water supply scheme	Project affected wards	Improvement/repair and support for intake construction	6.00	1.00	7.00
4	Enhancement of technical skill of the deprived people	Project affected wards	Proposed skill training in driving, and house wiring to 30 people	1.80	1.00	2.80
5	Cultural support program	Project affected wards	Assist and promote cultural groups to strengthen their	0.50	0.25	0.75

S.N.	Proposed Activities	Location	Required Support	Cost (Million NRs)		
				Construction	Operation	Total
			traditional culture of the area			
6	Sports support program	Project affected wards	Assist and promote local clubs in sports, provide sport material	0.50	0.25	0.75
7	Rural electrification	Project affected wards		5.00	2.00	7.00
8	Other program as per suggestion received in stakeholder consultation and public hearing	Project area	Provide required assistance in the area based on the priority of local community	8.00	2.58	10.58
Total				31.80	9.08	40.88



8. ENVIRONMENTAL MANAGEMENT PLAN

8.1 Introduction

The Environmental Management Plan (EMP) has been prepared as an integral part of BHP to set out the procedural framework to ensure the implementation of mitigation measures, monitoring and auditing requirements. The plan specifies the environmental responsibilities of the parties involved in project development and detail environmental management requirements for the project during the pre-construction, construction and operation phases. The plan also specifies the coordination mechanism with various line agencies, non-project participants and schedule. The monitoring component likewise defines the monitoring and reporting mechanism. The impact audit defines the auditing parameters and responsibility.

The project proponent will be responsible for the implementation of the EMP. The plan will apply adaptive management to accommodate changes in project design during project implementation.

8.2 Objectives of EMP

The EMP is an environmental operation manual for use by management and staff employed on the project, and will serve as an advisory document to regulatory authorities such as Ministry of Energy, Water Resources and Irrigation (MoEWRI) and Ministry of Forests and Environment (MoFE).

The EMP has five primary objectives, namely to:

- define environmental management principles and guidelines for the design, construction and operation of the project;
- establish the roles and responsibilities of all parties involved in project environmental management;
- describe mitigation measures that shall be implemented to avoid or mitigate adverse environmental impacts;
- formulate environment management framework to ensure the implementation of mitigation measures and monitoring programs; and
- establishment of supervision, monitoring, auditing and reporting framework

8.3 Environmental Legislation

The Environmental Protection Act and Environmental Protection Rules is the main umbrella Act and Rules in Nepal, which cover environmental aspects of the project. The MoFE is the lead agency, which administers environmental matters emphasizing environmental conservation and management through internalizing environmental assessment, pollution control and prevention, conservation of natural heritage sites, compensation for environmental damage etc. However, there are several other policies, guidelines, acts and rules which relate to construction and operation of BHP and the project proponent will comply with the provisions by the involved parties in relation to the project.



8.4 Environmental Standards

There are very few environmental standards endorsed by MoFE and other GoN line agencies (Table 8-1 to Table 8-8). Except for vehicular emissions standards and tolerance limits for inland effluent discharge, most of the environmental pollution standards are in the formulation process. Considering the above situation following environmental standards are proposed for BHP construction and operation. These environmental standards shall be treated as other acts and regulations until GoN enforces standards in the specified sector for project environmental compliance proposes.

Table 8-1: Standards for effluents for inland waters from the construction sites and camps

SN	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 – 9.0
4	Temperature	Shall not exceed 40 °C in any section of the stream within 15 meters down-stream from the effluent outlet
5	Biochemical oxygen demand (BOD) for 5 days at 20 °C, mg/L, Max	30 – 100
6	Oils and grease, mg/L, Max	10
7	Phenolic compounds, mg/L, Max	1
8	Cynides (CN), mg/L, Max	0.2
9	Sulphides (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 (F), mg/L, Max	2
14	Arsenic (As), mg/L, Max	0.2
15	Cadmium (Cd), mg/L, Max	2
16	Hexavalent chromium (Cr), mg/L, Max	0.1
17	Copper (Cu), mg/L, Max	3
18	Lead (Pb), mg/L, Max	0.1
19	Mercury (Hg), mg/L, Max	0.01
20	Nickel (Ni), mg/L, Max	3
21	Selenium (Se), mg/L, Max	0.05
22	Zinc (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

Source: Standards adopted from MOSTE, 2058

Table 8-2: Drinking water quality standards for construction camps and sites

S N	Parameters	Desirable limits	Maximum tolerable limit
1	Colour, Hazen units, Max	10	15
2	Odor	Unobjectionable	
3	Taste	Agreeable	
4	Turbidity, NTU, Max	5 ²	10
5	Total Dissolved Solids, mg/l, Max	500	1500
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 (CaCO ₃) mg/l, Max	250	
8	Calcium (Ca), mg/l, Max	75	
9	Magnesium (Mg), mg/l, Max	30	
10	Copper (Cu), mg/l, Max	1	may be extended upto 1.5
11	Iron (Fe), mg/l, Max	0.3	
12	Manganese (Mn), mg/l, Max	0.1	may be extended upto 0.5
13	Chlorides (Cl), mg/l, Max	250	
14	Sulphate, (SO ₄), mg/l, Max	150 ³	
15	Nitrate (NO ₃), mg/l, Max	45	No relaxation
16	Fluoride (F), mg/l, Max	1.5	
17	Phenolic compounds, (C ₆ H ₅ OH), mg/l, Max	0.001	May be relaxed upto 0.002
18	Mercury (Hg), mg/l, Max	0.001	No relaxation
19	Cadmium (Cd), mg/l, Max	0.01	No relaxation
20	Selenium (Se), mg/l, Max	0.01	No relaxation
21	Lead (Pb), mg/l, Max	0.01	No relaxation
22	Arsenic (As), mg/l, Max	0.05	No relaxation
23	Cyanide (CN), mg/l, Max	0.05	No relaxation
24	Chromium (Cr ⁶⁺), mg/l, Max	0.05	No relaxation
25	Residual free Chlorine, (Cl), mg/l, Min	0.2	
26	Ammonia (NH ₄), mg/l, Max	1.5	
27	Aluminium (Al), mg/l, max	0.2	
28	Boron (B), mg/l, max	0.3	
29	Nickel (Ni), mg/l, max	0.02	

²Value for turbidity is 5 in FAR (for mineral water), PFA, BS, WHO³Value for Sulphate BS: 200, FAR (for mineral water) and PFA: 250

S N	Parameters	Desirable limits	Maximum tolerable limit
30	Hydrogen Sulphide (H ₂ S), mg/l, max	0.1	
31	Zinc(Zn), mg/l, max	3	

Source: Standards adopted from Department of Water Supply and Sewerage

Table 8-3: Ambient air quality standards in the project area

Parameters	Units	Averaging time	Concentration in ambient air, maximum
TSP	µg/m ³	Annual	-
		24-hours*	230
PM10	µg/m ³	Annual	-
		24-hours*	120
PM2.5	µg/m ³	24-hours*	40
Sulphur Dioxide (SO ₂)	µg/m ³	Annual	50
		24-hours**	70
Nitrogen Dioxide (NO ₂)	µg/m ³	Annual	40
		24-hours**	80
Carbon Monoxide (CO)	µg/m ³	8 hours**	10,000
		15 minute	100,000
Lead (Pb)	µg/m ³	Annual	0.5
		24-hours	-
Benzene	µg/m ³	Annual	20****
		24-hours	-

Source: National Ambient Air Quality Standard, 2012, MOSTE

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

** 24 hourly standards for NO₂ and SO₂ and 8 hour standard for CO are not to be controlled before MOPE has recommended appropriate test methodologies. This will be done before 2005

**** To be re-evaluated by 2005

Table 8-4: Nepal vehicle mass emissions standard for petrol operated vehicles, 2069

Types of Vehicles	Limit Value (Grams per Kilometer)		
	Mass of Carbon monoxide (CO)	Mass of Hydrocarbon (HC)	Mass of Nitrogen oxide
Light vehicle less than 2.5 ton	2.3	0.2	0.15
Vehicles more than 2.5 tons			
LCV(RM= or < 1305kg)	2.3	0.2	0.15
LCV(1305>RM< or 1760 kg)	4.17	0.25	0.18
LCV (RM>1760 kg)	5.22	0.29	0.21

Source: MoFE, 2075

Table 8-5: Nepal vehicle mass emissions standard for diesel operated vehicles, 2069

Types of Vehicles	Limit value, Grams per Kilometer				
	Carbon monoxide (CO)	Hydrocarbon (HC) and Nitrogen Oxide (HC+ Nox)	Nitrogen oxide (Nox)	Mass of Particulate Matters (PM)	Smoke per meter
Light vehicle less than 2.5 ton (Passenger car)	0.64	0.56	0.5	0.05	
Vehicles more than 3.5 tons	2.1	0.66	5	0.10/0.13	0.8

Source: MoFE, 2075

Table 8-6: Proposed noise exposure limits for the work environment

S N	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: Marsh, 1991.

Adopted from Occupational Safety and Health Administration (OSHA).

Table 8-7: Noise Standard for the different areas

S N	Land use	Noise Level (L_{eq}) decibel	
		Day	Night
1	Industrial	75	70
2	Commercial	65	55
3	Residential area(rural)	45	40
4	Residential area(urban)	55	50
5	Residential area (mix)	63	55
6	Silence zone	50	40

Source: MoEST, 2069



MoEST also established standard for the different kinds of equipment such as water pump (65 decibel), diesel generator (90 decibel) and entertainment instruments (70 decibel).

Table 8-8: Proposed average equivalent sound levels

S N	Land use	Measure	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

8.5 Environmental Management Plan

This EMP has two components; environmental management activities and the activities responsible implementing body and its responsibilities.

8.5.1 Environmental Management Actions

The environmental management activity is a synthesized plan incorporating the elements of environmental mitigation and enhancement measures. The environmental mitigation and enhancement measures are bundled in a series of activities in the project life cycle.

The environmental management actions for the project area broadly described in the following headings; Permits and Approval Plan; Resettlement and Rehabilitation Plan; Construction Camps and Traffic Management Plan, Pollution Abatement Plan; Terrestrial Ecology Management Plan, Aquatic Ecology Management Plan, Erosion Abatement and Muck/spoil Management Plan, Public Health and Occupational Safety Management Plan, Emergency Management Plan, Grievance Redress Plan and Public Disclosure Plan. The elements stipulated in the above plan go hand in hand throughout the project life cycle.

8.5.1.1 Permits and Approval Plan

The objective of permits and approvals is to comply with the government legislative mechanism and to keep cordial relationships with the project stakeholders. There are legislative provisions which require prior permits and approvals from the concerned government agencies to commence the work. As per Environmental Protection Rules 1997 the project proponent will have prime responsibility for the implementation of the EMP. The EPA 2076 and EPR made provisions for the compliance of EIA report. The implementation of EMP will be guided by GoN policies and legal framework. Land Acquisition Act 1977 regulates the land acquisition and compensation determination process. Likewise, Hydropower Policy, 2001 fixes the riparian release downstream of the weir/dam (10% of the minimum flow or as stated by EIA/IEE). There are other Acts, Rules and Policies which directly or indirectly regulate the environmental activities of the project.

Some activities would require consensus of the project area communities or individuals for successful implementation of certain activities of construction and operation without hindrance. In these cases project management should take prior permits and approvals or consensus of the people or individuals before the start of the activities. The project should ensure that all the permits and approval or consensus of the public is taken before the start of the activities. The permits and approval or consensus required for the project are presented in Table 8-9.

Table 8-9: Permits and approval plan

SN	Required permits and approval	Required agency	Implementation Time	Responsibility
1	EIA approval	MoFE	Detailed Design Phase	DoED, BHP
2	Tree clearing from community forest	DFO and MoFE	Pre-construction	DoED, BHP
3	Permanent land acquisition	DAO/CDO	Pre-construction	DoED, BHP
4	Land lease agreement for temporary facilities	Land owners	Pre-construction	DoED, BHP
5	Entry to private land and property, if required	Land owners	Construction	Contractor

Abbreviation: MoFE- Ministry of Forest and Environment, DFO- Division Forest Office, DAO- District Administration Office, CDO- Chief District Officer

8.5.1.2 Resettlement and Rehabilitation Plan

The objective of this plan is to ensure that the effects of acquiring land and property and its impact on the livelihood of the affected parties and individuals are addressed adequately and in time prior to the start of the project construction in an amicable and conducive environment with mutual consensus and agreement. Any grievances of the affected parties will be handled to the satisfaction of the affected parties or individuals through proper information sharing. The main elements of the Resettlement and Rehabilitation Plan are presented in Table 8-10.

8.5.1.3 Construction Camps and Traffic Management Plan

Transportation of construction equipment and accessories and establishment of various camps for engineers, contractors, workers, storage yards, and mechanical yards are the first activities of the project development. Though this is the beginning stage of the project, the construction preparation activities at the site, have lasting consequences both environmentally and socially. Therefore, planning for traffic management on site and along the road corridor and management of construction camps are very crucial to the overall environmental management plan. Proper and sensible planning at this stage will avoid many of the environmental and social adverse consequences. The construction camps and traffic management plan is presented in Table 8-11.

8.5.1.4 Pollution Abatement Plan

The objective of the pollution abatement plan is to avoid or minimize the pollution streams (gaseous, liquid, solid and acoustic) of the project activities during pre-construction, construction and operation periodsof the project. Both avoidance and mitigative measures will be



implemented by the project as mentioned in Chapter 8 for air, water, land, and noise pollution. Table 8-12 highlights key features of the pollution abatement plan.

8.5.1.5 Terrestrial Ecology Management Plan

The objective of the terrestrial ecology management plan is to ensure that the terrestrial resources such as forests/vegetation, and wildlife of the project site and surroundings are not impacted and conserved to the extent possible by the project construction and operation activities. The activities of the terrestrial ecology management plan are presented in Table 8-13.

8.5.1.6 Aquatic Ecology Management Plan

One of the key impacts of BHP will be on the aquatic ecology of the Budhi Ganga River. Though the impacts of the river diversion cannot be completely avoided, it can be minimized by implementing the activities listed (Table 8-14) as a part of the aquatic management plan in the project life cycle.

8.5.1.7 Erosion Abatement and Muck/Spoil Management Plan

The BHP development works involves several activities that directly interact with the existing landform. The objective of this plan is to minimize the landform instabilities to reduce land erosion to the extent possible. The secondary objective is to conserve the top soil, the lifeline for any vegetative productivity. The key elements of the management plan are presented in Table 8-15.

8.5.1.8 Public Health and Occupational Safety Management Plan

The project development sites in the rural areas are thinly populated and the population is not exposed to high pollution loads of diverse types.

The construction work is associated with diverse types of risk prone activities. The workers involved in the construction works are exposed to these occupational risks. Sickness, injuries, and even fatal accidents cannot be ruled out. Apart from this, people from different places and with different diseases come into the project area as project workers or economic opportunity seekers. They may also act as carriers of the transmission of diseases alien to the existing population. Increased traffic from construction vehicles and associated fugitive dust and noise is the other activity which could have a direct health effect, even fatal to both the project area people and occupational workers. Taking into consideration the above stated probabilities, this public health and occupational safety management plan has been developed to minimize the risk on public health and occupation health of the construction workers. Table 8-16 highlights the key features of the Plan.

8.5.1.9 Emergency Management Plan

The project management and Contractor management need to be prepared for unforeseen events during emergency operations. The emergency management plan highlights some key feature of the emergency preparedness in the event of such unforeseen events as shown in Table 8-17.

8.5.1.10 Grievance Redress Plan

Grievance redress mechanism will be established to allow project affected persons/ households (PAPs/HHs), community or other stakeholder to appeal any disagreeable decisions, practices and activities arising from compensation for land and assets, environmental and community concerns related to the project. The PAPs/HHs/community will be made fully aware of their rights and the procedures.

There is the potential for three types of grievances: grievances related to land acquisition, compensation and rehabilitation; community issues; and environmental problems. The PAPs/HHs/community will have access to both locally constructed grievance redress committees specified i.e. Local Consultative Forum and formal courts of appeal system. Under the latter system every PAP/HHs can appeal to the court if they feel that they are not compensated appropriately.

The Environment and Social Management Unit (ESMU) will establish a compliant desk to be manned by an administrative officer assisted by support staff. All complaints/concerns shall be received at this desk and resolved immediately by chief of ESMU if minor and involves procedural/policies and guidelines only. The Project Management Office (PMO) shall refer to the concerned office/group for all other issues, which cannot be resolved at the complaints desk. The community or individual shall be informed about the status of his/her concerns within a week by the PIC desk office.

The following procedure will be observed in the settlement of conflicts/concerns:

PAF, local people or community can lodge complains to ESMU. Then Unit Chief through its staff verifies the issues and gives their decision within 7 days of compliant register in the office. If the issue is settled the process ends.

If the party is not satisfied with the decision of ESMU, the issues will be forwarded to PMO. The PMO verifies the issues and discusses with the representative of the complaining community/individual and ESMU Chief to resolve the issue. The PMO will provide their decision within 10 days of complain being received in his/her office. The PMO may consult legal advisor or DoED Central Management if required. If the issue is settled the process ends.

If the issue is not resolved to the satisfaction of the complainant, the concern will be forwarded to LCF from PMO. The LCF will visit the site, verify the issues and call a meeting to solve the problem. The LCF will provide its decision on the concerned issues within 15 days of complaint received. If the issue is settled the process ends. The LCF will be headed by the Mayor of Sanfebagar Municipality and the chief of Mellekh Rural Municipality, Mayor of Budhi Ganga Municipality, representative of project and EMU chief will be the member of LCF.

If the concern remains unresolved and if community/individual is still not satisfied, this is elevated to the Court of Appeals and finally to the Supreme Court by AP.

8.5.1.11 Public Information Disclosure Plan

The Project Information Center will be established under ESMU which will disseminate information regarding the rights of the communities/individuals on various aspects of environment and social issues. Regular meetings with the communities and individuals will be conducted at frequent intervals to give new information and project activities to the local

communities by the PICstaff. Information regarding land acquisition, compensation amounts, rehabilitation/resettlement assistance, environmental enhancement activities, and project employment opportunities will be posted to the notice board of the PIC. The information will be updated regularly by the PIC. Public Relations Officer of the PIC will visit regularly the project influence area to aid project area community/individuals in matters related to project actions and impacts. The information collected at the community level will be passed to the concerned PMO staff to take action for effective management of project environmental and social issues.

The environmental monitoring report prepared by Budhi Ganga Environment Monitoring Unit and progress report prepared by Environment and Social Management Unit will be disclosed to local people through Project Information Center. The center will prepare quarterly bulletin in Nepali language covering the project activities including environmental mitigation measures and monitoring works. This quarterly meeting will be conducted with the local government and district level line agencies at project site to brief them about status of project, ongoing environmental and social activities and problems arisen during the implementation.

8.5.1.12 Environmental Enhancement Plan

Priority for local employment, promotion of enterprise development, enhancement of technical skill and community development program are the areas proposed for environmental enhancement. The ESMU will be responsible for the implementation of environment enhancement plan (Table 8-18).



Table 8-10: Resettlement and rehabilitation plan

S N	Actions	Timing of action	Responsibility
1	Re verification of the owners of the land to be acquired permanently including their affected land areas, land plot numbers and landownership.	Pre-construction (6 months before construction)	PMO /ESMU
	Identification of the household or parties traditionally using land without land certificates in case of acquisition /lease of such land	Pre-construction (6 months before construction)	PMO /ESMU
2	Acquisition of land as per the land acquisition act	Pre-construction	PMO
3	Implementation of resettlement and rehabilitation (R and R) packages as per the approved EIA report	Pre-construction and construction (initial phase)	PMO /ESMU
4	Evacuation of the owners from the land	Pre-construction (At least three months will be given to the affected parties to remove their belongings if any)	PMO /ESMU
5	Handling of grievances of the affected parties and individuals (formalities of Grievance Redress Mechanism)	Pre-construction and construction	PMO /ESMU
6	Monitoring of the implementation of R and R	Pre-construction and construction	EMU /Joint Monitoring Committee/ Panel of Expert

Abbreviation: LCF: Local Consultative Forum, EMU- Environmental Monitoring Unit, ESMU- Environment and Social Management Unit

Table 8-11: Construction camps and traffic management plan

S N	Activities	Timing of actions	Responsibilities
1	Pre-information to the local area people on the start date of project preparation works and the range of activities to be undertaken	Pre-construction	PMO /ESMU
2	Site clearance and construction plan for construction camps (engineer, contractor, labor force, mechanical yards, long term storage facilities etc.) with plans to save top soil for later use	Pre-construction	Supervising Engineer/EMU/Contractor
3	Preparation of a Guideline for construction vehicle operation (speed, use of horn, parking on the road and off the road etc.) and meet pollution criteria green stickers	Pre-construction	Supervising Engineer/EMU/Contractor
4	Preparation of sites for parking of the project vehicles , material storage and accommodation facilities for the early construction workers/contractors with	Construction	Contractor



S N	Activities	Timing of actions	Responsibilities
	adequate facilities of water supply, drainage, cooking, dining, toilets, solid waste collection and storage etc.		
5	Construction of camps and facilities	Construction	Contractor
6	Monitoring of related activities	Pre-construction and construction	Supervising Engineer/ EMU

Table 8-12: Pollution abatement and waste management plan

S N	Activities	Timing of actions	Location	Responsibilities
A. Air pollution abatement				
1	The earthen and graveled road corridors will be sprinkled regularly to minimize the fugitive dusts from the plying of the construction related vehicles particularly in the winter and Sumer dry season.	Pre-construction, Construction period	Headworks area, powerhouse area, road to adit and surge shaft and spoil disposal sites.	Contractor
2	The aggregate crushing sites and active construction sites will also be sprinkled regularly by water as to the requirement on the advice of supervising engineers/ Environmental Monitor	Construction period	Aggregate crushing site, and active construction site	Contractor
3	The occupational workers at the construction sites, engineers and supervisors will be provided with PPE (air masks, helmets and safety goggles as per the standard guideline)	Pre-construction, Construction period	All construction sites	Contractor
4	Ventilators of adequate capacity for ventilating the tunnel area during blasting and mucking period	Construction period	Adit portals to tunnel	Contractor
B. Water and land pollution abatement				
5	The sites for surface structure and all project facility sites (camps, mechanical yards, storage facilities, muck disposal sites etc.) will be facilitated with temporary drainage facilities to collect and discharge the runoff water after required treatment (sedimentation and oil and grease removal) safely to the natural water bodies.	Pre-construction, Construction period	All camp and facility sites	Contractor
6	Discharge of construction waste such as cement, and concrete slurry will not be discharged to the river water.	Construction period	Headwork, powerhouse	Contractor



S N	Activities	Timing of actions	Location	Responsibilities
7	The water discharged from aggregate washing plant will be collected in settling tanks/ponds at suitable location for sedimentation and treatment	Construction period	Aggregate waste water discharge point	Contractor
8	The unused chemicals, spent mobil, oil, grease etc. will discharged only with the approval of the chief of the Environmental Monitoring Unit	Pre-construction, Construction period	All construction sites, camps and other facility sites	Contractor
9	The petroleum bunkers will be placed in a separate area in a concrete bounded area with the facility of oil and grease separator	Pre-construction, Construction period	Storage yards	Contractor
10	The waste water from the mechanical yards will be collected in a separate area. The water will be treated for the oil and grease and then released to the water bodies.	Construction period	Mechanical yard waste water discharge point	Contractor
11	Stockpiling and storage of the construction materials in designated sites only away from the water sources. Prohibition on the stockpiling of construction materials in other areas	Pre-construction, Construction period	All camps and active construction sites	Contractor
12	Muck disposal will be carried out in the designated sites only. Prohibition of muck disposal in other non-designated areas	Construction period	All camps and active construction sites	Contractor
C	Waste Management Plan			
1	A solid waste collection and storage system will be established in all the construction related camps and construction sites. The collected waste will be segregated as to the property of the waste as degradable, glass, metals, plastics, cloths and leather etc. and will be stored in separate bounded areas. These materials will be disposed as to the recommendations and approval of the project environmental officer. Burning of the wastes and garbage during construction and operation will be restricted.	Pre-construction, Construction /operation	All camps and active construction sites/Operation camps	Contractor / Operation Manager
2	All spent oil and grease and mobil and unused or date expired toxic chemicals will be collected separately in plastic drums and stored in a safe place under shade	Pre-construction, Construction /operation	All construction sites, camps and other facility sites/operation	Contractor /Operation manager
3	Provision of adequate toilet facilities will be made in the camps and active construction sites. The toilet waste of the camps will be drained to a single treatment facility in each camp. The treated water will only be released to the nearby area.	Pre-construction, Construction period	All camps and active construction sites	Contractor



S N	Activities	Timing of actions	Location	Responsibilities
4	Open defecation will be prohibited in and around the construction sites, camp sites and in the river bank area. Information sign boards will be placed in the construction camps, and active construction sites.	Pre-construction, Construction period	In areas surrounding the construction sites	Contractor
5	Garbage containers of adequate size will be placed at critical places in the construction related camps and construction sites. The collected garbage will be collected daily for segregation and storage as outlined above	Pre-construction, Construction/ operation	All camps and active construction sites/Operation camp	Contractor /Operation Manager
D. Noise Pollution Abatement				
18	Operation of noise generating construction activities in the day time as far as possible	Pre-construction, Construction period	All camps and active construction sites	Contractor
19	Prohibition of surface blasting operations in the day time. Prior information will be given through siren blow 10minutes before the blasting operation and 10 minutes after the blasting operation	Construction period	Tunnel, headwork, and powerhouse	Contractor
20	Regular maintenance of vehicles to reduce the mechanical and body noise while plying	Pre-construction, Construction period	All vehicle and machinery	Contractor/ Supervising Engineers/ Proponent
21	Prohibition of blowing of horns in critical stretches close to villages and near the school area along the road	Pre-construction, Construction period	Villages and school areas	Contractor/ Supervising Engineers/ Proponent
22	Fitting of noise reducing equipment in the ventilators compressors and diesel generator sets	Pre-construction, Construction period	Ventilator compressors and diesel generator sets	Contractor
23	Controlled blasting will be practiced at all times while excavating the surface or underground area to have a minimum vibration impact	Construction period	All sites of blasting	Contractor
Monitoring				
24	Compliance monitoring of A, B and C	Construction /Operation	All above sites	EMU/ Supervising Engineers/ Operation Manager



S N	Activities	Timing of actions	Location	Responsibilities
25	Impact Monitoring related to A, B, and C	Construction /Operation	All above sites	EMU/ Supervising Engineers/ Operation Manager

Table 8-13: Terrestrial ecology management plan

S N	Activities	Timing of actions	Location	Responsibilities
1	Preference to local people for project employment as mentioned in mitigation section	Preconstruction, construction and operation	All project works	Project office, / Contractor / Supervising Engineers/ /Operation Manager
2	Provision of kerosene to the outside workforce for cooking	Preconstruction, construction	Construction workers of all project sites	Contractor
3	Provision for camp lodging to the outside workforce with a common LPG cooking facility	Preconstruction, construction	All outside construction workers	Contractor
4	Prohibition on the sale and purchase of the local NTFP and fishes in the camps	Preconstruction, construction and operation	All project locations	Contractor / Supervising Engineers/Operation Manager
5	Prohibition in roaming in the local forest area by the outside workforce	Preconstruction, construction and operation	Surrounding areas of project site	Contractor / Supervising engineers/Operation Manager
6	Compensatory afforestation as per the guideline for the use of forest land for national priority projects (2076) Land for land compensation for the permanently acquired land (18.20 ha) or pay the required amount to forest office. Compensatory plantings at 1:10 for the 4,748 trees to be felled by the project and planting of 77,210 saplings and five year management or pay equivalent amount to the concerned Division Forest Office to implement the compensatory plantation program. Mobilize the Community Forest Users Group for implementation of program in coordination with Division Forest Office.	Construction and Operation	Areas as designated by the Division Forest Office	PMO /ESMU



S N	Activities	Timing of actions	Location	Responsibilities
7	Lease Compensation to the Forest Land Area	Construction and Operation	All permanently occupied forest areas	PMO /ESMU
8	Clearing of the forest vegetation and stockpiling the vegetation products before handover:	Construction	All permanently occupied forest areas	PMO /ESMU
9	Implementation of training, NTFP and other forest related programs	Construction	Project affected community forest	PMO /ESMU
10	Project will inform in time to the local government, Community forest user groups and the forest office, if it finds the forest area is encroached close to the construction site	Construction	Surrounding forests of the project site	PMO /ESMU
11	Information boards will be placed at critical location of the Sanfe- Martadi Road, project component road and other public places on the preventive actions to control the forest fires	Construction	Surrounding areas of the project site	PMO /ESMU
12	Awareness programs will be launched to prevent forest fires in the local area	Construction	Surrounding areas of the project site	ESMU
13	Project workers will be regularly informed not to throw lighted cigarette tips in the forest areas and not to use forest area as picnic spots	Construction	Surrounding areas of the project site	ESMU
14	Compliance and impact monitoring of the related activities	Construction/ operation	All sites as designated	ESMU
15	Manual clearing of the trees without use of equipment's and herbicides	Construction phase	Dam, Reservoir, project road and adit sites	Contractor
16	Labor based construction work must be planned in forest area	Construction phase	Dam, Reservoir, project road and adit sites	Contractor
17	Controlled blasting	Construction phase	Tunnel, adit, powerhouse and other area	Contractor
18	Restriction of hunting and poaching	Construction phase	Project sites	Contractor
19	Identification of the stakeholder for the wildlife conservation awareness program	Construction phase	Project area	ESMU



S N	Activities	Timing of actions	Location	Responsibilities
20	Handing over wild animal to the concerned organization if seen in unusual condition in project area	Construction phase	Project area	ESMU
21	Compliance and impact monitoring of the related activities	Construction phase	All sites as designated	EMU

Table 8-14: Aquatic ecology management plan

SN	Activities	Timing of actions	Location	Responsibilities
1	Restriction on fishing activities by the construction workforce in the Budhi Ganga River	Preconstruction and construction	Budhi Ganga River headworks to Powerhouse 6.8 km stretch	EMU
2	Implementation of the activities of Table 9-12, Water and land pollution abatement	Pre - construction, Construction and operation	All project sites	EMU/ Contractor
3	Restriction on the use of pesticides, electrical gears and explosive for fish capture in Budhi Ganga River	Pre - construction, Construction and operation	Reservoir to powerhouse tailrace	Local government and EMU
4	Design and construct a fish ladder as an inbuilt structure in the dam and operation of the fish ladder at all times to allow upstream fish migration	Design/Construction/ Operation	Headworks	Design engineers/ supervising engineers/ operation Manager
5	Complete prohibition on the discharge of muck/spoil into the river	Construction	All construction sites	Contractor
6	Design the provision of releasing 10% of the minimum monthly flow as an inbuilt structure of the dam and ensure that the structure is constructed	Design	Dam	Design Engineer/ Supervising engineers/
7	Release an environmental flow as per Hydropower Development Policy 2001 from the dam through the fish ladder	Operation	Dam	Operation manager
8	Monitoring of related activities	Pre-construction/ Construction and operation	All project sites as designated	EMU



Table 8-15: Erosion abatement and muck/spoil management plan

SN	Activities	Timing of actions	Location	Responsibilities
1	Clearing of forest vegetation as to the requirement of project structures and facilities only	Pre-construction, construction	Project acquisition areas	Contractor
2	Compensatory afforestation as per the forest guideline for the use of forest land for national priority projects (2076)	Construction and operation	As designated by the Division Forest Office and local forest user groups and communities	PMO /ESMU
3	Preference to the local people for project employment	Pre-construction, Construction and Operation	All project sites	PMO/ contractor / Supervising engineers/ Operation Manager
4	While preparing the site for construction of project component roads, camp, etc., the top soil will be managed separately and stored in a separately for later rehabilitation works	Pre-construction/ Construction	All project sites	Contractor
5	Provision of kerosene to the workforce for cooking	Construction	All outside construction workers	Contractor
6	Provision for camp lodging to the outside workforce with a common LPG cooking facility.	Construction	All residential camps	Contractor/ PMO
7	Controlled blasting will be practiced at all times while excavating the surface area to have a minimum impact to the physical properties of the surrounding rocks.	Construction	All project sites	Supervising Engineers/Contractor
8	The excavated surface will be protected against the water erosion by adequate vertical and horizontal drainages and the water collected from the excavation area will be discharged into safe area.	Construction	All project sites	Supervising Engineer/Contractor
9	Stockpiling and storage of construction materials in designated sites only. Prohibition on the stockpiling of construction materials in other areas.	Construction	All project sites	Contractor



SN	Activities	Timing of actions	Location	Responsibilities
10	Prior to the start of muck disposal, the contractor will prepare a plan for muck disposal and get approval from the supervising engineers. The plan shall include quantity of muck generated from different project components, muck to be used for construction works and site and protection of muck areas from the monsoon washout. The supervising engineer will verify the data inspect the proposed spoil disposal sites and provide approval for the disposal.	Construction	Muck disposal site	Supervising Engineer/ Contractor
11	Muck disposal will be carried out in the designated sites only. Prohibition of muck disposal in other non-designated areas.	Construction	All project sites	Contractor
12	The muck deposited will be properly compacted and will be facilitated by surface runoff drainage facilities to avoid air pollution and run off erosion.	Construction	Muck disposal sites	Supervising Engineer/ Contractor
13	All project facility sites (camps, mechanical yards, storage facilities, muck disposal sites etc.) will be facilitated with temporary drainage facilities to collect and discharge the runoff water safely to natural water bodies.	Construction	All project facility sites	Supervising Engineer/ Contractor
14	The project component roads will be facilitated by side drain structures to collect water from the upslope area. The collected water of the side drains will be discharged to suitable natural waterway to avoid upstream and downstream erosion	Construction	All project sites	Supervising Engineer/ Contractor
15	Monitoring of related activities	Pre-construction, construction /operation	All project sites as designated	EMU



Table 8-16: Public health and occupational safety management plan

SN	Activities	Timing of actions	Location	Responsibilities
1	Construction plan for construction camps (engineer, contractor, labor force, mechanical yards, long term storage facilities etc.)	Pre-construction	Project camps	Contractor
2	Preparation of a Guideline for construction vehicle operation (speed, use of horn, parking on the road and off the road etc.)	Pre-construction	All project sites	Supervising Engineer and EMU
3	Implement Pollution Abatement Plan	Pre-construction, construction/operation	All project site	Contractor /Operation Manager
4	Preparation of occupational health and safety plan and submission to Engineer for approval	Pre-construction	For all project site construction workers	Contractor
5	Approval of the occupational health and safety plan	Pre-construction	For all project sites	Supervising Engineer
6	Information boards and traffic signs placed at critical locations on the traffic movement, speed, use of horns etc.	Pre-construction, construction	All project site and project component road corridors	Contractor
7	Provision of First aid facilities	Construction	All active construction sites and residential and non-residential camps and yards	Contractor
8	Provision of first aid clinic with Medical doctor, Health Assistant, Nurse and at construction site	Construction	Construction Camp	Contractor
9	Medical checkup of the workforce before employment	Construction	All Project construction workers	Contractor
10	Regular Medical Checkup of the construction workers every 6 months	Construction	All Project construction workers	Contractor
11	Water supply facility with a treatment unit	Construction	All project camps	Contractor
12	Establishment of garbage collection and management system	Construction	All project camps	Contractor
13	Establishment and construction waste collection system and management	Construction	All active construction sites	Contractor



SN	Activities	Timing of actions	Location	Responsibilities
14	Fencing of all construction sites and restriction on entry to outsiders other than authorized persons	Construction	All active construction sites	Contractor
15	Appropriate danger signs in all active construction and work areas as appropriate for the degree of risk in the site	Construction	All active construction sites	Contractor
16	Provision of Personal Protective Equipment (such as boots, gloves, masks, ear plugs, helmets, safety goggles etc.) to construction workers as to the requirement and risk of the working area and implement the use effectively	Construction	All construction workers	Contractor
17	Regular training (at least once in three months) to the construction workers and health and safety issues of the construction works	Construction	All construction workers	Contractor
18	Monitoring or compliance and impact related to the above mentioned	Pre-construction	Areas as designated	EMU
19	Insurance of workers	Pre-construction	All workers	Contractor

Table 8-17: Emergency management plan

SN	Activities	Timing of Actions	Location	Responsibilities
1	Provision of helipad for emergency evacuation of injured or other people	Pre-construction	Construction site	Contractor
2	Provision of standby ambulance to evacuate the injured at the earliest to project site hospital	Construction	Powerhouse and headwork area	Contractor
3	Provision of stabilizing equipment and facilities to the injured before he could be transported to the nearest hospital.	Construction	Project Hospital	Contractor
4	Provision of medication stock particularly for water borne diseases to tackle any epidemic in camp or in villages surrounding the project site	Construction	Construction site hospital	Contractor
5	Provision of firefighting equipment and trained personnel to fight fires	Construction/operation	Construction site/powerhouse area	Contractor/ Operation Manager



SN	Activities	Timing of Actions	Location	Responsibilities
6	Provision of sirens to inform the people of emergencies	Construction/operation	Powerhouse, camp sites, headworks, tunnel portals and reduced flow stretch	Contractor/ Operation Manager
7	Emergency preparedness training and on site exercise every 6 months	Construction/operation	All project site/ powerhouse and headwork	Contractor, PMO / Operation Manager/EMU
8	Monitoring of the above activities	Construction/operation	All project site/powerhouse and headworks	EMU / Operation Manager

Table 8-18: Environment enhancement plan

S N	Actions	Timing of action	Responsibility
A	Local Employment		
1	Verification the list of PAFs and preparation of final list based on the criteria set	Pre-construction (6 months before construction)	EMU /ESMU/PMO
2	Collect the information about qualification, training and their interest area regarding employment	Pre-construction (6 months before construction)	EMU/PMO
3	Provide the copy of list to contractor and consultant for preferential hiring	Pre-construction (3 months before construction)	PMO/EMU
B.	Promotion of Enterprise Development		
4	Conduct meeting with Contractor, Consultant and developer to collect their monthly requirement of food items such as milk, meat, egg, fresh vegetables and fruit	Pre-construction and construction (2month prior to start of construction work)	ESMU/EMU
5	Finalize the demand list	Pre-construction and construction (2month prior to start of construction work)	ESMU
6	Conduct meeting with local communities regarding the supply of required food item from within the community.	Pre-construction and construction (2month prior to start of construction work)	ESMU
7	If community /individual agrees facilitate agreement between the parties regarding the supply of required items	1 month prior to start of construction	EMU
C.	Social Support Program		



S N	Actions	Timing of action	Responsibility
8	Conduct meeting with local school, health post and local communities regarding the support in concerned area as per report	Five months prior to start of construction work	ESMU
9	Formation of users' group/recruitment of local contractor for the implementation of the program in coordination with concerned stakeholder	Construction phase	ESMU
10	Monitoring of the implementation of the above mentioned works	Pre-construction and construction	EMU /Joint Monitoring Committee/ Panel of Expert

Table 8-19: Vulnerable community development plan

SN	Actions	Timing of action	Responsibility
1	Re verification the list of vulnerable households as defined in EIA report.	Pre-construction (6 months before construction)	ESMU/EMU
2	Consultation with the concerned household regarding the selection of training program	Pre-construction (5 months before construction)	ESMU
3	Collection of database regarding the qualification, skill and other aspects of vulnerable PAFs	Pre-construction (5 months before construction)	ESMU
4	Identification of the relevant institution regarding the implementation of the training program	Pre-construction (3 months before construction)	ESMU
5	Compliance of the preferential recruitment of the vulnerable PAFs	Construction/operation	Contractor/EMU
6	Implementation of the proposed program	Pre-construction (3 months before construction)	ESMU
7	Monitoring of the implementation of the proposed activities	Pre-construction/construction	EMU /Joint Monitoring Committee

Table 8-20: Interagency/ Stakeholder coordination plan

S N	Actions	Timing of action	Responsibility
1	Identification of stakeholders relevant for the environment management of the project	Pre-construction (6 months before construction)	ESMU
2	Conduct meeting with stakeholders regarding their involvement, mode of coordination and participation in similar nature of the work	Pre-construction (6 months before construction)	ESMU



S N	Actions	Timing of action	Responsibility
3	Establish procedure and modality for the inter agency coordination	Construction Phase	ESMU
4	Monitoring of the participation of the concerned stakeholder in project environment management	Construction Phase	EMU /Joint Monitoring Committee

Table 8-21: Top soil saving management plan

S N	Activities	Timing of action	Location	Responsibilities
1	Loss of topsoil will be avoided by stripping and storing top soil prior to construction and reusing it for rehabilitation. In all other cases, erosion will be minimized by regular rehabilitation of areas not in use for project activities during construction. Rehabilitation will include: i. Immediate re-vegetation of slopes to minimize soil erosion ii. Use of topsoil removed and stockpiled from project erosion (using fast-growing species and different functional groups of plants to keep soil in place); Project component sites; iii. Installation of sediment runoff control devices. Parameters to be monitored: success of re-vegetation and erosion status/ vulnerability. In both cases, immediate action for replanting and stabilizing eroding sites will be taken.	Pre-construction, Construction period	Temporarily acquired land for camp and facility sites Borrow pits, quarry site	Contractor EMU/ Supervising Engineers

Table 8-22: Toxic and hazardous chemical handling and management plan

S N	Activities	Timing of action	Location	Responsibilities
1	i. Disposal of domestic waste and construction waste will occur regularly to approve disposal sites. ii. Hazardous waste will be collected and stored on-site in approved facilities per relevant standards. iii. Hazardous waste will then be removed from site to approved hazardous waste disposal facilities. iv. Parameters to be monitored: Ensure that standards are followed	Construction period	All camps and active construction sites, storage areas, construction yard, vehicle maintenance yard	Contractor



S N	Activities	Timing of action	Location	Responsibilities
2	i. Potential impacts to the environment are from accidental spillages affecting soil, groundwater and adjacent water bodies. Mitigation measures to prevent spillage will include installing appropriate hazardous materials storage facilities	Construction period	Construction area	Contractor
	ii. Providing berms around the containers to prevent spillage			
3	Regular monitoring will be done	Construction period	Construction area	EMU/ Supervising Engineers

Table 8-23: Demobilization and rehabilitation management plan

S N	Activities	Timing of actions	Location	Responsibilities
1	Explore the possible use of camp for the economic development of the area	Beginning of the project operation	Temporary camps	Contractor/PMO/ EMU
2	Demobilization of the camp and sell surplus materials and equipment	Beginning of the project operation	Temporary camps	Contractor
3	Rehabilitate temporary campsites and disposal area. Restore the productive areas by using the stock piled top soil wherever possible	Beginning of the project operation	Temporarily acquired land and disposal area	Contractor
4	Handing over the leased land to concerned land owner	Operation phase	Temporarily acquired land	Contractor
5	Monitoring of the above activities	Operation phase	Temporarily acquired land	EMU



8.5.2 Cost

The estimated cost for the implementation of proposed mitigation measures, establishment and operation of Grievances management system, establishment and operation of the Project Information Center is NRs. 17.46 million (Table 8-24).

Table 8-24: Cost for implementation of mitigation measures, grievances management and project information center operation

SN	Item	Resource-month	Rate/Month (NRs.)	Amount (NRs.)
A.	Program Implementation Cost			
1	Human Resources			
1.1	Unit Chief Environmental Expert	60	60,000	3,600,000
1.2	Civil Overseer	20	30,000	600,000
1.3	Sociologist/ Community Liaison Officer	60	40,000	2,400,000
1.4	Land Acquisition and Resettlement Officer	5	400,000	2,000,000
1.5	Office Assistant	60	30,000	1,800,000
1.6	Supervisor	24	25,000	600,000
1.7	Support Staff-1	60	20,000	1,200,000
	sub-total 1			12,200,000
2	Out of Pocket Expenses			
2.1	Transportation		LS	2,500,000
2.2	Daily allowances		LS	200,000
2.3	Report Production		LS	60,000
2.4	Miscellaneous		LS	200,000
2.5	Consultation meetings		LS	200,000
	Sub-total 2			3,160,000
	Total (1+2)			15,360,000
B.	Grievance Management			
1	Meeting allowances to LCF members		LS	1,000,000
2	Stakeholder consultation		LS	100,000
3	Miscellaneous		LS	100,000
	Sub-total -B			1,200,000
C.	Project Information Center			
1	Consultation meetings		LS	100,000
2	Newsletters			500,000
3	Audio visual documentation			300,000
	Sub-total -C			900,000
	Grand total			17,460,000



8.6 Implementation Approach and Mechanism

Project Stakeholders for Environmental Management

Key stakeholders including BHP, to be involved for project environmental management are:

- Ministry of Forests and Environment (MoFE);
- Ministry of Energy, Water Resources and Irrigation (MoEWRI);
- Department of Forests;
- Construction Management/Supervision Consultant;
- Project proponent Budhi Ganga HPP/DoED
- Environment Monitoring Unit
- Environment and Social Management Unit
- Local Consultative Forum
- Contractor;
- Local Government;
- District level offices such as District Coordination Office, Division Forest Office,
- NGOs and Community based Organizations (CBOs).

8.6.1 Institutional Arrangement and Responsibility

i) Project Manager Office

The BHP Project Manager Office has been established under the organizational setup of DoED. The Project Manager will have overall responsibility regarding the implementation of the EMP and will also be responsible for acquiring necessary permits for forest clearance from Ministry of Forests and Environment, land acquisition and payment of compensation etc. The Project Manager will be responsible to make sure the incorporation of EIA recommendations in tender document and contract agreement and allocation of necessary budget for the implementation of EMP.

ii) Budhi Ganga Environment Monitoring Unit (EMU)

The Budhi Ganga Environment Monitoring Unit office will be established under the supervising Consultant Office. The unit office will be site based for day to day environmental monitoring of the project, implementation of monitoring plan and coordination of work with concerned stakeholders.

The following resources will be deployed in the EMU.

- Environmental Expert/Unit Chief
- Ecologist/ Forest Expert
- Sociologist
- Field Technician/Supervisors-2
- Support staff – 1

iii) Environment and Social Management Unit (ESMU)

Environment and Social Management Unit Office will be established under the Project Manager Office. This office will be under direct supervision of PMO. This Unit will have three major responsibilities namely land acquisition and rehabilitation, implementation of proposed



mitigation measures and CSR works; and, establishment and operation of project information center (PIC). ESMU will consist of the following staff:

- Unit Chief Environmental Expert
- Sociologist/ Community Liaison Officer
- Land Acquisition and Resettlement officer
- Civil overseer
- Office Assistant
- Supervisor
- Support Staff

iv) Construction Contractor

The construction contractor will be responsible for implementation of mitigation measures specified in the part of contractor and compliance with the tender clauses. The contractor will be responsible for the implementation of spoil disposal, waste management, occupational safety, structural bioengineering measures, air, noise and water quality protection measures, etc.

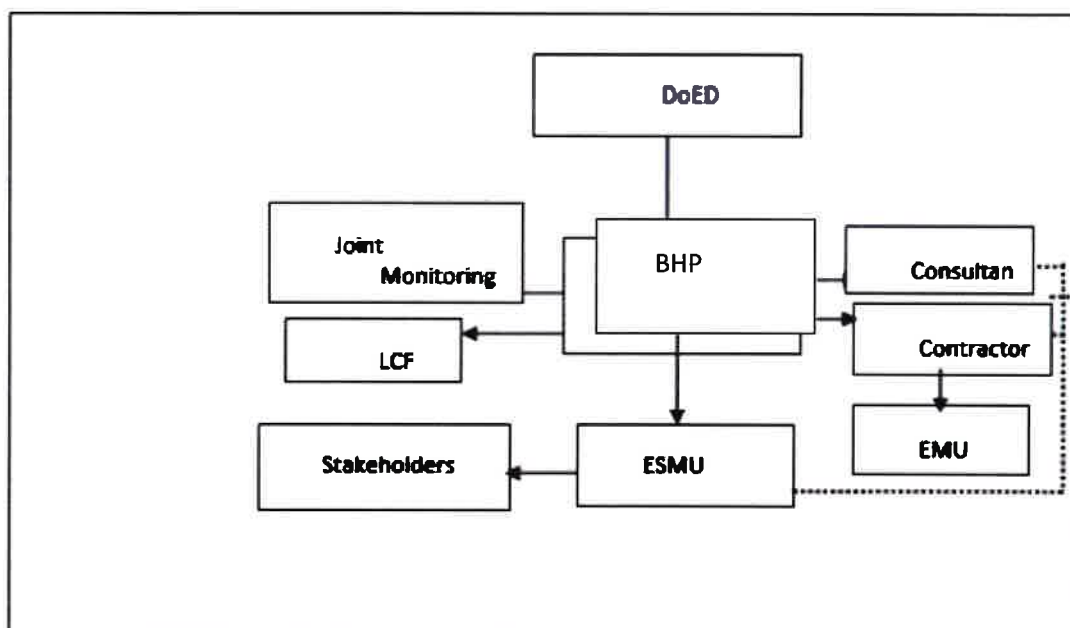


Figure 8-1: Organizational setup for environmental management

v) Construction Management/Supervision Consultant

The coordination of the compliance monitoring and mitigation program allocated under the contractor will be the responsibility of the Consultant. Environment Monitoring Unit will be established under the consultant organizational setup for the monitoring of compliance and impact and report to the chief of consultant engineer. The engineer's office will deliver written instructions to the Contractor for prompt action. The Engineer will have authority to stop work fully or partially; delay in approval of payment or otherwise penalize contractors for non-performance of environmental tender clauses. The Consultant will also be responsible for the supervision and quality control of the works conducted by the EMU and Contractor. The Consultant will also have responsibility for the approval of Environment Protection Plan, Health Safety Plan, Waste Management Plan and Muck Disposal Plan prepared by the Contractor on recommendation of EMU.

vi) Local Consultative Forum

A Local Consultative Forum (LCF) will be established to address the grievances regarding compensation and other social and environmental issues. This committee will work as an independent body and assist with grievance management for the project. The LCF will be headed by the Mayor of Sanfebagar Municipality and the Mayor of Budhi Ganga Municipality, Chief of Mellekh Rural Municipality, PMO representative, ESMU chief, EMU chief and liaison officer will be the member of LCF. Committee will promptly act to resolve the social and environmental issues related to the project.

vii) Joint Monitoring Committee

To ensure the proper implementation of mitigation measures and environmental monitoring work a joint monitoring team will be formed which will monitor the activities of the EMU, ESMU and Contractor on periodic basis. This monitoring team will be coordinated by the EMU Chief. The committee will include the representative of local government of the project area, DCC, DFO and local NGO working in the area.

8.7 Reporting

BHP-EMU will be responsible for the preparation of Environmental Monitoring Reports whereas ESMU will prepare quarterly progress report regarding the implementation of mitigation, enhancement, and CSR program. The Project Manager Office (PMO) will be responsible for the distribution of report to the concerned agencies. The following reports will be prepared for the project.

8.7.1 Pre-construction Environmental Report

This report will be prepared prior to start of construction work. The report includes changes in baseline situation and site condition prior to start of actual construction work. The Environment Management Plan will be updated during this period if required.

8.7.2 Construction Phase Environmental Report

The construction phase environmental monitoring report and environmental and social progress report will be prepared on quarterly basis and annual environmental report will be prepared at the end of each calendar year. A final environmental report will be prepared after the completion of the construction work. EMU and ESMU offices will be responsible for the preparation of report.

The report will be distributed to Ministry of Forests and Environment, Ministry of Energy, Water Resources and Irrigation, Department of Electricity Development and municipality and rural municipality offices of the project area.

8.7.3 Operation and Maintenance Phase Environmental Report

Operation and maintenance phase environmental report will be prepared for two years following construction. EMU and ESMU offices will prepare this report for project. The report will describe status of mitigation measures, problems and recommended solution. The report shall clearly identify where operational mitigation measures are not being met or where mitigation efforts are inadequate to protect natural and socioeconomic resources. Unanticipated adverse project impacts will be clearly identified. Measures to solve problem will be proposed and will be funded



under the project annual operating budget. The environmental audit report will be prepared by MoFE as per EPR 97.

8.8 Environmental Monitoring

8.8.1 Rational for Environmental Monitoring

Monitoring is an essential aspect of environmental management. It consists of collection of data to measure environmental changes associated with construction and operation of the project. Ministry of Energy, Water Resources and Irrigation is the responsible organization for the environmental monitoring of energy sector projects as per EPR 97. Manuals and Guideline prepared by line ministries are available which define the monitoring mechanism. The Manual for preparing Environment Management Plan for Hydropower Projects (DoED, 2002) and "A Guide to Environmental Monitoring of Hydropower Project" (MoEST, 2006) was considered during the preparation of the monitoring plan.

8.8.2 Objectives of Monitoring

Environmental monitoring is required to ensure compliance of the mitigation and enhancement program, tender clauses related to environment and social issues and to assess the actual impacts of these measures as well as the emerging impacts during different phases of the project. The objectives of monitoring will be:

- to comprehend the environmental condition in the project area prior to implementation of the project;
- to ensure the compliance status of the implementation of mitigation measures and regulatory standards;
- to ensure the effective compliance of tender clauses as per contract document;
- to check the effectiveness of mitigation and enhancement measures implemented by different project parties; and
- to verify the accuracy of EIA predictions and assess the emerging and cumulative environmental problems.

8.8.3 Site Inspections

BHP-EMU will conduct site inspection prior to construction, during construction and at the end of construction. The inspection will be coordinated with Contractor (s).

i) Initial Inspection

The initial inspection conducted during pre-construction will document the site condition just before start of construction work. Necessary standard for construction and required environmental control based on the available national and international practices will be established. Visual documentation of the site and photographs will be taken during the inspection.

ii) Progress Inspection



The progress inspection during construction will document the compliance and impact monitoring at specific sites. The purpose of inspection will be early identification of environmental and social problems and propose suitable remedial measures. The monitoring will be conducted daily, weekly and monthly basis for the parameters like vegetation clearance, spoil disposal, health and sanitation and safety. The contractor will be formally notified through letter of Project Manager/ Supervising Consult for remedial action if any deficiency is noted during monitoring.

iii) Final Inspection

The final inspection will be conducted at the end of construction phase to document the contractors' compliance of tender clauses related to the environment. The Contractor will be given written notice if cases of non-compliance or partially compliance are found during inspection.

8.8.4 Monitoring Types

i) Pre-Construction Monitoring

Baseline monitoring will be conducted during this phase to update the baseline condition of the project area prior to implementation of the project. The baseline will cover the major components of physicochemical, biological and socioeconomic and cultural environment. The key components such as water, air, and noise quality, land use, landslides and soil erosion, vegetation pattern, number of project affected families and their assets etc. will be considered for monitoring. The land acquisition, compensation, rehabilitation measures will be disclosed to people and common consensus will be made. It will be ensured that mitigation and monitoring requirements associated with the contractor were incorporated in tender document and contract agreement. Monitoring of the allocation of adequate budget for the implementation of the mitigation measures and monitoring works is the other aspect of monitoring.

The impact monitoring during pre construction phase includes clearance of forest, removal of private trees, loss of protected species of plants, acquisition of land, house etc.

ii) Construction Monitoring

Impact and compliance monitoring will be conducted during this phase of project development. The Contractor Health and Safety Plan, Environment Management Plan, Waste and Spoil Disposal plan will be reviewed and approved by the concerned authority.

Impact monitoring will be carried out to assess actual level of impact due to project construction. The impact monitoring includes:

- monitoring of the impacts of the project on physicochemical, biological and socioeconomic and cultural environment of the area;
- monitoring of the accuracy of the predicted impacts;
- identifying the emerging impacts due to project activities or natural process and developing remedial action; and
- monitoring of the effectiveness of mitigation measures

The compliance monitoring will be conducted to monitor the compliance of the proposed mitigation measures and monitoring activities. The compliance monitoring will mainly focus on:

- compliance of the tender clause;



- compliance of mitigation measures;
- timely and adequate implementation of Environmental Management Plan; and
- overall environmental and social performance of the project.

The compliance monitoring will be conducted to monitor the compliance of the proposed mitigation measures and monitoring activities. The compliance monitoring will mainly focus on the following.

Different types of compliance form such as daily log, advisory and non-compliance incident reports will be prepared to conduct compliance monitoring. Supervisors will be deployed at construction sites for day to day monitoring work. The chief of BHP-EMU will be responsible for the implementation of compliance monitoring. The supervisors completed daily environmental logs at each site showing the work conducted for each day. The supervisors also complete advisory forms for each site showing the area of non-compliance with reference to the relevant contract clauses in case of non-compliance. If the contractor does not address the non-compliances after advisory forms are received a non-compliance incidence report will be prepared. After preparation of non-compliance report the issue of non-compliance will be sent to Project Manager/Engineer for necessary action.

iii) Operation Monitoring

Both compliance and impact monitoring will be carried out during project operation phase. The compliance monitoring will focus on the compliance of mitigation and enhancement measures and monitoring program are being fully and properly carried out by the project. The impacts of operation and maintenance phase activities including operation of the power plant, regular maintenance, safety issues, changes in hydrological parameters, sedimentation etc. will be covered in impact monitoring.

8.8.5 Monitoring Parameters, Schedule and Agencies to be consulted

Land use pattern, forest status, settlement, public health, infrastructure, implementation of the mitigation measures and compliance of the tender clauses are some of the areas to be monitored. The schedule of monitoring will be daily, quarterly, half yearly and yearly depending on the parameters and type of monitoring. The detail of monitoring parameters, schedule, method and agencies to be consulted during pre-construction, construction and operation phases for physicochemical, biological and socioeconomic and cultural environment is presented in Table 8-25.



Table 8-25: Monitoring parameters, method, schedule and indicators

Parameters	Indicators	Method	Schedule	Location	Agencies to be consulted
Pre-construction Phase/ Baseline Monitoring					
Physical Environment					
River hydrology	Flow rate of river and its tributaries	Gauging station	Daily	Dam site	
River water quality	Temperature, pH, turbidity, TSS, DSS, hardness, chloride, ammonia, iron, calcium, DO, BOD, COD etc.	Water sampling and laboratory analysis in	Once prior to construction	Dam and powerhouse site	
Drinking water quality	Total Coliform, Ecoli, Giardia etc.	Water sampling and laboratory analysis in	Once prior to construction	Permanent and temporary camps	
Land use	Land use changes at project sites	Observation	Once prior to construction	Project sites	
Slopes	Stability and degree of slopes	Site observation	Once prior to construction preferable after rainy season	Project component road and other possible unstable areas	
Biological Environment					
Forest/vegetation	Forest status	Site observation and sampling	Once prior to construction	In and around construction sites, project components etc.	DFO
	Pegging of the forest site	Counting and marking the trees to be felled.	Once prior to construction	Reservoir, adit, and project component road	DFO
	Forrest clearance	Approval of the forest clearance from concern authorities	Once prior to construction	Reservoir, adit, and project component road	MoFE
	Actual acquisition of forest land	Cross checking the record	Quarterly	Reservoir, dam, adit, and project component road	DFO, CFUGs
	Number of trees and saplings removed	Observation and record checking	Monthly	Reservoir, dam, adit, and project component road	DFO, CFUGs



Parameters	Indicators	Method	Schedule	Location	Agencies to be consulted
	Removal of species having conservation significance such as Sal and Vyakur	Observation and record checking	Monthly	Reservoir, dam, adit, and project component road	DFO, CFUGs
Wildlife	Occurrence of wildlife species	Observation and checklist survey	Once prior to construction	In and around construction sites, project components	
Fisheries	Changes in fish population and diversity	Fish sampling and discussion with local fishermen	February -March and June – July	Intake, reduced flow zone and powerhouse tailrace	
Socio-economic and Cultural Environment					
Physical assets	Collect information about land, structures and other assets to be acquired by the project	Cadastral survey, Household survey etc.	Once prior to construction	Project structures and facilities sites	District Land Revenue Office
Settlement	Growth of settlements in project area	Discussion with local people, municipality and rural municipality and observation	Once prior to construction	Core project area	Rural Municipality and Municipality
Public health	Types of disease and incidence of disease in the project area	Meeting and discussion with in charge of local health posts and district hospitals, review of records and data	Once prior to construction	Project affected Rural Municipality and Municipality	Local health institutions
Law and order	Level of crime, types of crime, community disturbances etc.	Discussion with local people and local administration	Once prior to construction	Project affected Rural Municipality and Municipality	Local Administration , Rural Municipality and Municipality Offices
Land	Acquisition of land and lease of land for temporary facilities	Cross checking the list of compensation	Monthly	Project affected area/ sites	Rural Municipality and Municipality
House and other structures	Acquisition of house and other private structures	Cross checking the list of compensation	Monthly	Project affected area/ sites	Rural Municipality and Municipality
Fruit and fodder trees	Number of fruit and fodder trees to be felled	Observation and record checking	Monthly	Project structures and facilities	Rural Municipality and Municipality, DFO



Parameters	Indicators	Method	Schedule	Location	Agencies to be consulted
Construction Phase					
Impact Monitoring					
Physical Environment					
Slopes	Degree of slopes, stability of slopes, changes from the baseline	Site observation	Weekly	Project component road, borrow area and other unstable areas.	
Land use	Land use changes at project sites	Observation	Quarterly	Reservoir area, dam, camp and spoil disposal sites	
Spoil disposal and management	Dust pollution, river turbidity	Observation	Daily	Spoil disposal sites	
Storage area	Construction of dykes, provision of separate storage for inflammable items.	Observation and discussion	Weekly	Storage areas	
Air quality	TSP, SPM, PM ₁₀ , CO, NO ₂ and SO ₂ .	Site based measurement using ToxiRAE II NOX sampler, SKC gravimetric pumps, UCB PATS plus. The existing provision of the GoN will be followed.	Twice in dry period	Headwork, powerhouse, crushing and batching plant and road.	
Noise level	Leq, L _{max} , L _{min} , L ₅ , L ₁₀ , L ₅₀ , L ₉₀ and L ₉₅ .	Measurement through noise level meter (SPL meter)	Quarterly	Headwork, powerhouse, crushing and batching plant and project component road.	
Drinking water quality	Total coliform, Ecoli, Giardia	Water sampling and laboratory analysis	Quarterly	Permanent and temporary camps	
River water quality	Temperature, pH, turbidity, TSS, DSS, hardness, chloride, ammonia, iron, calcium, DO, BOD, COD	Water sampling and laboratory analysis	Twice in dry period	Dam and powerhouse site	
Biological Environment					



Parameters	Indicators	Method	Schedule	Location	Agencies to be consulted
Vegetation/Forest	Status of the forest clearance area	Observation and Cross checking the record	Quarterly	Reservoir, dam, adit, and project component road	DFO
	Loss of floral diversity (no of species felled)	Observation and record checking	Daily	Reservoir, dam, adit, and project component road	DFO
	Compensatory plantation activities such as site selection, nursery establishment and plantation works	Observation of Site, consultation with stakeholders	Monthly	Plantation sites	DFO, CFUGs
Wildlife	Occurrence and movement of wildlife species	Observation and discussion	Monthly	Construction area	
	Incidents of wildlife killing and hunting	Observation, interaction with project workers and local people	Quarterly	Core project area	
Fisheries	Changes in fish population and diversity	Fish sampling and discussion with local people	March, June and September	Intake, reduced flow zone and powerhouse tailrace	
Socioeconomic and Cultural Environment					
Public health	Types of disease and incidence of disease in project workers and local community	Meeting and discussion with in charge of local health posts and district hospitals, review of records and data	Quarterly	Project affected Rural Municipality and Municipality	Local health institutions
Land Compensation	Status of compensation, use of compensation, purchase of new land etc.	Cross checking the list of compensation, interview with PAFs	Quarterly	PAFs	Ward office
House	Demolition of house, construction of new house, status of R and R assistance etc.	Cross checking the list of compensation, interview with PAFs	Quarterly	PAFs	Ward office
Infrastructure	Pressure on local infrastructures due to increase in local population	Discussion with local school and health posts	Quarterly	Project area	Local health institutions



Parameters	Indicators	Method	Schedule	Location	Agencies to be consulted
Local Markets	Increase in demand of local consumable goods and thus increases in price and supply situation of the local markets	Observation and discussion	Quarterly	Local markets	
Gender and indigenous caste community	Impact on poor, indigenous and disadvantage people	Observation, group meetings and household survey	6 months	Major settlement of core project area	Project affected Rural Municipality and Municipality
Law and order	Occurrence of conflicts of interest and law and order situation	Observation and discussion	6 months	Major settlement of core project area	Project affected Rural Municipality and Municipality
Occupational safety	Cases of accidents, injuries and death	Observation and record checking	Weekly	Core Project area, structures and facilities sites	Health institutions
Health and sanitation	Health and sanitation condition in labor camps	Observation and discussion	Weekly	Labor camps	Local NGOs
Livelihood	Impact on income and livelihood due to project	Observation, discussion and survey	Quarterly	Affected households	Project affected Rural Municipality and Municipality
Economy	Local employment, rental, sales of consumable goods	Meeting and discussion with local communities	Quarterly	Project affected area	Project affected Rural Municipality and Municipality
Compliance Monitoring					
Approval for forest clearance	Approval letter	Review of letter	Following the submission of application to concerned institutions	Ministry of Forests and Environment	MOFE and DOF



Parameters	Indicators	Method	Schedule	Location	Agencies to be consulted
Implementation of proposed mitigation, enhancement measures and monitoring requirement	Incorporation of EIA recommendations into project documents	Review of project specification and tender documents	Following completion of tender documents	Kathmandu and site office of project	DFO, NGOs, MOFE, MOEWRI etc.
Incorporation of the environmental considerations from the tender documents into the contractors proposed work plan	Inclusion in the contractors work plan of the environmental consideration from the tender documents	Review of work plans submitted by contractors	During contract negotiation	Kathmandu and site office of project	
Allocation of adequate budget for the implementation of the environment mitigation measures and monitoring works	Budget for mitigation and monitoring	Discussion with concerned authority	Annual and each 4 month	Kathmandu and site office of project	
Construction logistics	Contractors arrangement regarding labor camps materials, storage and construction activities	Site observation	Beginning of the construction	Project sites	
Contractor Plans	Health and safety, environment management, spoil disposal, waste management plan	Review of plans submitted by the contractor	Beginning of the construction	Project office	



Parameters	Indicators	Method	Schedule	Location	Agencies to be consulted
Priority of employment to the local people	List of employment	Cross check the employment list	Monthly	Project sites	Rural Municipality and Municipality
Discrimination between ethnic group and gender	Imbalance in employment of specific groups	Cross check the employment list	Monthly	Project sites	Rural Municipality and Municipality
Compliance of the tender clauses	Implementation of mitigation and monitoring works	Observation and discussion	Daily	Project sites	
Clean up and reinstatement of the project area	Checking of the different aspects of project cleanup	Site observation	At the end of the construction period	Project sites	Rural Municipality and Municipality
Operation Phase					
Impact Monitoring					
Physical Environment					
Air quality	TSP, SPM, PM ₁₀ , CO, NO ₂ and SO ₂	Measurement	Once in dry period for 2 years	Powerhouse and headwork area.	
River Water quality	Temperature, pH, turbidity, TSS, DSS, hardness, chloride, ammonia, iron, calcium, DO, BOD, COD	Water sampling and laboratory analysis in	Once in a year for 2 years	Reservoir, reduced flow zone and powerhouse tailrace	
Hydrology and sedimentation	Changes in flow regime and sediment deposition pattern	Measurement and laboratory analysis	Quarterly	Reservoir	
Biological Environment					
Forest land	Changes of the 8.50 ha forest land into project structure and facilities	Observation and discussion	Annual	Project sites	
Vegetation/Forest	Survival of the plantation	Quadrat sampling and discussion with local people	Annual	Plantation sites	DFO



Parameters	Indicators	Method	Schedule	Location	Agencies to be consulted
Project structures and facilities	Continuous disturbances due to presence of electric light, physical structures and movement of vehicles	Observation and discussion	Annual	Project sites	
Socio-economic and Cultural Environment					
Local employment	Priority for the local employment	Cross checking the list of employment	Annual	Power plant office	Rural Municipality and Municipality
Economic status	Changes in economic condition of local people due to withdrawal of economic opportunity	Interview and discussion	Annual	Project affected families	
Infrastructure	Increase in local infrastructure	Interview and discussion	Annual	Project affected area	Rural Municipality and Municipality
Compliance Monitoring					
Implementation of operation phase environmental conditions mentioned in project documents and EIA report	Checking the implemented program	Site observation	Annual	Project area	
Continuation of the operation phase mitigation measures	Implementation status, involvement of local people and line agencies in program	Site observation	Annual	Project area	Rural Municipality and Municipality
Continuation of the operation phase monitoring program	Status of monitoring	Site observation	Annual	Project area	Rural Municipality and Municipality



8.8.6 Monitoring Cost

The estimated monitoring cost is NRs. 12.11 million for pre-construction, 4 year construction and two year operation phase monitoring. This cost includes cost for staffing, transportation, joint monitoring with line agencies and concerned stakeholder, report preparation etc. (Table 8-26).

Table 8-26: Environmental monitoring cost

SN	Item	Human Resource-months	Rate/Month (NRs.)	Amount (NRs.)
A.	Baseline/Pre-construction			
1	Human Resources			
1.1	Team Leader /Environmental Expert	1.5	60,000	90,000
1.2	Ecologist/Forest Expert	1	40,000	40,000
1.3	Socio-economist	1	40,000	40,000
	Sub-total			170,000
2	Out of Pocket Expenses			
2.1	Transportation	15	12,000	180,000
2.2	Field survey (Enumerators, supervisors etc.)		LS	50,000
2.3	Daily allowances	45	2,000	90,000
2.4	Data Analysis		LS	50,000
2.5	Report Production		LS	50,000
2.6	Miscellaneous			10,000
	Sub-total			430,000
	Total of A			600,000
B	Construction Phase (Compliance and Impact for 4 years)			
1	Human Resources			
1.1	Environmental Expert/ Unit Chief	48	60,000	2,880,000
1.2	Ecologist/Forest Expert	4	40,000	160,000
1.3	Fish Expert	4	40,000	160,000
1.4	Socio-economist	48	40,000	1,920,000
1.5	Supervisor	48	25,000	1,200,000
1.6	Support Staff-1	48	15,000	720,000
	Sub-total			7,040,000
2	Out of Pocket Expenses			
2.1	Transportation		LS	2,500,000
2.2	Daily allowances		LS	200,000
2.3	Report Production and Stationery		LS	10,000
2.4	Field test and laboratory analysis		LS	300,000
	Consultation meetings		LS	200,000
2.5	Miscellaneous			200,000
	Sub-total			3,410,000
	Total of B			10,450,000
C	Joint Monitoring Committee			
1	Daily allowances		LS	300,000



SN	Item	Human Resource-months	Rate/Month (NRs.)	Amount (NRs.)
	Sub-total of C			300,000
D	Operation and Maintenance Phase (Two Years Compliance and Impact)			
1	Human Resources			
1.1	Team Leader Environmental Expert	3	60,000	180,000
1.2	Ecologist/Forest Expert	1.5	40,000	60,000
1.3	Socio-economist	1.5	40,000	60,000
	Sub-total			300,000
2	Out of Pocket Expenses			
2.1	Transportation	20	12,000	240,000
2.2	Daily allowances	60	2,000	120,000
2.3	Report Production		LS	50,000
2.4	Miscellaneous		LS	50,000
	sub-total			460,000
	Total of D			760,000
	Grand Total (A + B + C+D)			12,110,000

8.9 Environmental Auditing

8.9.1 General

The Environmental Audit (EA) shall be carried out to assess environmental impacts, accuracy of predictions, the effectiveness of mitigation measures and the monitoring plan. It is intended that EA should relate actual impacts with predicted impacts which help in evaluating the accuracy and adequacy of EIA predictions.

An environmental audit provides a snapshot of the environmental situation, compliance or impact with documented evidences. In addition to fulfilling the formal requirements, an environmental audit is a good tool to promote environmental best practices and procedures. In general, environmental auditing is done with the following aims:

- assessing compliance with formal requirements;
- facilitating management control of environmental practices;
- promoting good environmental management and minimizing the risks; and
- establishing the performance baseline for an environment management system.

8.9.2 Types of Audit

The national EIA guideline 1993 has stated the following types of audit that may be carried out for large scale development projects.

Decision Point Auditing: Examines the effectiveness of EIA as a decision-making tool.

Implementation Auditing: Ensures that condition of contract has been fulfilled.

Participatory Auditing: Ensure that stakeholder participation and expectation has been addressed.

Performance Auditing: Studies the work of agencies associated with project management.



PredictiveTechniqueAuditing: Examines environmental changes arising from project implementation.

Environmental Impact Assessment Procedure Auditing: Examines critically the methods and approach adapted during the EIA.

8.9.3 Organizational Responsibility

The National EIA Guidelines, 1993 specify that environmental impact auditing must be carried out by the government agencies approving the project with the assistance of relevant government agencies and non-governmental organizations as necessary. The Guidelines also state that result obtained from an EA should be made available to the project proponent and concerned agencies. Ministry of Forests and Environment will carry out environmental auditing of the proposed BHP after two years of completion of the project as per EPR 97.

8.9.4 Auditing Parameters, Schedule and Agencies to be consulted

The detail of auditing parameters, schedule, location, method, indicator and agencies to be consulted are presented in Table 8-27. The environmental auditing shall include but not be limited the following:

- Accuracy of the predicted impacts;
- magnitude of the predicted impacts;
- effectiveness of the proposed mitigation measures;
- compliance of the recommendations and findings of EIA report;
- compliance of tender clauses;
- identification of number and area of non-compliance; and
- effectiveness of compliance monitoring systems.

8.9.5 Approach and Methodology

Environmental audit will follow the same methodology and survey sites covered in Environmental Impact Assessment and Monitoring Report. Review of monitoring report, field visit, checklist survey, meetings, and discussion with local community shall be the main methodology to be adopted for environmental auditing.

8.9.6 Schedule

The environmental impact audit of the BHP shall be conducted two years after completion of the project. The estimated time for the audit study is 6 months from the date of commencement.



8.9.7 Resourcing

The environmental impact audit also requires a team of multidisciplinary experts with relevant experience in hydropower projects. The following team is proposed for the environmental audit of the Budhi Ganga Hydropower Project:

- Environment Expert/ Team Leader
- Civil/ Environmental Engineer
- Forest specialist/Ecologist
- Fish Expert
- Sociologist
- Support staff



Table 8-27: Environmental audit parameters, schedule and agencies to be consulted

Parameters	Method	Indicator	Location	Sources	Agencies to be Consulted
A. Physical Environment					
Water quality	Collection of sample, analysis and comparison with baseline	Temperature, pH, turbidity, TSS, DSS, hardness, chloride, ammonia, iron, calcium, DO, BOD, COD and etc.	Reservoir, reduced flow zone and powerhouse sites	Analytical data	
Land use	Observation and interview with project authority preferably the environmental staff and ward member of the concerned ward	Changes in land use and reclaim temporary sites	Storage area, quarry, burrow, temporary camp concrete batching plant etc.	Review of project monitoring reports, consultation with ward members, local people and observation	Project staff and ward representative of concerned ward
Disposal of construction spoil and waste material	Observation and interview with project authority preferably the environmental staff and ward member of the concerned ward and local people of nearby settlement	Initiated erosion and impact on aesthetic value, degradation of land and water quality	Designated sites	Review of project monitoring reports, consultation with ward members, local people and observation	Project staff and ward representative of concerned ward
Excavation and slope cutting	Observation and interview with project authority preferably the environmental staff and ward member of the concerned ward	Initiated land erosion, local drainage pattern	Dam adits, project component roads, powerhouse, desander etc.	Review of project monitoring reports, consultation with ward members, local people and observation	Project staff and ward representative of concerned ward



Parameters	Method	Indicator	Location	Sources	Agencies to be Consulted
	and local people of nearby settlement				
Erosion and slope stability	Observation and measurement	Eroded and unstable areas on natural slopes	Project sites	Review of project monitoring reports, consultation with ward members, local people and observation	Concerned ward office
Structural damages	Observation and interview to the concerned house owner and ward member	Types of damage, compensation and other rehabilitation works	Project components	Review of project monitoring reports, consultation with ward members,	Concerned ward office of Affected Municipality and Rural Municipality
Bioengineering	Effectiveness of bioengineering measures to stabilize unstable slopes	Observation	Project Component road	Observation and discussion with local people and line agencies	
B. Terrestrial Environment					
Loss of forest	Examination of forest	Number of stumps of cut trees	Reservoir, dam, adit, and project component road	Review of project monitoring reports, consultation with CFUGs, DFO local people and observation	DFO, CFUGs
Plantation	Observation	Status of compensatory plantation	Plantation sites	Review of project monitoring reports, consultation with CFUGs, DFO local people and observation	DFO, CGUGs



Parameters	Method	Indicator	Location	Sources	Agencies to be Consulted
Wildlife	Interview with local people and CFUGs	Wildlife hunting and poaching	Forest area near the project site	Review of project monitoring reports, consultation with CFUGs ,local people and observation	DFO, CFUGs
	Observation and interview with local people and CFUGs	Frequency of the birds and mammals seen in the project area	Project area	Review of project monitoring reports, consultation with CFUGs ,local people and observation	DFO, CFUGs
C. Aquatic Environment					
Fisheries	Sampling	Species of fish occurrence and abundance as compared with pre project	Dam site, reduced flow zone and powerhouse	Review of project monitoring reports, consultation with local fisherman	
	Interview with people involved in fishing	Use of explosive, electric rod and nets	Project site	Review of project monitoring reports, consultation with local fisherman	Ward office
	Observation and measurement	Riparian release	Dam site	Local people of the Budhabagar settlement	Ward office
	Operation of fish ladder	Operation of the fish ladder, movement of fish etc.	Dam site	Operating staff and local fishermen	
A. Socio-economic and Cultural Environment					
Employment opportunity	Analysis of records, interview of local people and ward chairman	Number of local people employed in project constriction	Project site	Records from Project, contractor and local people	Affected Municipality and Rural Municipality



Parameters	Method	Indicator	Location	Sources	Agencies to be Consulted
	Analysis of records, interview of local women and ward member (female)	Number of women in workforce	Project sites	Records from Project, contractor, monitoring reports consultation with female ward members and local women	Ward office
Trade and commerce	Review of Records	Number of shops increased/decreased during construction and number of shops still in operation	Roadsides and in project sites	Records and local people	Ward office
	Inquiries and interview with local business man and ward chairman	Rental of houses and land space before, during and after construction	Local area	Local tenants	Ward office
Compensation	Survey and interview to PAFs	Payment of compensation for the acquisition of private assets and use of compensation received	Project area and out of the area	Review of project monitoring reports, consultation with PAFs	Ward office
Occupational and safety hazards	Records and interview	Types and number of accidents occurred during construction	Project sites	Records from Project, contractor, monitoring reports, ward office and local people	Affected Municipality and Rural Municipality
	Records and interview with the people involved in project works	Facility of first aid, emergency services provided	Project sites	Records from Project, contractor and local people and ward office	
Public health	Records and interview	Cases of communicable diseases	Project sites, health posts and hospitals	Medical records from local health posts	Hospital and local health posts



Parameters	Method	Indicator	Location	Sources	Agencies to be Consulted
Mitigation measures and enhancement programs	Records and interview with the ward chairman, CFUGs, PAFs and local people	Implementation status of mitigation program as per EIA report	Project area	Records from project managers office, contractor, local people and review of monitoring reports	DFO, CFUGs, Affected Municipality and Rural Municipality

Note:

TSS:	Total Suspended Solids	RM	:	Rural Municipality
DSS:	Dissolved Suspended Solids	MOFE	:	Ministry of Forests and Environment
DO :	Dissolved Oxygen	BOD	:	Biological Oxygen Demand
DFO:	Division Forest Office	COD	:	Chemical Oxygen Demand
CFUGs:	Community forest users group	PAFs	:	Project Affected Families



8.9.8 Auditing Cost

The estimated auditing cost is NRs. 1.17 million. This includes cost for staffing, transportation, survey, and report preparation (Table 8-28).

Table 8-28: Environmental auditing cost

SN	Item	Man-month	Rate/Month (NRs.)	Amount (NRs.)
1	Human Resources			
1.1	Team Leader Environmental Expert	2	120,000	240,000
1.2	Ecologist/Forest Expert	1	120,000	120,000
1.3	Fish Expert	1	120,000	120,000
1.4	Sociologist	1.5	120,000	180,000
	Sub-total			660,000
2	Out of Pocket Expenses			
2.1	Transportation	10 days	12,000	120,000
2.2	Field survey (enumerators, supervisors etc.)		LS	50,000
2.3	Daily allowances	40	4,000	160,000
2.4	Data Analysis		LS	25,000
2.5	Report Production		LS	50,000
2.6	Miscellaneous			100,000
	Sub-total			505,000
	Total			1,165,000

8.10 Environment Management Cost

The total estimated environmental management cost for the proposed project is 142.62 million NRs. which is 2.62% the total project cost (Table 8-29). The estimated cost includes implementation of mitigation and enhancement measures and environmental monitoring during pre-construction, construction and operation phases of the project. The summary of the cost is shown in the table below and details are given in Chapter 7 and Table 8-24 and Table 8-26).

Table 8-29: Environment management cost

Item	Amount NRs. (Million)
Cost for environmental mitigation measures	55.34
Cost for enhancement measures	16.83
Cost for community support program and corporate social responsibility	40.88
Cost for mitigation program implementation, PIC operation and grievance management	17.46
Cost for environmental monitoring	12.11
Total environment management cost	142.62
Total project cost	5450.32
Percentage of total environmental cost to the total project cost	2.62%



9. REGULATORY FRAMEWORK

9.1 INTRODUCTION

The GoN's current policies emphasize the importance of adopting environmentally sound and socially sustainable practices in development projects. GoN has passed sectoral policies, enacted acts and regulations, developed guidelines and manuals, and has signed international treaties and conventions all relating to the bio-physical and social environment. There are environmental requirements for planning, approval and implementation of hydropower and other electricity-generating projects.

This chapter focuses on a brief description of the policy, legal and administrative framework within which BHP will be implemented. The proponent complies with the legal requirement of Government of Nepal (GoN) and will be responsible for fulfilling provisions of all relevant acts, policies, rules, guidelines and standards while implementing the project. The policies, acts, rules, guidelines and conventions relevant to the proposed project are described below. The proponent will obey and follow if any other laws besides those already mentioned in the document become applicable due to various activities that will be undertaken as a part of the project.

Besides GoN environmental policy, legal and administrative frameworks the relevant policy of the donor agencies has also been reviewed during the preparation of EIA report.

9.2 National Policy, Legal and Administrative Framework

9.2.1 Constitution of Nepal

Article 18 explains about right to equity. The article 18 (3) stated that discrimination shall not be on the grounds origin, religion, race, caste, ethnicity, gender, sex, economic status, language, region, ideological conviction or any of these. Provided that nothing shall be deemed to prevent the making special provision by law for the protection, empowerment, or advancement of women, Dalit, indigenous people Aadibashi Janjati, Madeshi, Tharu, Muslim, suppressed group, ethnic minority, marginalized group, farmer, labor, youth, children, elder citizen, gender minority, disable, pregnant, helpless, remote area or poor Khas Arya. Article 18 (4) mentioned that there shall be no discrimination with regard to remuneration for same kind of work and social security on the basis of gender. Article 25 (2) mentioned that that the state shall acquire legal private property only for public interest, and Article 25 (3) mentioned that compensation shall be provided for such acquired property based on compensation as prescribed by law.

Article 30 (1) mentioned that every citizen has the right to live in a clean and healthy environment. Under state policy, Article 51 (5) mentioned that by increasing awareness of the public regarding environmental cleanness, minimizing the risk of industrial and physical development on environment conservation, promotion and sustainable use of forest, wildlife, birds, flora and biodiversity. Article 51 (6) explains about applying appropriate minimization or mitigation measures for negative impact on nature, environment or biodiversity. The proponent is committed to develop the project following the provisions made in Article 30 and 51 of constitution of Nepal.



9.2.2 Plans and Policies

9.2.2.1 Concept Paper of 15th Periodic Plan 2076 BS (2019 AD)

The National Development Board has passed the concept paper for the 15th periodic plan with a 25-year vision. The 15th plan has significance of its own as it is the first periodic plan being implemented by the federal government with a view to materializing the much-touted slogan of Prosperous Nepal, Happy Nepali. The concept paper has envisioned drastic economic growth in five years. The concept paper has set a target of reducing absolute poverty from the current level of 18.7 per cent to 13 per cent by the end of the 15th periodic plan. Regarding per capita income, it is aimed at achieving USD 1,600 per capita income by the end of the 15th periodic plan and a whopping USD 12,100 in 25 years from now. The government is planning to spend a huge amount of Rs. 9,246 billion during the 15th plan period with a focus on improving the industrial sector.

9.2.2.2 Hydropower Development Policy 2058 BS (2001AD)

This is the landmark policy that opened doors for investment of private sector in the hydropower sector of Nepal. The Hydropower Development Policy, 2001 AD emphasizes the need of implementation of mitigation measures in project affected area. The policy states that Resettlement and Rehabilitation works shall be conducted as per approved criteria of the GoN. The policy has mentioned that hydropower development shall be emphasized with due consideration of environmental conservation and as an alternate of bio and thermal energy. Section 6.3 deals with the provision for investment in generation, transmission and distribution whereas section 6.1.2.3 (a) deals with different kind of license required at different level of project development. Articles 6.3 and 6.1.2.3 (a) are relevant for project planning and investigation including EIA.

9.2.2.3 National Water Plan, 2058 BS (2002- 2007 AD)

The National Water Plan 2007-2027 (NWP) was prepared to implement the Water Sector Strategy of Nepal. The Plan targets an increase in Nepal's hydropower generation from 600 MW in 2007 to 4,000 MW by 2027. The NWP emphasizes the need for Strategic Environmental Assessment. Section 7 of the NWP highlights the Environment Management Plan (EMP) as a strategic document for the implementation, monitoring and auditing of environmental protection programs. Section 7 of the plan is relevant for the study especially for the preparation of EMP.

9.2.2.4 Rural Water Supply and Sanitation Policy 2060 BS (2004 AD)

The objectives of the policy is to provide safe, accessible and adequate water supply with sanitation facilities to all Nepalese people with due emphasis to rural people on priority. The policy emphasized the need of renovation and rehabilitation of existing water supply system to increase the production. The policy also stated that capacity of the community will be enhanced for empower and management of water supply. The policy emphasized the need for the use of appropriate technology affordable and manageable by the users' committee.

9.2.2.5 Land Acquisition, Resettlement and Rehabilitation Policy 2071BS (2014 AD)

The policy emphasizes the preparation of Land acquisition and compensation plan for development projects. Compensation shall have to be paid during the preliminary stage of project implementation. The project shall ensure the update of the land documentation such as plotting

and marking of discontinuation of ownership from main records (including lagat katta, kittakat) right after paying the compensation. In case of absentee land owners, the documentation of land ownership shall be done before the compensation money is transferred to the state treasury.

In case full compensation has been provided as mentioned in section (a), the land may be used by the Government of Nepal or any other authorized bodies for public purpose. In case, only part of the affected land is to be acquired but this renders the remaining parts of land fully unproductive or unusable, all such land shall be acquired if the land owner so requests. Compensation of physical infrastructure shall be provided in replacement cost. In case of loss of crops, fruits and pasture land, cash compensation shall be provided based on the standards provided by Department of Agriculture.

9.2.2.6 National Climate Change Policy 2076BS (2019AD)

In the changing context, the Government of Nepal, with the goal of contributing to socio-economic prosperity by developing climate resilient society, has released a Climate Change (CC) Policy in August 2019 by repealing the 2011 CC Policy. The 2019 policy has the objectives of advancing capacity on CCA, developing ecosystem resilience, promoting green economy by adopting low carbon economic development concept, mobilizing national and international financial resources, making effective the information service, mainstreaming climate change into relevant policy, strategy, plan and programmes, and also mainstreaming gender and social inclusion, including in climate change mitigation and adaptation programs. Article 8.3 of the policy mention about the water resources and energy consisting multiple use of water resources, low carbon emission and availability of reliable power. The policy also stated that while selecting the site for hydropower, water supply and irrigation projects environmental friendly site and climate friendly construction techniques shall be used.

9.2.2.7 National Land Use Policy 2072BS (2015 AD)

The land use policy 2015 emphasizes the management of lands in a sustainable manner by developing a specific land use system through Land Use Plans (LUPs). It includes 15 different policies covering various areas. Policy-1 emphasize the entire lands of the country shall be basically classified into different land use zones including agricultural, residential, commercial , industrial, mines and minerals, cultural and archaeological, river and lake-reservoir, forest ,public use and open space, building materials (Stone, Sands, Concrete) excavation and others. Policy-5 highlights about optimum use and protection of arable lands shall be ensured of upon discouraging of non-agricultural use of arable lands and the trend of keeping land fallow and rampant fragmentation. Policy 6 emphasized the need of hygienic, beautiful, well-facilitated and safe human settlement, as well as a planned and sustainable urbanization of the country shall be ensured. Policy-10 highlights to keep balance between development and environment for the mitigation of natural and human created-hazards, vulnerable zones shall be identified and the provision thereof shall be made to zones ensure of operating of certain activities only in those areas. Policy 13 highlights the need of developing information system on Land Use Plans (LUPs).

9.2.2.8 National Forest Policy 2075BS (2019 AD)

On the auspicious occasion of International Day of Forests, Honorable Minister Mr. Shakti Bahadur Basnet, Minister of Forests and Environment formally released the National Forest Policy



2075. The objectives of the policy is to increase the productivity, production of forest resources and area and enhancement of environmental services. The policy emphasized the need for the development of unified watershed management, water and land conservation. Schedule 8.1 of the policy stated that land ownership of the national forest and conservation area forest lies with the central government of Nepal. The policy also mentioned that Central Government of Nepal can provide permission for the use of forest land for the national priority projects if other alternatives are not available following the provision of procedural guideline following the land for land compensation for the reduced area and compensatory plantation. The policy also stated that developer shall provide equal forest land to concerned forest office in coordination with province and local government.

9.2.2.9 National Environment Policy 2076BS (2019 AD)

Government has endorsed the 'National Environment Policy-2019' to control pollution, manage wastes and promote greenery so as to ensure citizens' right to live in a fair and healthy environment. The policy aims to lessen and prevent all types of environment pollutions, manage wastes emanated from all sectors including home, industry and service, expand parks and greenery in urban area and ensure environment justice to the pollution affected population. The policy has specified special measures, including setup of effective systems for checking and reducing pollution of all types, encouragement for the use of environment-friendly technology in industry, hospital and vehicles, regulation of harmful pesticides in production and protection of human health from unauthorized food intake.

The policy include promotion of solar stove, electric stove, bio-gas, improved stove, e-vehicles, hybrid vehicles and vehicles consuming clean energy, enforce pollution control certificates in industrial yields and replace plastic use through environment means.

9.2.2.10 National Land Policy 2075BS (2019 AD)

Government of Nepal has adopted the National Land Policy 2019. It is a milestone in addressing long-standing problems such as recognition of informal tenure and equitable access to land for landless, small holders and informal settlers in the Nepalese society. It addresses land administration and land management reforms under six key pillars - security of tenure; access to land; land use; land valuation; taxation and land market; land acquisition; and modernization of land administration services. The National Land Policy is underpinned by an inclusive agenda that covers the land rights of women and vulnerable groups, including rehabilitation of the landless, squatters and informal tenure-holders for improved housing; access to land and security of tenure; tenure security for landless peasants for farming; women's access to land ownership; and the optimum use of land for sustainable housing. It is forward looking and considers key environmental challenges related to food security, infrastructure development and the application of fit-for-purpose techniques in land administration.

9.2.3 Strategies

9.2.3.1 Water Resources Strategy, 2058 BS (2002AD)

The GoN, through the Water and Energy Commission Secretariat (WECS), formulated its first comprehensive Water Resources Strategy (WRS) in 2002. To contribute to the national goal of improving the living conditions of the Nepali people in a sustainable manner, the WRS has



formulated short-term (five year), medium-term (15 year) and long-term (25 year) strategies for the water resources sector.

9.2.3.2 National Biodiversity Strategy and Action Plan, 2071-2077 BS (2014-2020 AD)

The NBSAP contains seven chapters, including: (i) introduction, (ii) the national context, (iii) threats to biodiversity in Nepal, (iv) efforts, outcomes and gaps in the management of biodiversity (v) strategy for management of biodiversity, (vi) arrangements for implementation of the strategy, and (vii) framework for Local landscapes extending from east to west. The National Biodiversity Strategy and Action Plan has been prepared with a 35-year vision of “conservation of biodiversity for sound and resilient ecosystems and national prosperity”.

9.2.4 Acts

9.2.4.1 Environment Protection Act, 2053 BS (1997 AD)

Nepal has enacted a comprehensive and umbrella-type environmental act, the Environment Protection Act (EPA), 1997 which is enforced through appropriate regulatory measures. The EPA provides a legal basis for the concerned authorities for regulating an Initial Environmental Examination (IEE) or/and Environmental Impact Assessment (EIA). Section 3, 4, 5 and 6 of the Act are relevant to studies and implementation since these articles deal with the preparation of IEE/EIA of the prescribed proposal, not to implement the proposal without approving EIA/IEE reports for the prescribed project, submission of EIA report to Ministry of Forests and Environment through concerned agency and approval of the EIA report. The EIA of this project is conducted following the procedures of EPA

9.2.4.2 Environment Protection Act, 2076 BS (2019 AD)

Article 2 section 3 of the act mention that proponent shall prepare environmental study report in prescribed format. Section 3 (vi) of the same article emphasize the need of public hearing during the preparation of environmental study report. Section 4 of the act describes the details of the alternative analysis to be conducted as a part of environmental study. Section 5 of the act deals with preparation of Scoping and ToR for EIA and ToR for IEE and brief environmental study. Section 8 of the act mention about the approval of environmental study report. Section 10 of the act define about the environmental management plan. According to cluse 4 of this section the proponent shall develop clear environment management plan, implement the plan and progress report regarding the implementation shall be submitted to concerned authority in each six month. Section 11 of the act mentioned about the provision of supplementary EIA whereas section 12 describes about the provision of environmental audit within 6 months after 2 years operation of the project. Section 13 of the act authorized concerned authority to stop the work if the project is implemented without prior approval of the environmental report or against the approved report. Schedule 6 section 35(1) clearly mention the provision of NRs 5 lakh to 50 lakh penalty for different kind of projects not following the provision mentioned in section 13.

Schedule 3(15) elaborates about the pollution control whereas schedule 4 (28) describes about the provision of carbon trading. Schedule 5 of the act make provision of the environment conservation fund for the environmental conservation, pollution control and regulation, climate change management and conservation of national heritage site. The EIA of this project is conducted following the procedures of EPA.



9.2.4.3 Electricity Act, 2049 BS (1992 AD)

The electricity act 1992 has been enacted to manage the survey, generation, transmission and distribution of electricity and to standardize and safeguard electricity services.

Article 3- No license is required to survey, generate, transmit or distribute electricity from the projects of capacity ranging from 100 kW to 1,000 kW. However, information should be provided to the designated authority about such a project.

According to Section 4 subsection-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. Section 24 of this act states that "While carrying out electricity generation, transmission or distribution, it shall be carried out in such a manner that no substantial adverse effect be made on environment by the way of soil erosion, flood, landslide air pollution etc". Section 4 of the Act is relevant for both study and implementation whereas section 24 is related to environment management during project implementation.

9.2.4.4 Water Resources Act, 2049 BS (1992 AD)

The Water Resources Act, 1992 has been enacted to make arrangement for the rational utilization, conservation, management and development of water resources in Nepal.

According to section 8, subsection 1 of the act, a person or corporate body who desires to conduct survey or to utilize water resources shall be required to submit an application to the prescribed officer or authority along with the economic, technical and environmental study report and with other prescribed particulars. This act is relevant to project that to get construction license above mentioned document must be submitted to DoED. Section 16 of the act mentioned that GoN will facilitate for land and house acquisition for development projects under prevailing rules.

9.2.4.5 Aquatic Animal Protection Act, 2017 BS (1961 AD)

This act is amended in 2055/10/07 BS (20 February 1997) covering wide area including water resources projects. Article -5 Kha emphasizes that fish ladder must be constructed while constructing Dam for Hydropower generation, irrigation or other purposes. The act also mentions that other alternative provision such as Fish Hatchery etc. should be explored as mitigation measures for the loss of fish density and diversity. Section 4 empowers the government to prohibit catching, killing and harming of aquatic animals through notification in the Nepal Gazette.

9.2.4.6 Land Acquisition Act, 2034 BS (1977 AD)

It is the main legislation to guide the land acquisition process in the country. Government can acquire land at any place in any quantity by giving the compensation pursuant to the act for the land required for any public purpose or for the operation of any development project initiated by government institution.

Section 3: GoN must be notified and requested about lands that need to be acquired.

Section 4: The project may acquire lands for the implementation of project works but the developer must bear all expenses incurred in acquiring land.

Section 7: The Developer must pay fair compensation to the landowners.



The compensation paid under this act will be given in cash. To decide about the amount of compensation the act has made provision for the constitution of Compensation Fixation Committee (CFC). This act is silent about the payment of compensation at market rate, which pose difficulty for the payment of compensation at present value. This act is useful for the acquisition of land and house for the project.

9.2.4.7 Forest Act, 2076 BS (2019 AD)

Article 2, section 3 (ii) of the act describe that changes of landuse in forest area, transfer of the ownership of the forest land, exchange or other uses are not allowed without prior approval of the cabinet of the Government of Nepal. Section 9 of the act authorize Division Forest Officer to prohibit entry in certain section or the entire national forest area by publishing public notice for certain period showing the need of importance of forest conservation. Section 12 of the act clearly mention that forest land with trees will not be allowed for resettlement or residence whereas transfer of community forest is described in section 18. Section 37 of the act authorized local government for the use of public land for the development forest, conservation, management, use/sell of the forest product. The development and management of city forest is described in section 38.

Section 42 (1) of the Act empowers the government to permit the use of any part of the forest land if there is no alternative except to use the forest area for the implementation of national priority projects, project having funding approved from lagani board, national Gaurav projects, if project will not cause significant adverse impact on environment based on the environmental examination of the project conducted as per the prevailing law. This act is relevant for project implementation since project requires forest area for the placement of project structures and facilities. The delays in the approval of the forest clearance hinder the project development and affect the construction schedule. Article (2) of the section 42 deals with land for land compensation whereas cash compensation is given in article 5. Section 42 (6) describe about the cost of plantation and 5 yeras management of the plantation site shall be paid by the developer of the project. Section 44 of the act deals with environmental secrvies and its management whereas provision of forest development fund is given in section 45.

9.2.4.8 Soil and Water Conservation Act, 2039 BS (1982 AD)

The article 2 (B) of the act defines the soil and water conservation. According to article -3 GoN can acquire area/land by giving written notice for the purpose of water conservation. But for such acquisition, compensation shall be paid, in case of private land, in consultation with local authorities (Rural Municipality/Municipality). Article 10 of the act elaborates the activities that are considered illegal in the area which are suspected for natural disaster. Under Section 10 of SWCA, 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. This act is relevant to project development since the project is located in a water conservation area.

9.2.4.9 Nepal Labor Act, 2074 BS (2017AD)

The Labor Act, 2074 has received the assent of president and become effective from the date Bhadra 19, 2074. The New Labor Act has been passed for provisions for the rights, interest,



facilities and safety of workers and employees working in enterprises of various sectors. The Labor Act has shortened the period of probation to 6 months only. The act made provision of maternity leave of 98 days consisting fully paid up to 60 days. Likewise provision of paid paternity Leave for 15 days has been made. The act made provision of compensation against injury and disability shall be paid from the insurance amount. Regarding death compensation the nearest successor is entitled to the amount of accident insurance as per the new act. Similarly, medical insurance coverage at least 1 Lakh per year for every worker has been made and premium to be paid equally by the employer and worker. Regarding accident Insurance coverage at least 7 Lakh for every worker has been made and premium of such insurance to be paid fully by the employer. Schedule 2 (5) of the act prohibit about the use of child labor against law whereas section 6 of the act make provision of no discrimination among workers based on the caste, gender, language, origin and ideology. The developer is committed to develop project following the provisions of labor acts.

9.2.4.10 Explosive Act, 2018 BS (1962 AD)

It is expected that use of explosives will be made during the construction of the Project. Other major points to be noted under this Act are:

Section 3 of the Act states that GoN, by a notification in the Nepal Gazette, may declare any substance as explosives.

Section 4 forbids producing, storing, using, carrying and importing explosives without license. The Section also provides the person to apply for a license to the Chief District Officer with necessary descriptions as prescribed.

Section 8 of the Act states that GoN must be informed of all explosive substance related accidents.

This act is relevant for project implementation since use of explosive, transportation and management required for the project construction will be guided by this act.

9.2.4.11 Land Reform Act, 2021 BS (1964 AD)

Article 9 'KA' of the act deals with land use and land fragmentation for maximum use of land. According to this act Government of Nepal can implement land use program in any part of the country. Similarly, government can do fragmentation and plotting of land to increase the productivity. This act is relevant for project implementation to acquire land for the placement of a structure.

9.2.4.12 Child Labor Act, 2056 BS (2000AD)

The Child Labor (Prohibition and Regulation) Act, 2056 is enacted and enforced adopting ILO Convention concerning Elimination of Worst Forms of Child Labor and Minimum Age Convention. This Act has defined the 'Child' as a person who has not achieved the age of 16 year. Article 3 bans the employing a child below the age of 14 to work as a labor and engaging a child in the hazardous and risky works listed in the Schedule of the Act. The proponent is mandatory to follow the Child Labor (Prohibition and Regulation) Act, 2056 (2000) during the project implementation phase. The contractor may use child labor during construction period. Hence, the contractor will be instructed to follow the Child Labor (Prohibition and Regulation) Act, 2056 (2000).



9.2.4.13 Plant Protection Act, 2029 BS (1972AD)

The Act imposes a ban on the collection, use, sale and distribution of certain plants. This act is helpful for the control of illegal harvest of the listed plant.

9.2.4.14 Solid Waste Management Act 2068 BS (2011AD)

This Act has been promulgated by the Constituent Assembly in the capacity of Parliament under Article 83 of the Interim Constitution of Nepal, 2063/10/013 BS (January 15, 2007). The local body shall be responsible for the management of solid waste by construction and operation of infrastructure like transfer station, landfill site, processing plant, compost plant, biogas-plant and collection of waste, final disposal and processing.

Sub-section (1) the responsibility for the processing and management within the set standard of harmful waste, health institution related waste, chemical waste or industrial waste shall be of the individual or body producing such solid waste. Article 5 (2) of the act clearly mentioned that it shall be the duty of every individual, organization or body to reduce the amount of remaining solid waste by making arrangement for disposal or reuse of solid waste which might have been otherwise disposed off on such individual, organization or body's own area. Article 6 deals with segregation of solid waste. The local body shall prescribe to separate the solid waste into at least organic and inorganic including different kinds at its source.

9.2.4.15 Local Government Operation Act 2074 BS (2017AD)

Schedule-3 of the act defined the role and responsibility of municipality and rural municipality. Schedule 3 1.1 A describe the mandate about the formation of city police, their operation and management. Section B highlights about the formulation of rules and regulation related to cooperatives. The municipality and rural municipality are authorized to provide approval for the operation of FM Radio up to 100 watt including its renewal, monitoring and suspension. Section D of the act authorizes municipal offices for different type of taxes including land tax, house tax, vehicle tax, tourism, business etc. Section J describes about the management of market, preparation of rules and regulation regarding environment and biodiversity conservation. Section h of the act mention about the management of schools whereas section deals about the health and sanitation issues.

9.2.4.16 Contribution Based Social Security Act 2074 BS (2017 AD)

The act was enforced from 2074/4/29. According to this act people not contributing in social security plan are unable to get social security. The employer must deduct the amount as per article 7 and deposit equal amount to the social security fund. Article 2 (8) of the act make provision that if any workers not get salary up to 3 months the employer shall deposit the required contribution in social security fund.

9.2.4.17 Landuse Act 2076 BS (2019 AD)

The act has been introduced based on the condition of land, population growth, requirements of land for various purposes like food and habitation and the need for economic development and infrastructure building, among others. The main aim of the act is to ensure that land is properly used and managed and that land set aside for one purpose is not used for other.



As per the act, land has been classified into 10 categories: agricultural; residential; commercial; industrial; mining and mineral; forest; river, stream, pond and wetland; public use; cultural and archaeological; and others. The act has provided for a land bank, which is itself a new concept in the country. Under the concept, land belonging to various people will be pooled together and leased out to those who are willing to invest in agriculture. The act has also provided for fines for failing to use land for the purposes it is meant for.

9.2.4.18 Consumer Protection Act 2075BS (2018 AD)

Article 3 of the act describe every consumer shall have the right to obtain quality goods and services which consist right of easy access to goods or services, right to choose quality goods or services at the fair competitive price, right to be informed of the price, quantity, purity, quality etc. of the goods or services etc. Article 4 of the act mentioned that Government of Nepal shall regulate the supplies, price, quality, measurement, label, advertisement of the goods and services regularly in order to protect the rights of the consumers. Article 5(1) mentioned that producer shall have to affix label on the goods produced by him or her. Article 7(1) of the act describe the liability of producer including provision of return of goods within 7 days. The provision of formation of Consumers Protection Council is described in Article 22 including Constitution of Consumer Court and Compensation claim.

9.2.4.19 International Trade Monitoring and Control Act for CITES Animal and Plant Species 2074 BS (2017 AD)

This act was enforced from 2074/1/10. This act was formulated for the conservation, monitoring and control of International trade of CITES species based on the CITES Convention 1973. According to Schedule -2 of the act people are prohibited for the trade and use of rare and endangered species without approval of the concerned authority of Government of Nepal. Schedule (vi) describe the provision and process of permission for such trade.

9.2.5 Rules/Regulation

9.2.5.1 Environment Protection Rules, 2054 BS (1997 AD)

The EPR provides a legal basis for the concerned authorities in regulating the Initial Environmental Examination (IEE) or/and Environmental Impact Assessment (EIA). It is apparent from this provision that any private or government agency who wishes to implement any of the proposals defined in the regulations must prepare either an IEE or EIA.

Rules 3 to 14 of the EPR are directly related to the study and they have been duly considered during the preparation of the report. The EPR elaborate provisions to prepare and submit the Scoping Report, Terms of Reference (ToR), and IEE/EIA Report for approval, and includes the public consultation process. Article 10 makes provision of the collection of recommendation letter of affected Municipality/Rural Municipality (VDCs) prior to submission of report to ministry for approval. Rule 4 of EPR obliges the proponent to publish a 15 days public notice in a National Daily Newspaper to provide the stakeholders to offer their opinions and concerns before preparing the EIA report. It also aims in collecting individual and institutional opinions and suggestions with regard to impacts of the implementation of the proposal in the preparation of Scoping Report.

The time given for the review and approval of EIA report is too short so a reasonable time frame should be given based on the exercise of past 20 years. It will help to developer for the proper



planning of project implementation. The delay in approval of the report increased cost of the project besides increasing power shedding problem.

9.2.5.2 Electricity Regulation, 2050 BS (1992 AD)

Section (Chha) of Article 12 and section (Chha) of Article 13 of Electricity Regulation 1992 are important from environmental viewpoint. The Rules 12 and 13 state that the proponent willing to produce and transmit electricity should analyse environmental impacts of the proposed projects and include impact mitigation measures and environmental measures including arrangements for the settlement of the displaced people. Rule 88 state that 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. This rule is applicable for the EIA study as well as project construction.

9.2.5.3 Water Resources Regulation, 2050 BS (1993 AD)

It is mandatory under Rule 17 (e) of the regulation that any person or corporate body, who desires to obtain a license for utilization of water resources must state in his application that appropriate measures will be taken to lessen the adverse effects due to the project on the overall environment. The report should be a part of the application for the water resources utilization permits. Rule 28 states that in a process of resolving any conflict, the Water Resources Utilization Investigation Committee should consider environmental impacts likely to occur from the proposal. It should also collect site-specific information on likely environmental impacts of the concerned project. This rule is relevant for project investigation including EIA.

9.2.5.4 Forestry Regulation, 2051 BS (1995 AD)

Forest regulation 1995 stated about the compensation to be paid for the loss of forest including cost required for cutting and transporting forest products from a forested area. The following clause of this regulation is relevant for project implementation.

Rule 3 of Forest Rules calls for the preparation and implementation of government managed forests, including programs related to soil conservation and protection of the environment.

Rule 9 (Clause 65) stipulates that the proponent of a project with national priority, occurring in any forested area, shall bear the amount of compensation to be paid for any loss or harm to any local individuals or communities. Similarly, the entire expenses required for the cutting and transporting of forest products in a forested area to be used by the project should be borne by the proponent.

9.2.5.5 Labor Rules 2075 BS (2018 AD)

On May 27, 2018, the Government of Nepal enacted the new Labor Rules 2075 (2018). The Labor Rules prescribe procedures to obtain Labor Permit and Work Permit from the Department of Labor to hire foreign national and to be engaged in work by foreign national. Depending on the foreign national's skills, the Labor Permit or Work Permit may be valid for a maximum period of 3 to 5 years. An employer must prepare and implement a Health and Safety Policy addressing,



among other issues, precautionary measures that must be taken when operating machinery, equipment and chemical substances.

An enterprise with 20 or more employees must also establish a Health and Safety Committee, which includes employees' representatives, to provide advice on workplace safety issues: An employee who is disabled due to a workplace accident is entitled to compensation based on his/her percentage of disability. Employers with 50 or more employees must arrange for break room and canteen for employees.

9.2.5.6 Solid Waste Management Rules 2070 BS (2014 AD)

The Rules have been issued by the Government of Nepal by exercising the power conferred by section 50 of the Solid Waste Management Act, 2068. Section 3(1) of the rules describes the segregation at least of organic and non-organic solid waste at its source. Section 3 (2) mentioned the responsibility of managing the chemical or harmful solid waste under Sub-Rule (1) shall be of concerned generator.

The section 5(1) describe No one shall discharge solid waste by mixing harmful, chemical organic or inorganic waste with other waste. Section 5(2) make arrangement for final discharge should only be made after processing of harmful, chemical, organic or inorganic waste into a general waste.

9.2.5.7 Contribution Based Social Security Regulation 2075 BS (2018 AD)

The government has approved the Contribution-based Social Security Regulations, 2075 on November 11, 2018. The Regulations provides for enlisting in the Social Security Fund the individuals drawing salary from government fund, the labourers in the informal sector and the self-employed individuals. It also has provision according to which an individual who has been de-listed from the Employers' List under certain stipulated condition cannot run away from the responsibility of paying to the contributor.

9.2.5.8 Explosive Rules - 2020 BS

As per the Explosive Act 2018 clause 14 the government has formulated this rule and gazette B.S. 2020/09/29. As per clause 3 (Ka) only licensed person can store, purchase and sale explosive materials. Similarly, as per clause 3 (Kha) only a licensed person can purchase, store and use the explosive materials. Similarly, as per clause 3 (2) any licensed person by himself or in his office as required, employ persons for the use, store and transport the explosive materials. As per the clause 13 (1), the explosive materials are classified as high explosive, low explosive and common explosive materials. Further as per clause 13 (5), at the place where high explosive materials are stored a signboard should be fixed explaining "Dangerous Explosive Materials".

9.2.6 Guidelines Manuals and Working Procedures

9.2.6.1 National Environmental Impact Assessment Guidelines, 2050 BS (1993 AD)



According to the guidelines, IEE is mandatory for hydroelectric projects with generating capacities up to 5 MW. This guideline is frequently used and quite helpful right from making terms of reference to preparing impact assessment matrix and assigning values on impacts ranking. The other important feature of the guideline is description on community participation. Clause 49 deals with the methods to involve the public.

9.2.6.2 Manuals published by the DoED/ USAID/ IRG, 2002 AD

Department of Electricity Development of Government of Nepal in collaboration with United State Agency for International Development and International Resource Group has prepared 8 manuals for different types of studies. These manuals are helpful for the preparation of EIA scoping document, Terms of Reference, Environment Management and Monitoring Plan. The manual for public involvement provide guideline for the involvement of local people in the EIA process. Likewise, a scoping manual is important for the identification of issues and notification process.

9.2.6.3 Community Forest Inventory Guidelines, 2062 BS (2005 AD)

The guidelines for inventory of community forests advise to classify the forests into timber trees; pole sizes trees and regeneration of based on diameter. It has recommended using 20 m × 25 m size of quadrant for timber trees, 10 m × 10 m for shrubs and 5 m × 5 m for regeneration plots in the community forests. Plants having dbh (diameter at breast height, i.e. 1.3 m above ground) greater than 30 cm is considered as trees. Trees having dbh between 10 and 30 cm are categorized as poles.

9.2.6.4 Environmental Management Guideline (Road), 2054 BS (1997 AD)

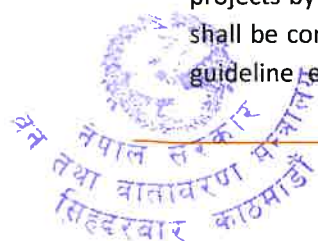
The environment management guideline (road) has been prepared to ensure that environmental considerations are integrated into the project survey and design, tender documents, contract documents and project supervision and monitoring. The guideline identifies the potential users of the guideline including different road sector offices, other government organization involved in road construction, consultant and contractor. It consists section like environmental mitigation measures to be incorporated in road projects, procedures for public participation and socio-economic consideration.

9.2.6.5 Forest Produce Collection, Sales and Distribution Guidelines, 2056 BS (2000 AD)

Clauses 3 to 10 of the guidelines specifies various procedure and formats for getting approvals for vegetation clearance, delineation of lands for vegetation clearance, evaluation of the wood volume etc., and government offices and officials responsible for the approval. These provisions have a direct relevance to the development of the projects and need compliance to these provisions.

9.2.6.6 Procedural Guideline for the Use of Forest Land for National Priority Project with Standard 2076 (2019AD)

Article (3) of the guideline clearly mentioned that while doing the feasibility study of development projects by the concerned ministry the no national forest option or minimum forest loss option shall be considered. The guideline describes the need of IEE/EIA as per EPR and EPA 1997. The guideline emphasizes the need for preparation of the EIA report along with Environment



Management Plan for the project not covered by EPR if there is forest loss. The guideline clearly mention the compensatory plantation 1:10 and management of planted sites for 5 years if trees are felled down from national forest. The guideline also mentions land for land compensation for the permanently acquired national forest.

9.2.6.7 Manuals and Guidelines Published by the MoEn/RNG/NDNM, 2006 AD

The then Ministry of Environment, Science and Technology (MoEST) with the assistance of Royal Norwegian Government and Norwegian (RNG) Directorate for Nature Management has prepared a different manual related to licensing and EIA process, monitoring and environmental management. The licensing manual describes the provision for license and its type, environmental scoping, terms of reference preparation including format for public notice for Scoping. This manual is also useful for review of different acts and conventions applicable for EIA studies. The environmental monitoring manual is applicable for the preparation of monitoring plan including baseline, compliance and impact monitoring its legal provision and parameters. The Environmental Management Plan defines the role of different stakeholder regarding the environmental management of the project during pre -construction, construction and operation phases of the project development.

9.2.6.8 National Energy Crisis Mitigation and Electricity Development Decade Concept Paper and Action Plan, 2072 BS

The government has on declared a National Energy Crisis Reduction and Electricity Development Decade (2016-2026) with the aim to end the existing energy crisis of the country and to develop hydropower projects. During the period, the government has planned not only end the current power crisis but also develop the hydropower project. The plan aims to reduce load shedding hours within a year and importing electricity from India to completely end the load shedding within three years. According to the plan the remaining seven-year period will concentrate on developing the hydropower sector.

9.2.6.9 Guidelines for License of Electricity Projects 2075 BS (2018 AD)

Schedule-2 of the guideline deals the procedure for the determination of capacity of the projects. Schedule 3 deals the provision of the survey license. According to this the developer must submit application as per schedule-2 for investigation license with required documents and Bank voucher deposited in the account of DoED. Article-3 (12) mentioned that investigation license will be generally issued for 2 year period. Article -3 (13) mention the requirement of generation license for which IEE/EIA report is required along with others.

9.2.6.10 Hydropower Environment Impact Assessment Manual 2075 BS (2018 AD)

This Environmental Impact Assessment (EIA) Manual has been developed by the Ministry of Forests and Environment to facilitate the sustainability of the hydropower sector development process in Nepal and provide guidance on "good practices". This Manual enforces a comprehensive EIA adhering to the spirit of Environment Protection Act, Environment Protection Rules, National EIA Guideline and international good practices for sustainable hydropower development.

The Manual is useful for all types of hydropower projects that require an EIA.

Chapter 4 of the manual highlighted about the stakeholder identification and analysis, stakeholder engagement plan grievances management mechanism. Chapter 5 deals the analysis of the alternatives and screening of the proposals. Chapter 6 deals with scoping, identification of issues, defining the area of influence and developing terms of reference. Chapter 7 deals about the identification of existing condition with elaboration of different environmental domain. Chapter-8 described the procedures of impact assessment which is helpful for the determination of impacts.

9.2.6.11 Social Security Scheme Operation Guideline 2075 BS (2018 AD)

The contribution-based social security scheme, which was launched by the government will prove to be a milestone in enhancing cordial relationship between workers and employers, as per stakeholders. As per scheme, of the total fund collected SSF will allocate 3.22 per cent for medical treatment, health and maternity security and 4.52 per cent for accident and disability security. It will allot 0.87 per cent for dependent family security and 91.39 per cent for old age security in the name of pension.

As per the scheme, from May 22, private sector employees will have to mandatorily contribute 11 per cent of their basic salary to the fund, while employers will have to contribute another 20 per cent of the employees' basic salary. Once these contributions are made, employees will be entitled to compensation if they lose a job or cannot attend the workplace because of pregnancy, illness or accident.

9.2.6.12 Decision Regarding Land Ceiling for Development Project

Nepal Government, Ministry of Land Reform and Management published a notice in section 67 number 29 Nepal Gazette part 5 by using the authority given in article 12 of Land Reform Act 2021, containing the provision of purchase more than dissociated land by the education or health institution, hydropower, cultural, industrial work, work for agriculture industry and cooperatives farming organization, if such industry or institutions need.

9.2.7 International Conventions

9.2.7.1 Convention on Biodiversity, 2049 BS (1992 AD)

GoN is committed to the protection and management of biological resources and their diversity on sustainable basis for the benefit of Nepal's present and future generations and for the global community as a whole in accordance with the principles of the Convention on Biological Diversity. The Nepalese parliament ratified the convention in 1993 and has taken policy and legal measures for the conservation of biodiversity in compliance with the convention. This convention provides the broader framework on the need for carrying out EIA to minimize adverse impacts of the projects and programs on biodiversity. The convention has 27 Articles. Article 2 provides the provision of the impact assessment and minimizing adverse impact. Article 14 of the Convention provides provision on impact assessment and minimizing adverse impacts. In broader sense, it calls upon the Parties to introduce appropriate procedures for EIA and ensure public participation; exchange information and consult on adverse effects on biodiversity of other States; notify immediately to other States in case of danger or damage to biodiversity and initiate action to prevent or minimize such damages; and promote national arrangements for emergency responses and establish joint contingency plans.



9.2.7.2 Convention on International Trade in Endangered Species (CITES) for Wild Flora and Fauna, 2029 BS (1973 AD)

Nepal is a party to the CITES that aims to control the trade of certain wildlife species to prevent further endangering of their survival. CITES classifies species according to the following criteria: I – species threatened with extinction, II – species which could become endangered, III – species that are protected (CITES 1983). As Nepal is party to the Conventions related to species conservation attention should be given to evaluate the impacts of the project activities on meeting their obligations. This convention is relevant for study as well as project implementation since several species listed under CITES category are found in project area.

9.2.7.3 ILO Convention on Indigenous and Tribal Peoples No.169, 2046 BS (1989AD)

Convention No. 169 was adopted in 1989 by the General Conference of the International Labor Organization at its seventy-sixth session. Nepal ratified ILO Convention No. 169 on September 14, 2007. In 2007 the UN Declaration on the Rights of Indigenous Peoples was adopted by the General Assembly. The declaration reaffirms the importance of the principles and approaches provided for under Convention No. 169 and its adoption therefore provide a fresh impetus for promoting the ratification and implementation of Convention No. 169. ILO Convention No.169 highlights the need to recognize indigenous and tribal people's specific knowledge, skills and technologies as the basis for their traditional economies and self-determined development process. Article-1 of the convention provide definition of the tribal and indigenous people. Article -6 deals the consultation of the peoples concerned through appropriate procedure and in particular through their representative institutions, whenever consideration is being given to legislative or administrative measures which may affect them directly.

In Article 15, the rights of the peoples concerned to the natural resources pertaining to their lands shall be specifically safeguarded. These rights include the right of these people to participate in the use, management and conservation of these resources. The use of the term lands includes the concept of territories, which covers the total environment of the areas that the peoples concerned occupy or otherwise use. The peoples concerned wherever possible shall participate in the benefits of such activities and shall receive fair compensation for any damages that they may sustain because of such activities. Article 16 (2) clearly mention that where the relocation of these peoples is considered necessary, exceptional measures such as relocation shall take place only with their free and informed consent. Where their consent cannot be obtained, such relocation shall take place only following appropriate procedures established by national laws and regulations, including public inquiries where appropriate, which provide the opportunity for effective representation of the peoples concerned. Article 16 (3) mention that whenever possible these peoples shall have the right to return their traditional land as soon as the grounds for relocation cease to exist. Article 16(5) elaborated the persons thus relocated shall be fully compensated for any resulting loss or injury.

9.2.7.4 United Nations Framework Convention on Climate Change, 2049 BS (1992AD)

The UN Framework Convention on Climate Change, 1994 was signed to stabilize the Greenhouse Gas (GHG) in the atmosphere. The Convention was enacted in Nepal on July 31, 1994. Hence, Nepal has responsibility to abide by the rules and regulations of the Convention. Hydroelectric



power project development generates GHG emissions during construction and inundation of vegetation in the reservoir and project implementation requires clearance of forest area that reduces the carbon sequestration capacity of the forest. This convention is relevant for project construction and implementation.

9.2.7.5 International Plant Protection Convention, 2008 BS (1951AD)

The convention aims for securing common and effective action to prevent the introduction and spread of pests and diseases of plants and plant products and to promote measures for their control, the contracting Governments undertake to adopt the legislative, administrative measures specified in this Convention. The convention defines plant" shall comprise living plants and parts thereof, including seeds in so far as the supervision of their importation under Article VI.

Article IV of the convention mentions that each contracting Government shall make provision, as soon as possible and to the best of its ability, for an official plant protection organization inspection of growing plants, of areas under cultivation plants and plant products in storage and in transportation particularly with the object of reporting the existence, outbreak and spread of plant diseases and pests.

9.2.7.6 Kyoto Protocol to the United Nations Framework Convention on Climate Change, 2054 BS (1997 AD)

The Parties included in Annex I shall, individually or jointly, ensure that their aggregate anthropogenic carbon dioxide equivalent emissions of the greenhouse gases listed in Annex A do not exceed their assigned amounts, calculated pursuant to their quantified emission limitation and reduction commitments inscribed in Annex B. Article 3 states that in order to promote sustainable development, enhancement of energy efficiency in relevant sectors of the national economy protection and enhancement of sinks and reservoirs of greenhouse gases not controlled by the Montreal Protocol taking into account its commitments under relevant international environmental agreements; promotion of sustainable forest management practices, afforestation and reforestation and promotion of sustainable forms of agriculture in light of climate change considerations shall be carried out.

9.3 International Safeguard Policies and Guidelines

9.3.1 World Bank

The World Banks' Environmental and Social Framework (ESF) was launched on October 1, 2018, enables the World Bank and Borrowers to better manage environmental and social risks of projects and to improve development outcomes. The framework includes the following major aspects:

- the World Bank's Vision for Sustainable Development
 - the World Bank's Environmental and Social Policy for Investment Project Financing (IPF), which sets out the requirements that apply to the Bank
 - the 10 Environmental and Social Standards (ESS), which set out the requirements that apply to Borrowers



- Bank Directive on Addressing Risks and Impacts on Disadvantaged or Vulnerable Individuals or Groups

ESS1 Assessment and Management of Environmental and Social Risks and Impacts sets out the Borrower's responsibilities for assessing, managing and monitoring environmental and social risks and impacts associated with each stage of a project in order to achieve environmental and social outcomes consistent with the Environmental and Social Standards (ESSs).

ESS2 Labor and Working Conditions recognizes the importance of employment creation and income generation in the pursuit of poverty reduction and inclusive economic growth.

ESS3 Resource Efficiency and Pollution Prevention and Management recognizes that economic activity and urbanization often generate pollution to air, water, and land, and consume finite resources that may threaten people, ecosystem services and the environment at the local, regional, and global levels. This ESS sets out the requirements to address resource efficiency and pollution prevention and management throughout the project life-cycle.

ESS4: Community Health and Safety addresses the health, safety, and security risks and impacts on project-affected communities and the corresponding responsibility of Borrowers to avoid or minimize such risks and impacts, with attention to people who, because of their circumstances, may be vulnerable.

ESS5: Land Acquisition, Restrictions on Land Use and Involuntary Resettlement should be avoided. Where involuntary resettlement is unavoidable, it will be minimized and appropriate measures to mitigate adverse impacts on displaced persons (and on host communities receiving displaced persons) will be carefully planned and implemented.

ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources recognizes that protecting and conserving biodiversity and sustainably managing living natural resources are fundamental to sustainable development and it recognizes the importance of maintaining core ecological functions of habitats, including forests, and the biodiversity they support.

ESS7: Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities ensures that the development process fosters full respect for the human rights, dignity, aspirations, identity, culture, and natural resource-based livelihoods of Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities. ESS7 is also meant to avoid adverse impacts of projects on Indigenous Peoples/Sub-Saharan African Historically Underserved Traditional Local Communities, or when avoidance is not possible, to minimize, mitigate and/or compensate for such impacts.

ESS8: Cultural Heritage recognizes that cultural heritage provides continuity in tangible and intangible forms between the past, present and future. ESS8 sets out measures designed to protect cultural heritage throughout the project life-cycle.

ESS9: Financial Intermediaries (FIs) recognizes that strong domestic capital and financial markets and access to finance are important for economic development, growth and poverty reduction.

ESS10: Stakeholder Engagement and Information Disclosure recognizes the importance of open and transparent engagement between the Borrower and project stakeholders as an essential element of good international practice. Effective stakeholder engagement can improve the



environmental and social sustainability of projects, enhance project acceptance, and make a significant contribution to successful project design and implementation.

9.3.2 Asian Development Bank

Environmental Safeguards

ADB's environmental safeguards aim to ensure the environmental soundness and sustainability of projects, and to support the integration of environmental considerations into the project decision-making process. The Safeguard Policy Statement (SPS) requires borrowers to identify project impacts and assess their significance; examine alternatives; and prepare, implement, and monitor environmental management plans. The SPS requires borrowers to consult people likely to be affected by the project and disclose relevant information in a timely manner and in a form and in languages understandable to those being consulted.

Involuntary Resettlement

ADB's involuntary resettlement safeguards aim to avoid involuntary resettlement wherever possible; to minimize involuntary resettlement by exploring project and design alternatives; to enhance, or at least restore, the livelihoods of all displaced persons in real terms relative to pre-project levels; and to improve the standards of living of the displaced poor and other vulnerable groups.

Involuntary resettlement safeguards call for meaningful consultation with affected people; compensation of losses and provision of assistance to and benefit sharing with displaced persons, and special measures for the poor and vulnerable. Involuntary resettlement safeguards also require the preparation, implementation, and monitoring of time-bound resettlement plans.

Indigenous People

ADB's indigenous people's safeguards aim to ensure that the design and implementation of projects foster full respect for indigenous peoples' identity, dignity, human rights, livelihood systems, and cultural uniqueness as defined by the indigenous peoples themselves so that they receive culturally appropriate social and economic benefits, are not harmed by the projects, and can participate actively in projects that affect them.

For a project with impacts on indigenous peoples, the Safeguard Policy Statement (SPS) requires borrowers to carry out meaningful consultation and to prepare and implement an indigenous peoples plan. The plan includes measures to ensure that indigenous peoples benefit, and that adverse impacts are prevented, or where this is not possible, mitigated. The SPS requires that broad community support of affected indigenous peoples' communities be ascertained for project activities to which indigenous peoples are deemed particularly the vulnerable.



10. PUBLIC CONSULTATION AND INFORMATION DISCLOSURE

10.1 General

As per the EPR, public consultation and information dissemination is mandatory in the EIA process. Public consultation and information disclosure of any development project from the initial stage of project development is important to reduce misunderstandings and successful implementation of the project.

Public consultation is a process of both providing information and listening to issues and concerns of concerned stakeholders for project planning and successful implementation of a hydropower project with full support of the stakeholders. BHP has given high priority to public consultation and information disclosure throughout the EIA process from the initial stage of scoping.

10.2 Procedure for Consultation and Participation

Public consultation during EIA preparation involved formal and informal discussions with a range of district and local level stakeholders and directly affected people of the project area of the BHP. Public consultation process started from the initial stage of EIA i.e. scoping document preparation.

In accordance with the requirements of the EPR, the former VDCs/municipality, institutions and communities in the project area were notified about the EIA scoping through a public notice published in the Annapurna national daily newspaper on August 14, 2016 (2073/4/30 BS). The notice contained a brief background of the project, name of districts and VDCs and municipality that are likely to be affected by the project, impact of the project on existing physical, biological, and socio-economic and cultural environment and addresses for communication. Through this notice, institutions and individuals were requested to submit written opinions and suggestions on likely environmental impacts of the project within 15 days of the notice publication.

As part of the scoping process, the public notice was fixed in all the project-affected VDCs and municipality, DDC (now municipality and rural municipality) and other institutions (schools, health posts) and public places of Achham and Bajura districts. Deed (Muchulka) of the public notice fixation was collected from concerned institutions and the public. Altogether, 24 public notices were posted in different locations of the project affected districts including 6 in Bajura and 18 in Achham district.

Six group meetings were then conducted in the project area to familiarize the local people with the project and obtain their views and concerns regarding project implementation as well as identify issues for the Project EIA.

A team of environmental experts (physical, biological, socioeconomic and cultural) also visited the area and interacted with local people focusing on issues likely to arise due to implementation of the project, existing environmental conditions of the project area and views/concerns of stakeholders that formed a basis for the environmental scoping document and ToR preparation.

After approval of the Scoping Document and TOR, extensive field study for the EIA was conducted in April 2018. During the EIA study, as part of public consultation and information disclosure 11 ward level PRA with local stakeholders were conducted in the affected municipalities (Sanfegagar and Budhiganga) and rural municipally (Mellekh Rural Municipality). Consultation meetings were



also conducted with local stakeholders including vulnerable people and women in the project area (Vol II Appendix: E). PRA (11) and consultation meeting (5) were used as the main tools for community consultation and information dissemination during the EIA process. Key informant interviews (14), census of directly affected households (socioeconomic survey of 80 HHs), and informal meetings/consultations with key stakeholders of the project area were used as other tools for public consultation and information disclosure (Table 10-1).

Table 10-1: Sample distribution

Municipality /Rural Municipality	Former VDC /Municipality /Ward	Ward No.	Sample Distribution				
			Survey of Project Affected HHs	Ward Level PRA	Consultation Meeting with Stakeholders	KII	Market Survey
Sanfebagar Municipality (Achham)	Sanfebagar Municipality - 6	4	4	1			2
	Ghughurkot VDC	10	16	2	1	3	2
	Babala VDC	13	10	2	1	3	2
Mellekh Rural Municipality (Achham)	Kushkot VDC	4	8	2	1	3	2
	Hatikot VDC	8	37	2	1	3	2
Bhudhiganga Municipality (Bajura)	Barhabis VDC	10	5	2	1	3	2
Total	-	-	80	11	5	14	12

10.3 Key Issues/Concerns Raised in PRA, Consultation Meetings, KIIs and Informal Meetings

All consulted people of the project area have a positive attitude regarding the project. They suggested quick construction of the BHP, realizing the need of hydropower development for regular supply of electricity and local development.

During community consultation several issues and concerns were raised by the people. The major issues/concerns are related to livelihood (employment, support for income generation), infrastructure development, construction, protection of water mills, conservation of community forests, community participation and transparency in project activities.

These concerns/issues have been incorporated in relevant sections of the EIA. The key issues/concern raised by the local people during community consultations is summarized in Table 10-2. It is not possible for the project to incorporate all issues/concerns of the local people. Issues/concerns such as providing share of project to local people, free electricity to directly affected households is beyond the scope of the study hence not considered for implementation. Since fulltime fishers are not found in project area the issue of compensation loss for fishery income is not relevant. The forest loss in community forest will be mitigated as per the provision of Procedural Guideline for the Use of Forest Land for National Priority Project 2074. Other issues/concerns are basically the community support program which will be covered under CSR program based on the priority of the local people and available budget.



Table 10-2: Summary of key issues/concerns of local people

Key Issues/Concerns	Municipality/Rural Municipality/Ward	Details of issues/concerns	Issues Addressed	Issue beyond the scope of the study
Share of BHP	Budhiganga - 10	Provide share of project to local people		It will be done as per the prevailing rule
Livelihood	Budhiganga - 10	Employment to local people as per their skill	Ref.7.2.1.1	
		Support for income generation activities	Ref 7.3.3.4 (ii) , (v) and (vi) and 7.4.2.1	
		Good compensation of land	Ref 7.3.3.1	
	Mellekh - 4	Priority for employment to local people as per their skill	Ref.7.2.1.1	
		IG activities for women	Ref 7.3.3.4 (v) and (vi)	
		Compensation for loss of fishery income	Ref 7.3.2.2 (2)	
	Mellekh - 8	Employment to local people	Ref.7.2.1.1	
	Sanfebagar - 4	Employment to local people as per their skill	Ref.7.2.1.1	
	Sanfebagar - 10	Employment to local people as per their skill	Ref.7.2.1.1	
		Employment to project affected households due to land acquisition	Ref.7.2.1.1 and 7.3.3.4 (vi)	
	Sanfebagar - 13	Provide employment to local people as per their skill	Ref.7.2.1.1	
		Support poor and women for income generating activities	Ref 7.3.3.4 (v)	
		Provide skill development training	Ref 7.3.3.4 (ii) and 7.4.2.1	
Infrastructure development/ community support	Budhiganga - 10	Support to local schools for drinking water, toilet and educational materials	Ref 7.4.2.2, 7.4.2.4	
		Support for Chadapani Ghat Irrigation Project	Ref 7.4.2.2, 7.4.2.4	
		Support for Ikri Gad-Kuskot foot trail	Ref 7.4.2.2, 7.4.2.4	
		Protection of Malika-Kuskot foot trail	Ref 7.4.2.2, 7.4.2.4	

		Support to protect and maintenance of Lingbagar-Kuskot foot trail	Ref 7.4.2.2, 7.4.2.4	
		Support for tourism development of Bhagwati Rock area (Huge rock where > 500 people stay)	Ref 7.4.2.2, 7.4.2.4	
		Support for Mastmandu Temple	Ref 7.4.2.2, 7.4.2.4	
		Support to manage Khokela Spring of Mastmandu Community Forest	Ref 7.4.2.2, 7.4.2.4	
		Support for electrification	Ref 7.4.2.3	
		Support to establish health service center	Ref 7.4.2.2 and 7.3.3 (iii)	
		Support on maintenance of Salleri- Khokela Drinking water Scheme (Estd. in 2041)	Ref 7.4.2.2, 7.4.2.4	
	Mellekh - 4	Support for schools infrastructure development/renovation of local schools (physical facilities construction/ rehabilitation, toilet, drinking water, building/class room)	Ref 7.4.2.2, 7.4.2.4	
		Support for drinking water, toilet and educational materials to local schools and child development center	Ref 7.4.2.2, 7.4.2.4	
		Use of Odalkota spring for drinking water and irrigation scheme development	Ref 7.4.2.2, 7.4.2.4	
		Support Barhabishe-Kuskot (Lamakhadi-Dab market) Road	Ref 7.4.2.2, 7.4.2.4	
		Protection of Lingkot Temple	Ref 7.4.2.2, 7.4.2.4	
		Support for maintenance of Budhipandhera and Babai drinking water schemes	Ref 7.4.2.2, 7.4.2.4	
		Support to start up of Saranigad Microhydro	Ref 7.4.2.2, 7.4.2.4	
		Support for establishment of health post	Ref 7.4.2.2 and 7.3.3 (iii)	

		Support to manage existing irrigation Schemes	Ref 7.4.2.2, 7.4.2.4	
	Mellekh - 8	Support for schools (physical facilities - toilet, drinking water, building/class room)	Ref 7.4.2.2, 7.4.2.4	
		Support for renovation of health post building of the ward	Ref 7.4.2.2 and 7.3.3 (iii)	
		Support for drinking water (intake, source improvement/ conservation)	Ref 7.4.2.2, 7.4.2.4	
		Support for Hatikot - Thanti and Hatikot-Mastmandu foot trail	Ref 7.4.2.2, 7.4.2.4	
		Support for conservation of historic Vimkot Palace located in ward no. 9	Ref 7.4.2.2, 7.4.2.4	
	Sanfebagar - 4	Support to manage irrigation schemes	Ref 7.4.2.2, 7.4.2.4	
	Sanfebagar - 10	Support to manage irrigation schemes	Ref 7.4.2.2, 7.4.2.4	
	Sanfebagar - 13	Conservation of Virkhamba (archeological Importance)	Ref 7.4.2.2, 7.4.2.4	
		Support for Ardali Microhydro power project	Ref 7.4.2.2, 7.4.2.4	
Project construction related	Budhiganga - 10	Protection of traditional water mills (Ghatta)	Ref 7.3.3. (vi) and 7.3.3.4 (vii)	
		Protection of Ikri Gad (mora) cremation site	Ref Table 7.8	
	Mellekh - 4	Protection of traditional water mills (Ghatta)	Ref 7.3.3. (vi) and 7.3.3.4 (vii)	
		Protection of Lingkot Temple (2 K.M upstream from Dam)	Ref 7.4.2.2	
		Protection of cremation sites	Ref Table 7.8	
		Support to improve Lamakhadi- Dab Bazar road	Ref 7.4.2.2, 7.4.2.4	
	Mellekh - 8	Protection of water mills	Ref 7.3.3. (vi) and 7.3.3.4 (vii)	
	Sanfebagar - 10	Protection of water mills	Ref 7.3.3. (vi) and 7.3.3.4 (vii)	
		Protection of cremation site	Ref Table 7.8	

	Sanfebagar - 13	Protection of cremation sites(Ardalighat, Budhabagar)	Ref Table 7.8	
		Protection of water mills	Ref 7.3.3. (vi) and 7.3.3.4 (vii)	
Others	Budhiganga - 10	Funding support to Ikri Micro Hydro project	Ref 7.4.2.2	
	Mellekh - 4	Quick implementation of the project	The proponent is trying level best for quick implementation of the project	
		Coordination/information to the community before starting construction activities	Ref 7.3	
		Transparency regarding project activities and compensation	Ref 7.3	
		Support for conservation of community forest (Juka, Ikri Gad)	Ref 7.3.2.1 (i) , (iv) and 3	
		Project should implement study report of Budhiganga HEP of 2052 B.S.	The present study is advance level study than previous one and prepared following the procedure of Government of Nepal. The proponent will implement project based on the present study.	
		Compensation for forest loss of Jukaban Community Forest	Ref 7.3.2.1 (i) ,(iv) and 3	
		Free electricity for directly affected HHs		Beyond the scope of the EIA
	Mellekh - 8	Conservation of Imil Tukra Community forest	Ref 7.3.2.1 (i) ,(iv) and 3	
	Sanfebagar - 4	Timely completion of project	The proponent will try level best for timely completion of the project	



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		Support for local development	Ref 7.4.2.2, 7.4.2.4	
		Support to management of water resources	Ref 7.4.2.2, 7.4.2.4	
	Sanfebagar - 10	Support to manage water resources	Ref 7.4.2.2, 7.4.2.4	
		Support for local development of the ward	Ref 7.4.2.2, 7.4.2.4	
		Timely completion of the project	The proponent will try level best for timely completion of the project	
	Sanfebagar - 13	Support for conservation of Rakshe Community Forest	Ref 7.3.2.1 (i) ,(iv) and 3	
		Protection of water resources of the area	Ref 7.3.1.3 (vii)	
		Implement awareness raising program against Chhaupadi tradition	Ref 7.3.3.2 vi	

Source: Field survey ,2018

10.4 Public Hearing

10.4.1 Introduction

A public hearing was conducted in Thanti Bazar, ward no. 10 of Sanfebagar Municipality on August 21, 2018 as per rule 7 (2) of EPR 1997 (2054). Altogether 164 participants including 133 males and 31 females participated in the public hearing. The public hearing started at 12:15 pm and closed at 4:30 pm.

10.4.2 Objectives of Public Hearing

The main objective of the public hearing was to inform local people regarding findings of the EIA and solicit their comments and suggestions to finalize the EIA report. The specific objectives of the public hearing were to:

- Inform local people, NGOs, line agencies and other stakeholders about the technical and environmental aspects of the project;
- Brief stakeholders about the status of the project and on-going activities;
- Solicit comments and suggestions from public on the proposal; and
- Revise the EIA report based on the concerns/suggestions of local people, as appropriate.

10.4.3 Planning of Public Hearing (Public Notice, Advertising and Invitations)

Public notice inviting stakeholders to participate in the public hearing of BHP and to provide their valuable comments and suggestions was published in the national Daily News Paper "Arthik Karobar" (Volume II, Appendix:F). The copy of the public notice was also displayed on notice

boards of the affected municipalities and the wards, schools, health posts, police posts and major settlements of the project area (Bajura and Achham districts).

Information regarding the public hearing was also broadcasted from local FM radio "Lokpriya" located in Sanfebagar Municipality for one week before the hearing. The FM radio has wide coverage in the project affected areas.

In addition, invitation letters requesting participation in the public hearing were sent to the concerned GoN ministries and departments, namely MoFE and MoEWRI, district level government line agencies, DCC Offices, offices of district level political parties, all the affected wards of the project area and affected municipalities of Achham and Bajura districts.

Before the date of public hearing, a team consisting of EIA members was mobilized in the project area for planning, logistical management and meeting with local stakeholders and government officials regarding the program.

10.4.4 Implementation of Public Hearing

A. Information Dissemination (Display of EIA Report, Project Layout Map and Photographs)

The Draft EIA report, summary of EIA report, project layout map and photograph of major project components were displayed for information dissemination at one corner of the public hearing location. The EIA team members had briefed interested local people about the technical and environmental aspects of the project.

B. Schedule of Public Hearing

The schedule of the public hearing consisted of registration of participants, inaugural session; welcome speech and objectives of the program; distribution of EIA summary report and presentation of summary of findings of the EIA; remarks by the guests; question/answer session (distribution and collection of question/suggestion sheets); vote of thanks; and concluding remarks by Chairman (Volume II, Appendix: F).

C. Registration and Distribution of EIA Summary Report

Altogether 6 local volunteers including 4 females and two males were mobilized to facilitate the registration process as well as to provide logistical support. After registration of the participants, a summary of the EIA report prepared in simple Nepali language was distributed to the participants. It consisted of salient features of the project, impacts of the project, mitigation and enhancement measures, environmental management plan and map of the project area.

D. Opening/Inaugural Session

The public hearing program was started at 12:15 pm (1:15 hrs. late from scheduled time due to delay in arrival of guests/participants) with opening session by Mr. Pankaj Kumar Pokharel, the master of ceremony. He announced name of distinguished guests as per their hierarchy and requested for taking their seats. Mr. Bir Bdr. Bohara, (Site In-charge of BHP) facilitated the guests with Khata (traditional ceremonial scarf) and provided them with name tags (batch).

Mr. Lok Bdr. Bogati, Headmaster of Shree Thanti Primary School chaired the public hearing program. Mr. Nar Bahadur Bogati, Coordinator of DCC Achham was chief guest of the program (Photo 10-1) and Mr. Kul Bahadur Kunwar (Photo 10-2), Mayor of Sanfebagar Municipality was



Special guest of the program. Similarly, there were other 19 other guests representing elected ward chairs/members of local bodies, and representatives of political parties, government offices and civil society organizations. The public hearing program was inaugurated by the Chief Guest Mr. Nar Bahadur Bogati, Coordinator of DCC, Achham.



Photo 10-1: Inauguration of Public Hearing by Chief Guest



Photo 10-2: Mr. Kul Bdr. Kunwar
addressing the participants

Mrs. Poonam Pandey, Project Engineer of BHP welcomed the participants for their valuable presence on behalf of the project and requested for their active participation in the program.

E. Presentation of Summary of EIA Report

Mr. Pankaj Kumar Pokhrel, EIA team member spoke about the objective of the public hearing and presented a summary of EIA. Similarly, Dr. Narayan Bhakta Shrestha, Project Coordinator of BHP highlighted technical aspects of the project. Nepali version of summary of EIA report is presented in (Volume II, Appendix: F).

F. Comments/Suggestions and Question and Answer Session

Altogether 11 guests including chief guest and special guest of the program made remarks, comment/suggestions on EIA and technical aspects of the project.

Later, the floor was open for discussion. Question/suggestion sheets were also distributed to interested participants for providing their written questions, comments and suggestions. Some participants raised their questions and provided comments and suggestions verbally (Photo 10-3). Ten participants provided their written questions, comments/suggestions. The comments/suggestions of the participants are given below.



Photo 10-3 Participant of Public Hearing Providing comments/Suggestion on the EIA Report

Table 10-3: Comments/suggestions of the participants

Name	Address	Occupation	Questions, Comments/Suggestion	Issues Addressed	Issues clarified
Dammar Bdr. Saud	Budhiganga M - 10	Agriculture	1. Why our compensation rate of land not increased	Ref 7.3.3.1	Compensation are paid and will be paid as per the rate fixed by CDC
			2. Why discrimination in compensation rate for our land	Ref 7.3.3.1	
			3. Why we have not received compensation on time		Compensation will be paid on time
			4. Why there is no community development program in our area	Ref 7.4.2.2, 7.4.2.4	
Padam Bdr. Saud	Budhiganga M - 10	Business	1. Why delay in implementation of DW project of Rs. 2 million in Budhiganga Municipality -10.		It will be implemented soon
			2. Why delay in hiring of local staff by the project as said?	Ref 7.2.1.1	The required manpower will be hired based on the project development
			3. What is measure to protect Tithana from submergence	Ref Table 7-8	
Nirpa Bdr. Saud	Mellekh RM - 4	Agriculture	1. What should be done for operation of water turbines (Ghatta) and income of local people from fishing?	Ref 7.3.3. (vi) and 7.3.3.4 (vii) and 7.3.2.2 (2)	
			2. What should be done to raise income of local community?	Ref 7.3.3.4 (ii) , (v) and (vi) and 7.4.2.1	
			3. What strategy should be adopted for seriously affected and affected community	Ref 7.3.3.1 and 7.3.3.4	
			4. Compensation of excluded land, house and trees	Ref 7.3.3.1	

			5. Access road to local people from dam site and powerhouse area		No provision from dam it may be allowed from powerhouse area
Rinari Saud	Mellekh RM - 4	-	1. Compensation for unregistered land	Ref 7.3.3.1	
			2. When compensation of house and trees will be distributed	Ref 7.3.3.1	It will be distributed soon
Kamal Saud	Mellekh RM - 4	Agriculture	1. Mitigation measures for tunneling impact on water sources	7.3.3.2 (x)	
			2. Access road and bridge to connect Sanfebagar ward no 13 and Mellekh ward no. 4.	Ref 7.4.2.2, 7.4.2.4	
			3. Fencing of dam area for protection of users		Area is steep and fencing entire area is not practical
			4. Establish Fish hatchery	Ref 7.3.3.2 fish pass	Fish pass is appropriate for this project considering the species found in river
Nain Bdr. Saud	Mellekh RM - 8	Agriculture	1. Alternative for people like me dependent on fishing	7.3.2.2 (2) aquaculture	
			2. Provide net	7.3.2.2 (2) aquaculture	
Puspa Raj Bhatta	Sanfebagar -9	Journalist	1. Increase coordination	Ref 7.3	
			2. Accelerate construction work		It will be done as per schedule
			3. Rehabilitation of affected people	Ref 7.3.3.1, 7.3.3.2, 7.3.3.3 and 7.3.3.4	
Bhpendra Mahata	Sanfebagar -10	Agriculture	1. Why tender/quotation for community support programs such as DW, irrigation, school and health? How to end the system?		It was done and will be done as per public procurement act of Gon
Sagar Sing Babali	Sanfebagar -13	Politics	1. As the dam site is in Babala it should be given main role in project activities	Ref.7.2.1	

Rudra Aryal	Bhalbari -1, Morang	Researcher, Anthropology Dept. TU.	1. Provide data of directly and indirectly affected HHs/families	Ref EIA report	
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The queries of the guests and participants were responded to by Mr. Bir Bahadur Bohara, Dr. Narayan Bhakta Shrestha and Mr. Pankaj Pokhrel as appropriate. The comments/suggestions provided by the participants have been incorporated in the relevant chapters of this EIA report. The community development and infrastructure support work will be covered under CSR based on the availability of budget as per the priority of the local people following the procedure of public procurement act. Considering the fish diversity, upstream migration, problem in breeding and lack of breeding technology of the some of important species fish ladder is proposed for this project.

G. Recording of the Public Hearing

Audio and visual recording of the program was made using movie camera and recorder. Photographs of the public hearing were also taken. It will be presented separately to the client as part of the public hearing record.

H. Participants of the Public Hearing

Altogether 164 participants including 133 males and 31 females had participated in the public hearing program. Of the participants 91 were from Sanfebagar Municipality, 29 from Mellekh Rural Municipality, 8 from Budhiganga Municipality (Bajura), 4 from other areas of Achham district and 17 from other districts of Nepal (Kathmandu, Bajura, Banke, Kailali and Morang).

The participants of the public hearing were people of the project affected municipalities and rural municipality, directly project affected families, elected representatives (DCC Coordinator, Mayor, Ward Chairperson, Ward Members) of local bodies, representatives of political parties, government line agencies and civil society organizations, security personnel, teachers, students, journalist, health workers, businessmen, representatives of proponent and consultant (DOED, project staff, EIA team members), social workers and other intellectuals of the area. The list of the participants is given in (Volume II, Appendix: F).

10.5 Recommendations of Affected Municipality/Rural Municipality

Recommendation letters from the project affected municipality and rural municipality were collected as per EPR 1997 (Volume II, Appendix: G). The consent letter of affected community forest is also collected and presented in (Volume II, Appendix: H).

10.6 Disclosure of EIA Report

The EIA report submitted to Ministry of Forests and Environment was disclosed for public review by publishing 30 days public notice. The copy of EIA report was circulated to District Coordination Committee Office of Project districts, project affected municipality and rural municipality, Central Library of Tribhuvan University and other concerned stakeholders.



10.7 Review Meeting and Presentation

The Review Committee was held in DoED and MoFE. Technical and environmental presentation was made by the relevant experts. The comment and suggestion received in the meeting were incorporated in the final EIA report.

10.8 Continuation of Consultation Process

The consultation process will be continued during the construction phase of the project. A Public Information Center (PIC) will be established in the project site for continuation of the public consultation process. All genuine issues/concerns raised by the local people will be collected and addressed accordingly by the proponent (DoED). In addition, periodic reporting of project activities/progress (in Nepali) will be made to ensure that the public and stakeholders are well informed regarding project activities.



11. CONCLUSION

Budhi Ganga Hydropower Project is proposed by DoED on Budhi Ganga River. The proposed project is located in Achham and Bajura districts of Farwest Province of Nepal. The project covers ward numbers 4, 10 and 13 of Sanfebagar Municipality and ward numbers 4 and 8 of Mellekh Rural Municipality of Achham district and ward number 10 of Budhiganga Municipality of Bajura district.

The proposed project is PPR scheme with a six-hour daily peaking capacity. The project has an installed capacity of 20 MW generated through a gross head of 94.83 m and a design discharge of 26 m³/s.

Project component include a dam, an intake, an underground desander, a headrace tunnel, an underground surge shaft and penstock a surface powerhouse and a tailrace. The estimated cost of the project is NRs. 5,450.32 million, and its estimated construction period is four years.

The EIA for the project was conducted based on field survey and review of secondary information. This EIA report is an outcome of the study conducted adhering to the existing policies, acts, rules, regulations and guidelines pertinent to the EIA study.

Employment for 400 people (75 skilled, 150 semi-skilled and 375 un-skilled), increase in enterprise development and economic opportunity, enhancement of technical skill, project induced development, revenue generation and contribution in national development by providing 109.61 GWh renewable energy are the major positive impacts of the project. The project will also contribute to tourism development and land value of the area by providing better facilities and infrastructure.

Changes in land use pattern of 51.74 ha land area, impact due to solid waste and spoil disposal, slope stability, soil erosion and changes in hydrology and sedimentation, water, air and noise pollution are the main adverse impacts identified in the physical environment. The terrestrial environment impacts include acquisition of 18.20 ha forest land, loss of 4,809 standing trees (4,481 poles and 328 trees) of 16 species, increase in demand of fuel wood and timber and increased access to forest. The project will fell 2,460 trees (2,342 pole size and 118 trees) of Sal. The project will also affect seedling of non-timber forest product species including Asuro, Amala, Jamun and Aiselu and saplings Sisno. Loss of natural habitat and construction disturbances are the impacts identified on wildlife.

The impact on the aquatic environment includes destruction of spawning and rearing ground of fish, changes in flow of river especially in reservoir area, reduction in river flow in 6.8 km section of the river downstream of the dam, water quality changes and water fluctuation.

The major socio-economic and cultural environmental impact include permanent acquisition of 17.34 ha private land from 80 households, relocation of 6 houses and 5 cowsheds, occupational safety, health and sanitation, increase and decrease in economic activities and impact on gender and vulnerable groups. Loss of 47.02 MT food productions, 50 private trees, impacts on water uses are the other impacts identified in socio-economic and cultural environment.

Out of the 19 impacts identified in the physical environment 13 are categorize as low, 5 are medium in magnitude and 1 is high in magnitude. In terrestrial environment, out of 18 identified impacts, 13 are low and 5 are moderate. Similarly, in aquatic environment 14 impacts were identified. Out of these, 8 are low, 4 moderate and 2 are high in magnitude. In socio-economic

and cultural environment 28 impacts were identified. Out of these, 19 are low, 6 moderate and 3 are high in magnitude.

Preventive, avoidance and mitigation measures have been proposed for all identified/ predicted adverse impacts and enhancement measures are developed to maximize project benefits. A community support program has been proposed to strengthen the local institutions and develop good relations with local people. Bio-engineering measures, proper disposal of spoil and solid waste, spray of water twice a day and water quality protection measures are the major mitigation measures proposed for the physical environment.

Land for land compensation, Plantation of 77,210 saplings and its management for 5 years, distribution of 30,000 non-timber forest species to community forest users group affected by the project, environmental flow release of 0.99 m³/s, construction of fish pass and habitat management program are the major mitigation measures proposed to minimize the impacts on the biological environment.

Compensation for the acquisition of land and houses, transportation allowances, dislocation allowance, camp facilities for the workers, implementation of occupational safety measures, fencing of construction site, operation of fair price shop, rehabilitation of foot trails, implementation of agriculture assistance, compensation for the loss of trees in farm land, social awareness program and skill development training are the major mitigation measures proposed for the socio-economic and cultural environment.

Establishment of Budhi Ganga Environment Monitoring Unit for day to day environmental monitoring, formation of Environment and Social Management Unit for implementation of environmental and social mitigation measures, grievance management and Local Consultative Forum (LCF) are proposed for implementation of project environment management. In addition, a joint monitoring committee is proposed to ensure the proper implementation of mitigation measures and monitoring work.

The total estimated environment management cost for the proposed project is NRs. 142.62 million which is 2.62% the total project cost. This cost includes NRs. 55.34 million for impact mitigation, NRs 16.83 million for enhancement measures, NRs 40.88 million for community support program, NRs. 17.46 million for program implementation and NRs. 12.11 million for monitoring. In addition, NRs. 1.17 million is proposed for environmental auditing of the project. It excludes cost for environmental engineering works and fish pass construction which are included in the engineering costs for the project.

The findings of the EIA shows that adverse impacts on the physical, terrestrial, aquatic as well as socio-economic and cultural environments due to implementation of the project are low to moderate with implementation of the proposed environmental management measures in the EIA report.



12. VOLUME II: APPENDICES

Please refer separate volume for this chapter.



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Budhi Ganga Hydropower Project (20 MW)

Response to Comments of MOFE/Experts on EIA Report

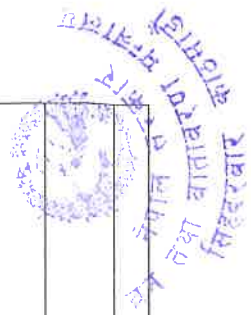
S.N.	Heading/Subheading	Page No.	Comments & Suggestion	Incorporated	Response from Consultant	
					Brief about changes (Chapter section and page)	Remarks (Not incorporated/Clarification)
A.	MOFE					
1			Dewatered zone मा प्रयोग हुने/नहुने, crimpation site मा water release को बारे उल्लेख गर्नुपर्ने ।	Revised	Ref sections 5.3.3.3 G for impacts (page 5-42)	
2			Cultural environment बारे प्रष्ट रूपमा उल्लेख गर्नुपर्ने ।	Revised	Ref sections 4.3.2.17 (page 4-63 & 4-64)	
3			Construction material बारे उल्लेख गर्ने ।	Clarification		Ref sections 2.4.2, 2.4.3, 2.4.4 & 2.4.5 (page 2-17 to page 2-18)
4			Pondage को प्रभावबारे उल्लेख गर्ने ।	Clarification		Ref. section 5.3.1.2 ii, 5.3.1.3 i, ii, iii, 5.3.2.2 B iv (page 5-7 to 5-25)
5			Irrigation scheme मा पर्ने सबैको प्रभाव र त्युनिकरणको उपायबारे उल्लेख गर्नुपर्ने ।	Revised	Ref sections 5.3.3.3 G for impacts and 7.3.3.3 v for mitigation (page 5-42 & page 7-29)	
6			Waste Management plan बारे उल्लेख गर्नुपर्ने ।	Incorporated	Ref Table 8.12 D (page 8-14)	
7			Public hearing मा उठान भएका विषयहरु कहाँ कसरी सम्बोधन गरिएको छ उल्लेख गर्नुपर्ने ।	Incorporated	Ref. Table 10-3 (page 10-10)	
8			Plot size फरक हुनुको कारण उल्लेख गर्नुपर्ने ।	Elaborated	Ref 3.5.2.1(ii) (page 3-6)	
9			Floral fauna को listing कसरी गरियो methodology खुलाउनुपर्ने ।	Elaborated	Ref 3.6 (page 3-16, & page 3-17)	
10			Scientific names revisit गर्नुपर्ने ।	Corrected	Ref section 4.2 (page 4-21 and page 4-22)	



11			Protected plant / animals conservation को लागि कस्तो योजना समावेश गरिएको छ खुलाउनुपर्ने ।	Incorporated		and Annex C6 to C13 Ref section 7.3.2.1 A(ii) and section 2 Wildlife A (iii) (page 7-11, page 7-15)
12			Appendix B दोहोरिएको ।	Corrected		Ref Annex B of volume II Appendices
13			Reference मा CBS 2012, CBS 2014 उल्लेख रहेको सच्याउनुपर्ने ।	Corrected		Ref Reference (page 13-1 to 13-3)
14			घुर्कुकोट गा.वि.स. उल्लेख रहेकोले सच्याउनुपर्ने (दुधरुकोट हुनसक्ने) ।	Clarification		The name of former VDC is Ghughurkot but there is typo error in the CBS data (refer letter of the VDC provided for scoping, district profile of Achham 2071 P no. 5 and other GON documents).
15		Pg. 4-47	तालिका 4-21 मा सच्याउनुपर्ने (साफेबगर नगरपालिका (४,१०) बुढीगांगा नगरपालिका, मेलेख गाउँपालिका) ।	Revised		Ref Table 4-21 and section 4.3.2 (page 4-49)
16			Uterus prolapse बारे विवरण उल्लेख गर्नुपर्ने ।	Revised		Ref section 4.3.2.12 (page 4-60)
17			छाउपडी मुक्त क्षेत्र हो होईन खुलाउनुपर्ने ।	Incorporated		Ref section 4.3.2.17 (page 4-63)
18			राजाको दरबार र अन्य ऐतिहासिक संरचनाबारे उल्लेख गर्नुपर्ने ।	Incorporated		Ref section 4.3.2.17 (page 4-64)
19			Birth center को विवरण समावेश गरी उपयुक्त हुने ।	Incorporated		Ref section 4.3.2.12 (page 4-60)
20			15 th Plan Approach Paper, Land Use Policy, 2072, National Land Policy, 2075, National Forest Policy, 2075, National Env., Policy, 2076, Environment Protection Act, 2076, Forest Act, 2076, Land Use Act, 2076, Consumer Protection Act, 2075, National CC Policy, 2076 जग्गा प्राप्ति ऐन, २०३४, संकटापन्न बच्यजस्तु, २०७३, Forest regulation मूल प्रतिवेदन र कार्यकारी सा. मा review गर्नुपर्ने ।	Incorporated		Ref section 9.2.2, 9.2.4 (page 9-2, page 9-5)

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21			Manpower को स्थानमा human resource उल्लेख गर्दा उपयुक्त हुने ।	Incorporated	Ref section 4.3.2.10, Table 5-1, 8-24 (page 4-58, page 5-6, page 8-26)	
22			Pollution monitoring मा appropriate method उल्लेख रहेकोले नेपाल सरकारको प्रावधान बमोजिम उल्लेख गर्नुपर्ने ।	Incorporated	Ref Table 8-25 (page 8-33)	
23			वन क्षेत्र कति आवश्यक हो वन ऐन, २०७६, को आधारमा उल्लेख गर्नुपर्ने ।	Revised	Ref section 5.3.2.1 (IA) and 1.3 of chapter 1 (page 5-19, page 1-1, page 1-2)	
24			१-१० को दरमा compensatory plantation गरिने बारे उल्लेख गर्नुपर्ने ।	Revised	Ref section 7.3.2.1 (page 7-10)	
25			Muck disposal plan समावेश गरी सोको verification गर्ने संयन्त्रबारे उल्लेख गर्नुपर्ने ।	Revised	Ref Table 8-15 (10) (page 8-19)	
26			Catchment area management बारे उल्लेख गर्नुपर्ने ।	Incorporated	Ref section 7.3.1.3 (vii) (page 7-9)	
27			अवशोषण उल्लेख रहेकोले सच्याउनुपर्ने ।	Revised	Ref Nepali ES (page i to xi)	
28			Safetic tank सहित २५ वटा toilet उल्लेख रहेकोले revisit गर्नुपर्ने ।	Revised	Ref section 7.3.1.2 (iv) (page 7-4)	
29			माछा मार्न प्रतिवन्ध लगाउने responsibility कसको हुने बारे उल्लेख गर्नुपर्ने ।	Revised	Ref section 7.3.2.2 operation phase (iii) (page 7-21)	
30			Fish migration, fish ladder/ fish passage बारे उल्लेख गर्दा उपयुक्त हुने ।	Clarification	Ref 7.3.2.2 operation phase (i) Fish pass (7-16)	
B. Niranjan Shrestha, Expert/Physical Environment						
1			Please correct the minor language errors in the report especially in Nepali executive summary and throughout the report.	Revised	Ref Nepali ES (page i to xi)	
2			Various information related policies, guidelines, administrative structures should be updated as per changed context.	Incorporated	Ref section 9.2.2, 9.2.4 (page 9-2, page 9-5)	
3	Chapter 4, 4.1.3		Temperature subheading can be included under subheading '4.1.2 climate'.	Incorporated	Ref section 4.1.2 (page 4-1)	
4	Chapter 4.1.15		Please mention about the landslide induced	Revised	Ref section 4.1.8 for	



			lakes area and landslide, sedimentation deposit status in upstream part of project. Please mention about GLOF status in catchment area of the project.			sedimentation, 4.1.14 for erosion and 4.1.6 for GLOF (page 4-4, page 4-7, page 4-20)	
5	Chapter 4.3.2.16		It mentions that water from Budhi Ganga river is used for irrigation and drinking purposes for the settlement located just upstream of the powerhouse site. If so, please assess the impacts and recommend appropriate mitigation measures in respective chapters.	Revised		Ref section 5.3.3.3 G for impacts and 7.3.3.3 v for mitigation (page 5-42, page 7-29)	
6	Chapter 4.3.3		Please include the information on details of physical and community infrastructures, cultural environment related information (cultural and historic sites, archaeological sites, cremation sites). Please recommend the mitigation measures for the impacts on them with mitigation cost when necessary.	Clarification		Ref section 4.3.2.16 for Infrastructure and section 4.3.2.17 for cultural environment baseline. Ref section 7.3.3.2 (viii) for Infrastructure and (xiii) for cultural environment (page 4-63, page 7-27, page 7-28)	
7	Chapter 5,	page 5-11	Please mention about the size of crusher plant, its impact and mitigation measures under respective headings.	Revised		Ref section 2.4.6 for size Ref section 5.3.1.2 ii, iii, iv for impacts Ref section 7.3.1.2 iii, x for mitigation measures (page 2-18, page 5-7, page 7-3, page 7-6)	
8	Chapter 5.3.1.3		Please mention about the impact due to 'pondage' and recommend mitigation measures in respective chapter.	Clarification		Ref. section 5.3.1.2 ii, 5.3.1.3 i, ii, iii, 5.3.2.2 B iv (page 5-7, page 5-13, page 5-14, page 5-15, page 5-26)	
9		Page 7-10,	provision of compensatory plantation should be revised as per new 'Karyabidhi'.	Revised		Ref section 7.3.2.1 (page 7-10)	
10	Chapter 8.5.1.2		If resettlement is necessary for displaced			Ref section 7.3.3.1 (ii)	Resettlement for this project

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			people, information on proposed resettlement location.		(page 7-23)	is not required.
11	Chapter 8.5		Please add the 'waste management plan'.	Incorporated	Ref Table 8.12 D (page 8-14)	
12			Please ensure the incorporation of issues, raised in table 10-2 in mitigation chapter.	Incorporated	Ref. Table 10-2 (page 10-3)	
C. Dr. Chitra Bahadur Baniya, Expert /Biological Environment						
General Comments						
			Problem of Biological methodology all the way from sampling size selection to data analysis specific to biological taxon, justification of sample size, handling of vulnerable/threatened species and their sound management with local involvement.	Revised	Ref section 3.5.2 and 3.6 (page 3-6, page 3-16, page 3-17)	
Specific Comments						
1	ii) Forest sampling	Page 3-6	Not found mentioned about 30x30m ² quadrat size also justification needed to have different sized sample plots for the same study.	Revision /Clarification	Ref section 3.5.2.1 (ii) (page 3-6)	Standard sample plot of 25mx25m was taken for the study as per approved ToR
2	Section 3.6; Data Analysis	page 3-17	Nomenclature of the collected species: rather old fashioned, recent literature wanted.	Revised	Ref section 4.2 (page 4-21)	
3	"		This section meant for both plants as well as all categories of animals from rodents to mammals. Data analysis methods for the said were completely lacking.	Incorporated	Ref section 3.6 (page 3-16)	
4	Section 4	page 4-23	Paragraph 1, <i>Asparagus racemosus</i> mentioned more concerned about NTFPs and local income generation program.	Clarification		This species is concerned both for NTFP (medicinal) and income generation purpose.
5	Chapter 7, section 7.3.2		Management plan specific to the sensitive /threatened biological group in a clear steps must be needed.	Incorporated	Ref section 7.3.2.1, I (ii), 2 (iii) (page 7-10, page 7-11)	
6			Details about conservation/management of threatened and important plant as well animal groups needed.			

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Volume II Appendix

Volume II Appendix				
1		Appendix B repeated	Corrected	Ref revised Appendix
2		Table - C-12: Relative Abundance and Species Composition make this title specific to the work.	Revised	Ref table C-12 of Appendix
3		Table - C-13: make this title specific to the work.	Revised	Ref table C-13 of Appendix
4		Table - C -3 to Table –D-I e: Recheck all botanical name with recent accepted names, uniformly mention.	Revised	Ref table C-3 to Table D-I of Appendix
5		Over all this reports is good. After improvement on above suggestions, the biological part will be accepted for this EIA.		
D.	Upendra Prasad Adhikari, Expert/Socioeconomic Environment			
General Comments				
1		Abbreviations are not in alphabetical order. e.g. DHQ than DCC, DO than DBH.STD than SPS etc.	Corrected	Ref Abbreviations (page 1, page 2 & page 3)
2		Abbreviations are missing. e.g. Dba (page ii), NPX, SO2 (page iv) ha (page i)DED (page 2-2) etc.	Incorporated	Ref Abbreviations (page 1, page 2 & page 3)
3		References are not in alphabetical order.	Corrected	Ref Reference (page 13-1, page 13-2 & page 13-3)
4		Field survey 2018 is missing in the References.	Incorporated	Ref Reference (page 13-1, page 13-2 & page 13-3)
5		CBS (2012) National Population and Housing Census, Central Bureau of Statistic, Government of Nepal, November 2012 is not complete (in the references.)	Revised	Ref Reference (page 13-1, page 13-2 & page 13-3)
6		References are is not in standard format. Need to write in accepted format: such as: Central Bureau of Statistic (2012). National Population and Housing census 2011, National Report Vol. 1. National Planning	Revised	Ref Reference (page 13-1, page 13-2 & page 13-3)



नेपाल सरकार
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Specific Comments						
1		Page 4-46	Fifth paragraph, among diseases Uterus Prolepses is missing.	Revised	Ref section 4.3.2.12 (page 4-49)	
2	4.3.2.	Page 4-47	There was no VDC as Ghughurkot in Achham district (may be Dhudharukot ?)	Clarification		The name of former VDC is Ghughurkot but there is typo error in the CBS data (refer letter of the VDC provided for scoping, district profile of Achham 2071 P no. 5 and other GON documents).
3		Page 4-47	Table 4-21, Population of Budhiganga Municipality 10 of Bajura is wrong. Likewise population of Sanfebagar Municipality 4 is not correct.	Revised	Ref Table 4-21 and section 4.3.2 (page 4-49)	
4			Executive Summary - grammatical/ spelling mistake (Nepali).	Revised	Ref Nepali ES (page i to xi)	
5			Better to use information from concern RM/ Municipality such as historical place, health institutions including birthing centres, educational institutions including community learning centre and child development centre etc.	Clarification		The available data of the RM/Municipality is used.
6			Instead of 14 th Plan, please discuss about 15 th plan.	Revised	Ref section 9.2.2 (page 9-2)	
7			Manpower/ Chairman	Revised	Ref Table 4-21 and section 4.3.2 (page 4-49)	

