

Environmental Impact Assessment

Project No. 43281
Final Report
August 2009

NEP: Tanahu (Upper Seti) Hydropower Project

Prepared by Nepal Electricity Authority (NEA).

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NEPAL ELECTRICITY AUTHORITY

ENGINEERING SERVICES



Environmental Impact Assessment of Upper Seti Storage Hydroelectric Project

FINAL REPORT (Volume 1: Main Report)

Submitted to:
Ministry of Environment
through
Department of Electricity Development
and
Ministry of Energy

Prepared and Submitted by:
Environmental & Social Studies Department
Engineering Services
Nepal Electricity Authority
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August, 2009



Acronyms and Abbreviations

ACRP	-	Acquisition, Compensation and Rehabilitation Plan
AVR	-	Automatic Voltage Regulator
BOD	-	Biological Oxygen Demand
CBO	-	Community Based Organization
CBS	-	Central Bureau of Statistics
CITES	-	Convention on International Trade of Endangered Species
COD	-	Chemical Oxygen Demand
DCS	-	Distribution Consumer's Service
DDC	-	District Development Committee
DFO	-	District Forest Office
DNPWC	-	Department of National Park and Wildlife Conservation
DO	-	Dissolved Oxygen
DoA	-	Department of Agriculture
DoED	-	Department of Electricity Development
EIA	-	Environmental Impact Assessment
EL	-	Elevation
EMP	-	Environmental Management Plan
EMSU	-	Environmental Monitoring Sub-Unit
EPA	-	Environmental Protection Act
EPR	-	Environmental Protection Rules
ESMU	-	Environmental and Social Monitoring unit
ESSD	-	Environment and Social Studies Department
FSL	-	Full Supply Level
FUG	-	Forest User's Group
GER	-	Gross Enrollment Rate
GoN	-	Government of Nepal
ha	-	Hectares
HEP	-	Hydro-electric Project
Hh	-	Household
ICIMOD	-	International Center for Integrated Mountaineering Development
IEE	-	Initial Environmental Examination
INPS	-	Integrated Nepal Power System
IUCN	-	International Union for Conservation of Nature
JICA	-	Japan International Cooperation Agency
km	-	Kilometer
m	-	Meter
MBF	-	Main Boundary Fault
MBT	-	Main Boundary Thrust
MCT	-	Main Central Thrust
MoE	-	Ministry of Energy
MoEnv	-	Ministry of Environment
MoEST	-	Ministry of Environment, Science and Technology
MoFSC	-	Ministry of Forest and Soil Conservation



MOL	-	Minimum Operating Level
MW	-	Megawatt
NARC	-	National Agriculture Research Center
NEA	-	Nepal Electricity Authority
NER	-	Net Enrollment Rate
NGO	-	Non-Governmental Organisation
NRDB	-	Nepal Red Data Book
ODA	-	Official Development Assistance
PAF	-	Project Affected Families
PDD	-	Power Development Department
PMF	-	Probable Maximum Flood
PMO	-	Project Management Office
RCC	-	Reinforced Cement Concrete
RP	-	Resettlement Plan
SAP	-	Social Action Plan
SLC	-	School Leaving Certificate
SPAF	-	Seriously Project Affected Families
SRCL	-	Soil, Rock and Concrete Laboratory
TL	-	Transmission Line
TOR	-	Terms of Reference
USSHEP	-	Upper Seti Storage Hydroelectric Project
VCDP	-	Vulnerable and Community Development Program
VDC	-	Village Development Committee
WHO	-	World Health Organization

कार्यकारी सारांश

१. परिचय

पश्चिमाञ्चल विकास क्षेत्रको तनहुँ जिल्ला स्थित रहने माथिल्लो सेती जलाशययुक्त जलविद्युत आयोजनाको जडित क्षमता १२७ मे.वा. र बाँधको उचाई १४० मिटर रहने छ । यसको सम्भाव्यता अध्ययन नेपाल विद्युत प्राधिकरणद्वारा २०५८ सालमा सम्पन्न गरेको थियो । यसको अलावा २०६१ सालमा नेपाल सरकारको अनुरोधमा जापान अन्तर्राष्ट्रिय सहयोग नियोग (जाईका) ले आयोजनाको स्तरबृद्धिको लागि प्राविधिक अध्ययन २०६२ सालमा गरेको थियो । जाइका अध्ययन टोलिले वातावरणीय अध्ययन समेत गरेको थियो ।

प्रस्तावित माथिल्लो सेती ज.वि.आ.को वातावरणीय प्रभाव मूल्यांकन प्रतिवेदन नेपाल विद्युत प्राधिकरण अन्तर्गत स्थापित वातावरण तथा सामाजिक अध्ययन विभागले तयार गरेको हो र यसमा जाइका अध्ययन टोलिबाट औल्याईएका वातावरणीय संवालहरु समेतलाई समावेश गरिएको छ । प्रतिवेदन तयारीको सन्दर्भमा वातावरण संरक्षण ऐन २०५३, वातावरण संरक्षण नियमावली २०५४ र जाइका निर्देशिकालाई प्रमुख आधार बनाईएको छ ।

वातावरण तथा सामाजिक अध्ययन विभाग वातावरणीय प्रभाव मूल्यांकन अध्ययनको सन्दर्भमा पूर्ण जिम्मेवार छ । जलविद्युत आयोजना संग सम्बन्धीत वातावरण तथा सामाजिक अध्ययनको अनुभव र दक्षता वातावरण तथा सामाजिक अध्ययन विभागमा रहेको छ । सन् १९८७ देखी वातावरणीय ईकाइ बाट यसले वातावरणीय अध्ययनको कार्यको थालनी गरेको हो । हाल यो विभाग व्यापारिक ईकाइको रुपमा स्थापित छ । यसले अन्तर्राष्ट्रिय दातृ निकायहरूसंग मिलेर जलविद्युत तथा प्रसारण लाइनको क्षेत्रमा वातावरणीय प्रभाव मूल्यांकन, प्रारम्भिक वातावरणीय परिक्षण, उत्पीडित समुदाय विकास कार्यक्रम र अधिग्रहण तथा क्षतिपूर्ति एवं पुर्नस्थापना कार्यक्रम सम्बन्धी कार्य गर्दै आएको छ ।

जाइका अध्ययन टोलिमा विद्युत ऊर्जा विकास कम्पनी र निप्पन कोइको सहभागिता थियो । निप्पन कोइ बहुआयामीक ईन्जिनियरिङ्ग तथा व्यवस्थापन परामर्शदातृ संस्था हो जसको केन्द्रिय कार्यालय जापानको टोकियोमा छ । यस कम्पनीबाट अध्ययनमा संलग्न सम्बन्धीत प्रतिनिधिहरुको ज्ञान र अनुभव पनि विभिन्न विकासमूलक कार्यको लागि पर्याप्त छ । निप्पन कोइ कार्यालयको स्थापना सन् १९७४ मा काठमाडौँमा भएको थियो । त्यसपछि यसले विभिन्न विकास कार्यमा संलग्न हुदै आइरहेको छ । यसै गरी विद्युत ऊर्जा विकास एक ईन्जिनियरिङ्ग कम्पनी हो र यसमा ऊर्जा क्षेत्र संग सम्बन्धित विषयका विज्ञहरु कार्यरत छन् । यसको केन्द्रीय कार्यालय जापानको टोकियोमा छ ।

२. आयोजनाको विवरण

प्रस्तावित जलाशययुक्त आयोजनाको १४० मी. अग्लो कंक्रीट ग्राभिटि बाँध बनाइने छ । जसको उचाई समुद्र सतहदेखी ४१५ मी. हुने र ७.२६ बर्ग कि.मी. क्षेत्रफलमा फैलने छ । यसै गरी २९,५१,००,०००- घन मी. पानी, एउटा सतहि इन्टेक ९२७ लामो सुरुङ्ग, १९५



म. लामो पेनस्टक र २ x ६४ मेगावाटको फ्रान्सीस टर्बाइन र भूमीगत विद्युतगृह बनाइने छ । सेती र मादी नदीको दोभान देखी बांध आवत जावत गर्न ३ कि.मी. सडक बनाइनेछ ।

३. अध्ययन विधि

वातावरणीय प्रभाव मूल्यांकन कार्य प्रक्रिया वातावरण संरक्षण ऐन २०५३ तथा वातावरण संरक्षण नियमावली २०५४, एवं राष्ट्रिय वातावरणीय प्रभाव मूल्यांकन सम्बन्धि राष्ट्रिय निर्देशिका १९९३ अवलम्बन गरी गरिएको छ । यो वातावरणीय प्रभाव मूल्यांकन नेपाल सरकारको कानूनी आवश्यकता पुरा गर्न स्थलगत अध्ययन, स्थानीय जनता तथा निकायसंग समन्वय गरी तयार गरिएको हो । माथिल्लो सेती जलाशययुक्त ज.वि.आ.को स्तरबृद्धि संभाव्यता अध्ययन का लागि जाइकाले प्राविधिक सहयोग व्यवस्थापन गरेको थियो ।

३.१. क्षेत्र निर्धारण तथा कार्यसूची

वातावरणीय प्रभाव मूल्यांकन को लागि क्षेत्रनिर्धारण सम्बन्धि कार्य २०५९ सालमा प्रमुख वातावरणीय सवालहरूको पहिचान तथा सम्बन्धित सरोकारवालाहरूसंग आयोजना बारे सल्लाह, सुझाव र प्रतिक्रिया लिईएको थियो । स्थलगत अध्ययन भ्रमणको अवसरमा स्थानीय सरोकारवालाहरूसंग छलफल गरि तयार गरिएको क्षेत्र निर्धारण तथा कार्यसूची तत्कालीन जनसंख्या तथा वातावरण मन्त्रालयले २०५९।९।२२ मा स्वीकृत गरेको थियो ।

३.२ आयोजना प्रभावित क्षेत्र

पश्चिमाञ्चल विकास क्षेत्रको तनहुँ जिल्ला स्थित १२७ मेगावाट को माथिल्लो सेती जलाशययुक्त ज.वि.आ. को बांधको उचाई १४० मी. रहेको छ । करिब ७.२६ वर्ग कि.मि. जलाशय रहने यस आयोजनाको भूमीगत विद्युतगृह काहुशिवपुर गा.वि.स. को कुनौटेमा हुनेछ ।

प्रस्तावित आयोजनाले तनहुँ जिल्लाको ८ गा.वि.स. र १ न.पा. क्षेत्रको करिब ३८७.५३ व.कि.मि. क्षेत्रफल ओगटेको छ । आयोजनाबाट प्रभावित भीमाद, छाड, जामुन्ने, कोटदरवार, काहु शिवपुर, रिसिङ रानीपोखरी, माझकोट, पोखरी भञ्ज्यांग गा.वि.स. र ब्यास न.पा. पर्दछन् । यस मध्ये पोखरी भञ्ज्यांग गा.वि.स. तल्लो तटिय प्रभावित क्षेत्र भित्र पर्दछ ।

३.३ आधारभूत तथ्यांक संकलन

स्थलगत अध्ययन कार्य पूर्व वातावरणीय प्रभाव मूल्यांकन अध्ययनको सन्दर्भमा सम्बन्धित विभिन्न सन्दर्भ सामग्रीहरू संकलन गरी पुनरावलोकन गरियो । अद्यावधिक सूचना स्रोतबाट हावापानी, जलाधार तथा भौगर्भिक सम्बन्धि सन्दर्भ सामग्री तथा तथ्यांक संकलन गरिएको थियो । केन्द्रिय तथ्यांक विभाग तथा अन्य सरकारी तथा गैर सरकारी निकायहरूबाट प्रकाशित सामाजिक, आर्थिक तथा सांस्कृतिक वातावरण सम्बन्धि तथ्यांक तथा सूचनाहरू र आयोजनासंग मिल्दो जुल्दो अन्य आयोजनाको वातावरणीय प्रभाव मूल्यांकन प्रतिवेदनहरू समेत पुनरावलोकन गरियो ।

१:२५००० स्केलको भौगोलिक नक्शालाई आधार मनि प्रत्येक २० मि. को अन्तरालमा स्थलगत भ्रमण एवं अध्ययन गरिएको थियो । स्थलगत सर्भे कार्यको लागि जि.आई.एस. नक्शाको प्रयोग पनि गरिएको थियो । आयोजनाको जलाधार तथा भौगोलिक अवस्थाको

जानकारीका लागि जाइका अध्ययन टोलिको प्राविधिक समुहबाट संभाव्यता तथा स्तरवृद्धि संभाव्यता अध्ययन प्रतिवेदनका लागि सूचना प्राप्त गरिएको थियो । तनहुं जिल्ला स्थित आयोजना प्रभावित क्षेत्रको स्थलगत भ्रमण सम्बन्धित विज्ञहरु जस्तै: वातावरणीय इन्जिनियर, समाजशास्त्री, अर्थशास्त्री, जीवशास्त्री, भौ-गर्भिकशास्त्री, पुनर्वास सम्बन्धी विज्ञ तथा माछा विज्ञबाट भएको थियो ।

अध्ययनको क्रममा प्रभावित क्षेत्र जलाशय, बांध, विद्युतगृह प्रवेश मार्ग र-तल्लो तटिय क्षेत्रको पैदल यात्रा गरीएको थियो । भिरालो क्षेत्र, भू-क्षय तथा चट्टान खलन आदीको अध्ययन नक्शा तथा स्थलगत अवलोकनबाट गरिएको थियो । यसको अलावा २०६२ सालमा जाइका अध्ययन टोलीले स्तरवृद्धि संभाव्यता अध्ययन पनि गरेको थियो । अध्ययन भ्रमणको क्रममा वन सम्पदाको अवलोकन तथा मूल्यांकन गरिएको थियो । वन र वनस्पतिको विश्लेषण र जीवजन्तुको पहिचान गरियो । यसको साथै जाइका अध्ययन टोलीबाट पनि ६२५ वर्ग मिटर (२५ मी. x २५ मी.) वन क्षेत्रको छनौट गरी विश्लेषण गरेको थियो । आयोजना क्षेत्रमा प्रत्यक्ष रुपमा वन्यजन्तु, तिनीहरुको अवस्था र वासस्थानको सर्वेक्षण गरिएको थियो । साथै, अप्रत्यक्ष प्रभावहरुको पनि अवलोकन गरिएको थियो । स्थानीय व्यक्तिहरु बिचको छलफल र सूचनालाई आधार बनाईएको थियो ।

माछा तथा जलचर सम्बन्धि सर्वेक्षण वातावरणीय प्रभाव मूल्यांकन अध्ययनको सन्दर्भमा गरियो । माछाको प्रजाती, संख्या, बसाइसराई, वासस्थान सम्बन्धमा सूचना संकलन गरीएको थियो । साथै जाइका अध्ययन टोलिले पनि संभाव्यता अध्ययन चरणमा यस सम्बन्धी अध्ययन गरेको थियो ।

सामाजिक आर्थिक सर्वेक्षणको लागि जग्गाको नाप नक्शा सम्बन्धित नापी शाखाबाट प्राप्त गरिएको थियो भने जि.आइ.एस. नक्शा परामर्शदातृ संस्थाबाट लिईएको थियो । अध्ययनको क्रममा जग्गा सम्बन्धी विवरण नापी कार्यालय र मालपोत कार्यालयबाट प्राप्त गरिएको थियो ।

प्रभावित गा.वि.स. तथा न.पा. भित्र पर्ने घरधुरीको नमूना संकलन गरी प्रश्नावलीबाट आधारभूत सूचना लिइएको थियो । यस्तै गरी लक्षित समूहमा महिला, केटाकेटी र किसानलाई राखी छलफल गराई सर्वेक्षण गरिएको थियो । साथै अन्य जान्ने सुन्ने व्यक्तिहरुलाई समेत राखी छलफल गराई आधारभूत सूचना संकलन गरिएको थियो ।

३.४ जनसहभागिता

वातावरणीय प्रभाव मूल्यांकन अध्ययन चरणमा वातावरणीय अध्ययन टोलिले तनहुं जिल्लाका विभिन्न कार्यालयहरुको भ्रमण गरेको थियो । मूलतः व्यास न.पा., जि.वि.स., खानेपानी, सिंचाइ र कृषि कार्यालय अध्ययनको क्रममा समेटिएका थिए ।

तनहुं जिल्लाको व्यास न.पा.मा मिति २०६४।९।२० गते सार्वजनिक सुनुवाई कार्यक्रम गरिएको थियो । यस सम्बन्धि सूचना राष्ट्रिय दैनिक गो.प.मा समेत प्रकाशित गरिएको थियो । आयोजना बारे जानकारी दिन संक्षिप्त विवरण नेपाली भाषामा बनाई सहभागिहरुलाई वितरण गरिएको थियो ।

स्तरवृद्धि संभाव्यता अध्ययन चरणमा जाइका अध्ययन टोलिले स्थानीय जनताहरूसँग थप अन्तरक्रिया गरेको थियो भने जाइका निर्देशिका बमोजिम ३ पटक आयोजना क्षेत्रमा सरोकारवालाहरूको बैठक राखी छलफल गरीएको थियो । यस्तै बैठक काठमाडौँमा पनि आयोजना गरिएको थियो ।

४. अद्यावधिक वातावरणीय अवस्था

४.१ भौतिक वातावरण :

माथिल्लो सेती जलाशययुक्त ज.वि.आ. पश्चिमाञ्चल विकास क्षेत्र स्थित गण्डकी नदी क्षेत्रमा पर्दछ । यसको इन्टेक देखीको जलाधार क्षेत्र १५०२ वर्ग कि.मी. छ जसमा १२९ वर्ग कि.मी. हिउँ क्षेत्रमा पर्दछ । यस क्षेत्रमा हिम तालहरु पहिचान भएको छैन । यसको जलाधार क्षेत्रलाई भौगोलिक क्षेत्रको आधारमा माथिल्लो र तल्लो हिमाली क्षेत्र भनी छुट्टयाउन सकिन्छ । यद्यपी सेती नदीको जलाधार क्षेत्र प्रभावको हिसावले दीगो रुपमा पाइन्छ तर भिमाद बजार वान्टेन खोला जलाशय क्षेत्र भने कमजोर रुपमा रहेको छ ।

जलाशयको प्रमुख बांध खण्ड गल्छीमा रहने र नदीको दुवै किनार तर्फ भने जंगल रहेको पाइन्छ ।

आयोजनाको भूउपयोग मूलतः जङ्गल र उर्व र कृषि भूमी जलाशय क्षेत्रमा पर्दछ । प्रारम्भिक चरणको करिब ८ कि.मी. जलाशय क्षेत्र नदी किनारको गल्छी खण्डमा पर्दछ । यसपछि कृषि भूमीमा रिसिङ पाटन, साउने, भिमाद गाउँ का केहि फराकिलो खण्ड पर्दछ ।

सेतीको जलाधार क्षेत्र धेरै चिसो र समशितोष्ण हावापानी क्षेत्र अन्तर्गत परेको पाइन्छ । आयोजना क्षेत्रको अधिकतम तापक्रम २८.४ डिग्री सेल्सीयस र न्यूनतम १६.८ डिग्री सेल्सीयस सम्म छ । यस क्षेत्रमा सामान्यतया वर्षा जेष्ठ महिनाको अन्तिम हप्ताबाट शुरु हुन्छ ।

माथिल्लो सेती जलाशययुक्त ज.वि.आ. पश्चिम नेपालको तल्लो हिमालय खण्डको मध्य क्षेत्रमा पर्दछ । धादिङ्गको डोलोमाइट, वेनीघाटको स्लेट नोरपुल आदिको मिश्रित संरचनाले डोलोमाइट स्लेट, फिलाइट्स, क्वार्टजाइट, डोलोमाइट, क्वार्टजीट, आदीको मिश्रित प्रतिनिधित्व रहेको छ ।

४.२ जैविक वातावरण

(क) वनस्पति:

आयोजनाको भौगोलिक संरचनामा महाभारत श्रृंखला र मध्य भागमा पाइने विशेष प्रकारको वन र वनस्पति पाइन्छ । सेती नदीको दुवै किनारमा १००० मी. भन्दा कम उचाइका पहाडहरु पूर्व पश्चिम फैलिएका छन् । जसमा विभिन्न जातका वनस्पतिहरुको मिश्रित संरचना रहेको छ ।

सेती गल्छीको करिव १०० मी. माथि सालको जङ्गल पाइन्छ भने सेतीको तल्लो भागमा खर तथा अन्य मिश्रित खाले वनस्पती भेटिन्छन् । पहाडी साल यहाँ प्रशस्त पाइन्छ । यो करिव समुद्र सतह देखी ४०० मी. को उचाइमा रहेको पाइन्छ । यसको अलावा चिलाउने, वोटधएँरो, भोर्ला र सदन पनि मिश्रित रुपमा पाइन्छ ।

यसको साथसाथै मिश्रित खुला जङ्गल नदी किनारमा भेटिन्छन् । पहाडी जङ्गलको प्रतिनिधित्व गर्ने साज, सिन्धुरे, खिर्छो, बांस, वोटधएँरो, भोर्ला सदन आदी यस क्षेत्रको वनमा भेटिने प्रजातीहरु हुन । साथै खयर सेती नदीको किनारमा भेटिन्छन् भने सिमल, सिसौ, खिर्छो भने तल्लो तटिय क्षेत्रमा पाइन्छ । सिसौ मूलतः जङ्गली खयर संगै रोपिने विरुवाहरु हुन ।

आयोजना क्षेत्रमा ९ वटा सामुदायिक वन पर्दछन् । नीजि वन पनि आयोजना क्षेत्रमा पर्दछ । भिमाद र वांदरकुना विचको सेती जलाशयको माथिल्लो खण्डमा सिसौ र खयर पनि देखिन्छन् ।

कूल १०१ प्रजातीका वनस्पतिहरु यस क्षेत्रमा भेटिन्छन् । यहाँ पाईएका २०९ वनस्पती मध्ये ३ प्रजातीका वनस्पती नेपाल सरकारको संरक्षित वर्गमा पर्दछन् । यस्तै ५ प्रजाती साईटिस वर्ग र अर्को ६ प्रजाती भने आइयुसियन संरक्षित वर्गमा पर्दछन् ।

(ख) वन्यजन्तु

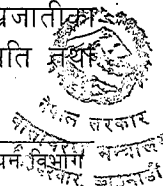
माथिल्लो सेती जलाशययुक्त ज.वि.आ. देशको मध्य पहाडी भौगोलिक क्षेत्रमा पर्दछ । जङ्गल भित्र स-साना गोरेटाहरु भएकाले यस क्षेत्रमा वन्यजन्तु प्रजातीमा विविधता पाईदैन । यद्यपी २७ प्रजातीका स्तनधारी वन्यजन्तु जनावर र ६२ जातीका चराचुरुङ्गी आयोजनाको स्थलगत सर्भेक्षण अवधिमा पाइयो । यस क्षेत्रका वन्यजन्तुमा मूलतः रातो बाँदर, ढेडु बाँदर, मलसांप्रो, स्याल, चितुवा, घोरल, वन विरालो, फ्याउरो, उड्ने लोखर्के, लोखर्के, हरिण, बाँदेल, दुम्सी आदी पाईन्छन् ।

अयोजना क्षेत्रमा नेपाल बाहिरबाट पनि केहि चराहरु आउने गरेको पाइन्छ । कोइली, जंगली काग, काठफोरुवा र कालीज आयोजना क्षेत्रका रैथाने चराहरु हुन । स्थलगत अध्ययन भ्रमणको सन्दर्भमा जङ्गली कौवा र रातो सिउंर भएको निलो जुरेली पनि देखियो ।

(ग) माछा र अन्य जलचर प्रणाली

वातावरणीय प्रभाव मूल्यांकन अध्ययनको सन्दर्भमा सेती नदीमा ३६ प्रजातीका माछाहरु पहिचान गरियो । यस अध्ययनले माछाको विविधता सेती नदीको तल्लो तटिय क्षेत्रमा अत्यधिक रुपमा रहेको देखाएको छ । कूल ३६ प्रजातीका माछाहरु मध्ये सेती नदीमा, ६ प्रजातीका लामो दूरी देखी बसाइ सरी आएका ६, प्रजाती मध्य दूरी देखी बसाइ सरी आएका र २३ प्रजातिका रैथाने माछाहरु पाईएका हुन ।

सेती नदीको विभिन्न ठाउँलाई स्टेशन बनाई गरीएको सर्भेक्षण अनुसार ३५ प्रजातीका फाइटोप्लाङ्कटन, १३ प्रजातीका जुप्लाङ्कटन र ३४ प्रजातीका कीरा जातका वनस्पति जीव भेटिएका थिए ।



४.३ सामाजिक, आर्थिक र सांस्कृतिक वातावरण

(क) परियोजनाबाट प्रभावित गा.वि.स. र नगरपालिकाको सामाजिक तथा आर्थिक अवस्था:-

माथिल्लो सेती जलाशययुक्त जलविद्युत परियोजनाबाट तनहुँ जिल्लाको आठ (८) गा.वि.स. र एक (१) नगरपालिका प्रभावित हुनेछन् । प्रभावित हुने गा.वि.स.हरुमा भीमाद, छांग, माभकोट, रिसिंग रानीपोखरी, कोटदरवार, जामुने, काहुँ शिवपुर र पोखरी भञ्ज्याङ्ग साथै व्यास नगरपालिका पर्दछन् ।

वि.सं. २०५८ सालको राष्ट्रिय जनगणना अनुसार यस क्षेत्रको जनसंख्या ८०,८८४ र घरपरिवार संख्या १६,१५२ रहेको छ । यस क्षेत्रको औषत परिवार सदस्य संख्या ५.० छ जुन समग्र जिल्लाको औषत परिवार सदस्य संख्यासंग मिल्दो जुल्दो छ । आठ गा.वि.स. र एक नगरपालिकाको जनघनत्व विच विविधता रहेको छ । व्यास नगरपालिकाको उच्च जनघनत्व छ भने काहुँ शिवपुर गा.वि.स.को निम्न जनघनत्व रहेको छ । व्यास नगरपालिका क्षेत्रमा ४०९ व्यक्ति प्रति वर्ग कि.मि. र काहुँ शिवपुर गा.वि.स.मा ९२ व्यक्ति प्रति वर्ग कि.मि. जनघनत्व रहेको छ ।

जातिगत संरचनाको दृष्टिकोणबाट अध्ययन गर्दा ब्राह्मण १४%, दलित १२%, क्षेत्री ८%, नेवार ९% र अन्य २१% रहेको देखिन्छ । जनसंख्याको सबभन्दा बढी हिस्सा रहेको मगर जाती यस क्षेत्रको मुख्य बहुसंख्यक जातिको रूपमा रहेको छ । यसको प्रतिशत ३६ रहेको छ ।

माथिल्लो सेती जलाशययुक्त जलविद्युत परियोजना क्षेत्रको बहुसंख्यक जनसंख्या हिन्दु धर्मावलम्बीहरु रहेका छन् । यसको अलावा बौद्ध, इस्लाम र क्रिश्चियन धर्म मान्नेको संख्या पनि रहेका छन् । यस क्षेत्रमा ९९.१% जनता हिन्दु, ७.८% बौद्ध, ०.७% इस्लाम र ०.१% जनता क्रिश्चियन धर्म मान्ने रहेको देखिन्छ । आयोजना प्रभावित गा.वि.स. र नगरपालिका क्षेत्रमा विशेषगरी हिन्दु र बौद्ध धर्मावलम्बीहरुको संख्या धेरै पाउन सकिन्छ । आयोजना प्रभावित क्षेत्र विशेषगरी व्यास नगरपालिकामा ८०% जनसंख्या इस्लाम धर्म मान्ने रहेका छन् भने पोखरी भञ्ज्याङ्ग, भीमाद, रानी पोखरी र व्यास नगरपालिका क्षेत्रमा क्रिश्चियन धर्म मान्ने मानिसहरु वसोवास गर्दछन् ।

आयोजना प्रभावित गा.वि.स. र नगरपालिका क्षेत्रमा १५१ वटा प्राथमिक विद्यालय, २० वटा निम्न माध्यमिक विद्यालय, ३५ वटा माध्यमिक विद्यालयहरु, दुइवटा उच्च माध्यमिक विद्यालय र तीनवटा विश्वविद्यालयबाट सम्बन्धन प्राप्त क्याम्पसहरु श्रोत केन्द्रको सुपरिवेक्षणमा सञ्चालित छन् । आयोजना प्रभावित गा.वि.स.हरुमा साक्षरता प्रतिशत कुल साक्षरताको ६१% रहेको छ ।

आयोजना क्षेत्र तनहुँ जिल्लाको दमौली स्थित व्यास नगरपालिकामा १५ शैयाको एक अस्पताल, एक प्राथमिक उपचार केन्द्र जुन भीमाद गा.वि.स.मा छ, जसमा तीन शैयाको सुविधा छ । त्यसै गरी आयोजना प्रभावित छांग गा.वि.स.को थारु भन्ने स्थानमा एउटा स्वास्थ्य चौकी संचालन भइरहेको छ । साथै अरु ६ वटा आयोजना प्रभावित गा.वि.स.हरुमा ६ वटा उप-स्वास्थ्य चौकीहरु सञ्चालित छन् ।

आयोजना प्रभावित गा.वि.स.हरुमा कुल जनसंख्याको ५२% ले मात्र धारावाट वितरित खानेपानी पिउने गर्दछन् । आयोजना प्रभावित गा.वि.स.हरुमा शुद्ध खानेपानीको अभाव ४८% जनताहरुमा र शौचालय सुविधाको अभाव ७७% जनताहरुमा रहेको पाइन्छ ।

यस आयोजनावाट प्रभावित गा.वि.स. हरूमा १३.३% जनताहरुले मात्र वस्तिको लागि विद्युत सेवा उपभोग गर्न पाएका छन् ।

ख) मुख्य आयोजना क्षेत्रको सामाजिक तथा आर्थिक अवस्था

आयोजनावाट प्रभावित भएका गा.वि.स.हरु र नगरपालिका क्षेत्रको सामाजिक, आर्थिक तथा सास्कृतिक अवस्थाको पहिचान गर्न नमूना छनौट विधिद्वारा ३९९ घरपरिवार छनौट गरी घरधनी सर्वेक्षण गरिएको थियो । यसमा जलाशयको ४२५ मी. उचाई भन्दा कम क्षेत्रमा जमिन भएका वा नभएका परिवारहरु समावेश गरिएका थिए । उक्त पारिवारिक सर्वेक्षणवाट विश्लेषण गर्दा ८०% घरपरिवारको नेतृत्व पुरुषले गरेका पाइयो । ३९९ घर परिवारको कुल जनसंख्या २८३९ रहेको पाइयो । यसमा औसत परिवार सदस्य संख्या ७.१ जुन आयोजना प्रभावित अन्य गा.वि.स.हरुको तुलनामा उच्च रहेको देखिन्छ ।

यस क्षेत्रमा मगर जातिले जनसंख्याको सबैभन्दा बढी हिस्सा (५१%) ओगटेको छ । साथै ब्राम्हण जातिले दोस्रो स्थान अर्थात् १५.७९, गुरुङ्ग जाति ८.५२% र दलित जाति ८.२५% रहेका छन् । यस क्षेत्रका बहुसंख्यक परिवारहरु, हिन्दु धर्म मान्ने गरेको पाइन्छ जुन कुल परिवार मध्ये ८६% देखिन्छ । त्यसैगरी बौद्ध धर्म मान्ने १४% र क्रिश्चियन धर्म मान्ने ०.३% परिवार छन् । बौद्ध धर्म र क्रिश्चियन धर्म मान्ने मानिसहरु विशेष गरि आदिवासी तथा जनजाती समुदायहरुमा पाइन्छन् ।

मुख्य आयोजना क्षेत्र अन्तर्गत नमूना छनौटमा परेको धेरै जनसंख्या (७९%) साक्षर रहेका छन् । नमूना छनौटमा परेको जनसंख्याको साक्षरता प्रतिशत, जिल्लाको समग्र साक्षरता प्रतिशत र आयोजना प्रभावित गा.वि.स. हरूको तुलनात्मक रुपमा निकै राम्रो देखिन्छ । जिल्लाको साक्षरता ७१% र आयोजना प्रभावित गा.वि.स. हरूको साक्षरता ६९% मात्र रहेको छ ।

सर्वेक्षण गरिएको क्षेत्रहरुमा बहुसंख्यक घरपरिवारहरुले (८५%) पाईपद्वारा वितरित खानेपानी प्रयोग गरेका छन् भने १४% घरपरिवारले पिउने पानीको लागि कुवा तथा पोखरी धाउने गरेको र एक प्रतिशतले पानीको मुहान धाउने गर्दछन् । नमूना छनौटमा परेका ६०% भन्दा बढी घर परिवारले विद्युत सेवा उपभोग गरेका छन् भने ४३% परिवारले वस्ति वालको लागि मट्टीतेल प्रयोग गर्ने गर्दछन् ।

नमूना छनौटमा परेको अधिकांश घरपरिवारहरुले मुख्य पेशाको रुपमा कृषिलाई नै अगालेको पाइन्छ । कृषिमा आश्रित घरपरिवार सदस्यहरु ५६% रहेका छन् । त्यसैगरी नोकरी (सेवा तर्फ) १५%, व्यापार तर्फ १३% लागेका छन् । सर्वेक्षण गरिएका घर परिवारमा औषत रुपमा ०.६८५ हेक्टर जमिन पर्न आउँछ ।

आयोजना प्रभावित क्षेत्रका ७८% जनसंख्या आफ्नो जमिनवाट उत्पादित खाद्यान्न अपुग भई खाद्यान्न संकटमा परेको पाइन्छ । यसरी खाद्य संकटमा पर्ने धेरै जसो दलित जाति र महिलाद्वारा नेतृत्व गरिएका परिवारहरु पर्दछन् ।



सर्वेक्षण गरिएका घरपरिवारहरूको वार्षिक आम्दानीलाई विप्लेषण गर्दा औषत रु. १८५,३६४ पर्न आउँदछ, जुन जिल्लाको समग्र औषत आम्दानी भन्दा बढी देखिन्छ। वार्षिक खर्चको विप्लेषण गर्दा औषत रु. ११९,५११ देखिन आउँछ। यसरी गरिने खर्चहरूमा खाद्यसामग्रीका लागि ५७.९१%, स्वास्थ्य तथा शिक्षामा १३.१९% यातायात तथा सांस्कृतिक, धार्मिक क्रियाकलापहरूमा ९.२२% लत्ता कपडामा ७.३४% र इन्धनमा ६.८२% देखिन्छ। यसरी हुने औषत खर्च ब्राह्मण/क्षेत्री सामुदायहरूमा बढी देखिन आउँछ।

५. प्रभाव मूल्यांकन

५.१. भौतिक वातावरण

भौतिक वातावरणसंग सम्बन्धित प्रमुख प्रभावहरू जमिन संग सम्बन्धित रहेका छन्। जलाशयबाट प्रभावित परिवारको पुनर्स्थापना, जमिनको भिरालोपन स्थायित्वमा परिवर्तन, पानीको वहाव र ढल निकास परियोजनाले पार्ने मुख्य प्रभावहरू हुन्। वान्तेन खोला र फेदि खोलाको छेउछाउ र जलाशय वरिपरी हुने भुक्षयले मुख्यतया: भिमफेदी वजारमा असर गर्न सक्दछ।

परियोजनाको मुख्य नकारात्मक असर पानीको वहावमा आधारित हुनेछ। पानीको वहाव भौगोलिक संरचनाको प्रक्रियासंग अति संवेदनसिल हुन्छ। नयाँ वन्ने जलाशय ७.२६ वर्ग कि.मी. र लगभग १८ कि.मी. लम्वाई हुनेछ।

आयोजनाको सम्पूर्ण संरचना निर्माणको लागि करिब १०३४ हेक्टर जमिन आवश्यक पर्नेछ। जलाशय क्षेत्र वरिपरि मुख्यतः सामान्य जंगल र कृषियोग्य जमिन छ। तर उक्त जलाशय लगभग १८ कि.मी. गहिरिएर वगेको सेती नदीको ७२६ हेक्टरमा फैलिएको हुनाले त्यहाँहुन सक्ने स्थानिय सुक्ष्म हावापानीमा असर पर्न सक्दछ। जलाशयबाट हुनसक्ने पानीको वाष्पिकरणले हावापानी हुने आद्रता बढन सक्ने र यसको असर गृष्म ऋतुको औषत अधिकतम तापक्रम बढन सक्ने र जलाशयको नजिको क्षेत्रमा औषत तापक्रमको मात्रा बढन सक्नेछ। जब रात्रिको समय हुन्छ जलाशय र वरिपरिको भिरालो क्षेत्रमा मुख्यतः तापक्रम बढने तथा हुस्सु र कुहिरो देखा पर्नेछ।

परियोजना सञ्चालनले मुख्यतया २ कि.मी. सम्म गहिरिएर वगेको मादी र मादी नदीको दोभानसम्म असर पुग्नेछ। तैपनि मध्यम गतिमा वग्ने मादी नदीको औसत गति १४ कि.मी. प्रति सेकेण्डको गतिमा वहने सेती नदिसंग जोडिएको छ जुन २ कि.मी. तल बाँध सम्म वगिरहेको छ।

यसका अलवा जलाशयले पानीको गुणस्तरमा पनि असर गर्नेछ। तर परियोजना मौसमी जलाशय हुनाले बाँध क्षेत्र नजिक १४० मिटर गहिरो हुने हुनाले पानीको गुणस्तरमा अझ बढी नै असर गर्ने देखिन्छ।

तापक्रम समकिरण र Eutrophication ले जलाशयमा असर गर्ने देखिन्छ। Eutrophication को असर विश्लेषण गर्न Vollenweider Model प्रयोग गरिएको थियो। जुन प्रारम्भिक Eutrophication को मात्रा निकाल्ने Eutrophication को संभाव्यता सावित गर्नेको लागि प्रयोग भएको देखिन्छ।

५.२. जैविक वातावरण

यो परियोजना कार्यान्वयन गर्दा त्यस क्षेत्रको करिव गर्नाले वरिपरीको ४२२ हेक्टर वन फडानीले गर्दा प्राकृतिक बोट विरुवा क्षति हुन्छ । आयोजनाको लागि आवश्यक पर्ने जमिन अन्तर्गत निर्माण क्षेत्र र अर्धडुवनामा रहने जलाशय क्षेत्र पनि रहने छ । निर्माणमा संलग्न व्यक्तिहरुको वैकल्पिक उर्जाको रूपमा इन्धन प्रयाप्त नभए काठ र दाउरामा चाप पर्न जानेछ । यो परियोजनाको मुख्य असर हो ।

आयोजनावाट २९६.०५ हेक्टर क्षेत्रमा रहेको मिश्रित कडा काठको खुला जंगल पनि प्रभावित हुनेछ । त्यसै गरी ७३.९२ हेक्टरमा रहेको पहाडी सालको जंगल र ५२.६२ हेक्टरमा रहेको खयर र सिसौको जंगल प्रभावित हुन्छ ।

साइटिसको अनुसूची २ पर्ने गिठ्ठा पनि परियोजनाको क्षेत्रमा उल्लेख गरिएको छ । त्यसै गरी साल, खयर र सिमल व्यापारिक प्रयोजनका लागि कटानी गर्न नेपाल सरकारको वन निती २०५० ले प्रतिबन्धित गरेको छ ती पनि यहाँ पाइन्छन् ।

परियोजनाको कार्यान्वयनवाट दुर्लभ प्रजातिका टप्टेलो र छतिवन पनि प्रभावित हुन सक्नेछन् ।

परियोजना निर्माण अवधिमा जंगली वन्यजन्तुहरुको प्राकृतिक वासस्थान पनि लोप हुन सक्नेछ । परियोजना स्थलमा पाईने वन्य जन्तुहरु जस्तै *Panthera pardus*, *Presbytes entellus* र *Nemorheadus goral* CITES अनुसूची १ मा समावेश गरिएको छ भने *Macaca mulata* *Felis chaus* अनुसूची २ मा समावेश गरिएका छन । त्यसै गरी *Vulpes bengolensis*, *Martin flovigula* र *Cansis aerus* CITES को अनुसूची ३ मा समावेश गरिएका छन । ती सबै प्रजातिहरु NRDB Status अनुसार *Suscptible categories* अन्तर्गत पर्दछन ।

माथिल्लो सेती जलाशययुक्त जलविद्युत परियोजनाको निर्माण तथा संचालन कार्य गर्दा स्थानिय रूपमा उपलब्ध माछाका प्रजातिहरुमा केही प्रभाव पर्ने देखिन्छ । परियोजना कार्यान्वयनवाट ७.२६ वर्ग किलोमिटर नदि आसपासको वासस्थान डुवानमा पर्नेछ । माछाको आवागमनमा बाधा पुग्नको साथै बाँध स्थलवाट २ कि.मी. तलको भागमा पानीको वहाव कम हुन जानेछ । कुनै निश्चित ठाँउवाट वढी भागमा boulders हरु हटाउँदा माछाको वासस्थानमा असर पर्नेछ । उनीहरुको उपल्लो तटीय क्षेत्रसंगको आवागमनमा बाधा पर्नेछ र माछा मार्ने कार्य तिब्र हुन सक्नेछ ।

नदीको सतहवाट १४० मिटर अग्लो बाँध निर्माण गर्नाले लामो दुरी र मध्यम दुरीमा आवतजावत गर्ने प्रजातिहरुको आवागमनमा बाधा पुग्नेछ । Mid Range Migratory Fish, जो वयस्क अवस्थामा नदिको मध्य र तल्लो तटिय क्षेत्रमा रहन्छन र प्रजननका लागि माथिल्लो भागमा जाने गर्दछन तिनीहरुको पनि Spawning र Fry को Growth Area मा सिमीतता हुने हुनाले नकारात्मक प्रभाव पर्न सक्छन । पानीको गुणस्तरमा आउने परिवर्तनले गर्दा पनि वयस्क माछाहरुको वासस्थानमा भन्दा Spawning र Nursery Ground मा बढि प्रभाव पर्नेछ ।

५.३ सामाजिक आर्थिक र सांस्कृतिक वातावरण

माथिल्लो सेती जलशाययुक्त जलविद्युत आयोजना कार्यान्वयनवाट पर्न सक्ने मुख्य सामाजिक, आर्थिक तथा सांस्कृतिक प्रभावहरु, आयोजना निर्माण र सन्चालनको चरणमा विशेषगरी जलशाययुक्त जलविद्युत आयोजनाहरु सञ्चालन भएका स्थलहरुमा कृषिलाई मुख्य आर्थिक गतिविधिहरुको रुपमा र संस्कृतिलाई परम्परागत विचार र आस्थाको रुपमा लिएको पाईन्छ । तसर्थ: यस आयोजनावाट सामाजिक आर्थिक तथा सांस्कृतिक वातावरणीय क्षेत्रमा निम्न उल्लेखित प्रभावहरु देखिन्छन् ।

- जनसंख्या पुनर्स्थापन कार्य
- पानी, काठदाउरा, खेती योग्य जमिन आदी सामुदायिक श्रोतहरु माथि दबाव
- आयोजना सञ्चालन र निर्माण चरण, शिविर निर्माण कार्य जस्ता क्रियाकलापवाट वातावरण प्रदुषण, स्वास्थ्य तथा सरसफाईमा समस्या तथा पानीको गुणस्तरमा हास ।
- पुनर्स्थापना भै वृद्धि भएको जनसंख्याका कारण अवैध एवं गैर कानुनी क्रियाकलापमा वृद्धि, यस्ता क्रियाकलापहरुमा माछा मार्ने, जंगलमा शिकार खेल्ने तथा रुख कटान गर्ने आदि ।
- स्थानिय समुदायमा परम्परागत देखि चलिआएको धर्म संस्कृती माथि बाह्य दबाव ।
- आयोजना निर्माण र सन्चालनको चरणमा आएको जनशक्ति वृद्धिले सामाजिक संरचनाहरुको निर्माणमा वृद्धि र न्युन जनघनत्व भएको क्षेत्रमा जनसंख्याको चाप ।

यस आयोजनावाट १५१ २२ हेक्टर उत्पादनशिल कृषि भूमी प्रभावित हुनेछ । जुन परियोजनाको कूल जग्गा जमिनको १५% हुन आउँछ । यो परियोजना कार्यान्वयनवाट वार्षिक ६६० मे. टन अन्न उत्पादन नष्ट हुने अनुमान छ । आयोजना प्रभावित क्षेत्रमा औषत धानवाली उत्पादन प्रति हेक्टर ३.१५ मे.टन हुने अनुमान गर्न सकिन्छ । आयोजना कार्यान्वयनवाट कूल वार्षिक उत्पादनको करिव ४३% अन्न नष्ट हुने देखिन्छ । आयोजना क्षेत्रका अधिकांश लक्षित जनताहरु कृषि क्षेत्रमा नै संलग्न रहेका छन तसर्थ आयोजनावाट प्रत्यक्ष प्रभाव यिनीहरुको जिविकापार्जनमा पनि पर्न जानेछ ।

आयोजनावाट प्रभावित स्थानिय निजी जग्गा धनीको संख्या जम्मा ८३८ हुनेछ भने पुन-स्थापन गरिने परिवारहरुको संख्या ८६ रहने छ । आयोजना कार्यान्वयन गर्नुपर्दा यिनीहरुलाई पुनर्स्थापन गरिनेछ ।

आयोजना कार्यान्वयन पश्चात प्रत्यक्ष अप्रत्यक्ष रोजगारिमा वृद्धि, नयाँ रोजगारिको सिर्जना, नयाँ सेवा सुविधिहरुसंग परिचित, ग्रामिण विद्युतिकरण सेवा तथा अरु सामाजिक सेवाहरुको महत्व र विस्तार हुनेछ ।

६. वैकल्पिक अध्ययन

माथिल्लो सेती जलशाययुक्त जलविद्युत आयोजनाको वातावरणीय प्रभाव मूल्यांकन र सम्भाव्यता अध्ययन प्रक्रियाको चरणमा तुलनात्मक वैकल्पिक परियोजना रणनितिहरु,

आयोजना क्षेत्रको अवस्था, आवश्यक सुविधाहरु, प्रविधिहरु र आयोजनाको ढाँचाको विषयमा अध्ययन गरिएको थियो । प्राविधिक र वातावरणीय अध्ययन समूह बीच छलफल गरी प्रस्ताव गरिएका यी विकल्पहरु स्थलगत अवस्था र प्रयोगात्मक क्षेत्रसंग सम्बन्धित थिए । यो अध्ययन टोलीले दिएका विकल्पहरु निम्न अनुसार थिए ।

- परियोजनाका मुख्य संरचनाहरुको लागि उपयुक्त क्षेत्र र ढाँचा (वांघको उचाई, लम्बाई, चौडाई आदि)
- विद्युत गृह निर्माणको लागि उपयुक्त क्षेत्रहरु
- शिविर निर्माण गर्ने उपयुक्त स्थलहरु
- परियोजनाको विकल्प नरहेको अवस्था ।

जापान अन्तराष्ट्रिय सहयोग नियोग (जाईका) अध्ययन टोलीले सम्भाव्यता अध्ययनलाई स्तरवृद्धि गर्ने चरणमा यो परियोजनासंग सम्बन्धित विषयमा वैकल्पिक अध्ययन गरेको थियो । यस अध्ययनमा दुई किसिमका विकल्पहरु अध्ययन टोलीले दिएका थिए । (१) आयोजनाका लागि आवश्यक पर्ने सुविधाहरु जस्तो विद्युतगृह, पानी, जमिन मुनिको वाटो (सब वे) आदि निर्माणको लागि उपयुक्त स्थान छनौट गरि यसको ढाँचा निर्धारण गर्नु । (२) जलाशय क्षेत्रको तुलनात्मक रूपमा पूर्ण जलसतह अध्ययन गरी उपयुक्त जलसतह छान्ने । यो अध्ययन सामाजिक, आर्थिक, वित्तीय, प्राविधिक एवं वातावरणीय पक्ष संग सम्बन्धित थिए ।

७.० न्युनिकरणका उपायहरु

७.१ भौतिक वातावरण

जलाशययुक्त किसिमको जलविद्युत परियोजनाको प्रमुख प्रभाव भूमी डुवान संग सम्बन्धित हुन्छ । यसको न्युनिकरणको उपाय भनेको यथासम्भव थोरै जमिन डुवानमा पार्नु पर्ने हुन्छ । निर्माण अवधिमा हुन सक्ने प्रभावहरु जस्तै: भू-क्षय, पहिरो न्युनिकरणका लागि वायो ईन्जिनियरिङ्ग पद्धतिका साथै नियन्त्रित पानीको निकास र फोहोरको उचित व्यवस्थापन गरिनेछ । अन्य उपायहरुमा निर्माण अवधिमा निस्किएको फोहोरको समुचित प्रयोग र व्यवस्थापनका साथै borrow pits हरुको उचित ठाउँमा निर्माण गर्ने र राम्रो व्यवस्थापन अवलम्बन गरिनेछ । तर सेती किनारको जलाशयको २७.८ मी. अग्लो पानीको सतहबाट पर्न जान सक्ने प्रभावहरुलाई न्युनिकरण गर्न धेरै कठिनाई पर्न सक्दछ । जसको लागि जलाधार व्यवस्थापनका कार्यहरु गरिनेछ । जुन Enhancement Measures अन्तर्गत उल्लेख गरिएको छ । जलाधार व्यवस्थापन अन्तर्गत निम्न लिखित कार्यहरु गरिनेछन्:

- भू-क्षय नियन्त्रण र जलाशयमा हुने Sedimentation को समस्यालाई कम गर्नको लागि वृक्षारोपण गरिनेछ । साथै Tributaries वाट जानसक्ने Sediment लाई कम गर्नको लागि Check Dam निर्माण गरिनेछ ।
- विभिन्न सम्बेदनशील क्षेत्रहरु जस्तै भिमाद बजार, रिसिङ्ग पाटन, जरुवापानी र पहिरो जान सक्ने पहुँच मार्गका विभिन्न क्षेत्रहरुमा टेवा पर्खाल, जमिन पर्खाल निर्माण गर्न सकिनेछ । अन्य स्थलहरुमा आवश्यकता अनुसार Catch Drain र Sub-surface Drain निर्माण गरिनेछ । जसले गर्दा सतह पानी जम्म गरी Divert हुनेछ र सम्भावित पहिरोको जोखिममा रहेका Gullies हरुको सन्तुलन गरिनेछ ।

- बाधको तल्लो तटिय क्षेत्रमा २.४ घ.मी प्रति सेकेण्ड (औषत बहावको १०%) पानी छोडिनेछ जसले गर्दा नदीमा पानीको बहाव कम भई जलचरहरुलाई पर्न जाने नकारात्मक प्रभावलाई न्यूनिकरण गरिनेछ । साथै यस प्रभावलाई मादी खोलाबाट आउने १४ घ.मी. प्रति सेकेण्ड पानीको बहावले पनि निराकरण गर्नेछ ।

७.२ जैविक वातावरण

माथिल्लो सेती जलाशययुक्त परियोजनाको निर्माण कार्य र सञ्चालनबाट जैविक वातावरणमा पर्न सक्ने नकारात्मक प्रभावलाई न्यूनिकरण गर्नका लागि निम्न उल्लेखित न्यूनिकरणका उपायहरु अवलम्बन गरिनेछः

- क्षतिग्रस्त भिरालो जमिनमा बोटविरुवाहरुको वृक्षरोपण गरिनेछ ।
- सकेसम्म कम जंगल फडानी गरिनेछ र त्यसमा पुनः बोटविरुवा लगाइनेछ ।
- वन सम्पदाको संरक्षण गरिनेछ ।
- सामुदायिक वन सहयोग कार्यक्रम सञ्चालन गरिनेछ ।
- वन्यजन्तुको चोरी शिकारी कार्यको नियन्त्रण गरिनेछ ।
- संरक्षणका लागि वातावरणीय चेतनाका कार्यक्रमहरु सञ्चालन गरिनेछन् ।

वन विभागले सन् २००६ मा प्रकाशित गरेको “जङ्गल क्षेत्र र सो क्षेत्रको जमिन प्रयोग गर्ने वारेको निर्देशिक” (Guidelines for Utilization of Forest Land and Other Land Use) अनुसार १ रुख फडानीको अनुपातमा २५ वटा नयाँ रुख रोप्नु पर्ने प्रावधान रहेको छ । यस परियोजनाबाट लगभग १६०,००० रुख प्रभावित हुनेछन् र जसको सट्टामा ४० लाख विरुवा वृक्षारोपणको लागि आवश्यक पर्नेछन् । यो संख्या प्रभावित क्षेत्रहरुमा रहेका रुखहरुको विस्तृत अध्ययन पछि परिमार्जन हुन सक्नेछ ।

परियोजना क्षेत्रमा वन्यजन्तुको अवैध शिकार हुन सक्ने कार्यलाई कडाइका साथ नियन्त्रण गर्नका लागि टेन्डर दस्तावेज (Contract दस्तावेज) मा उचित बुँदाहरुको समावेश गरिनेछ । ठेकेदारलाई परियोजना स्थलको विभिन्न ठाँउहरुमा त्यहाँ उपलब्ध वन्यजन्तुहरुको वारेमा जानकारी र सचेतना सम्बन्धि बोर्डहरु राख्न सुझाव गरिनेछ ।

नकारात्मक असर कम गर्नका लागि सुझाव गरिएका न्यूनिकरणका उपायहरु यस प्रकार छन्ः निस्किएको फोहरको उचित व्यवस्थापन योजना, २.४ m³/s का दरले riparian release, माछा पोखरीको निर्माण र संचालन, Fish trapping and lauling program र पानीको गुणस्तर कायम राख्न उपायहरु रैथने र बाहिरबाट आएका माछाहरुमा कम प्रतिकूल प्रभाव पार्नको लागि open water stocking र fish culture लाई प्रोत्साहित गरिनेछ । स्थानिय माछिहरुको लागि तालिमको आयोजना गरिनुका साथै वातावरणीय चेतना सम्बन्धि कार्यक्रम लागु गरिनेछ । उनीहरुलाई व्यवसायको लागि कृषि सापटीको पनि व्यवस्था गरिनेछ ।

७.३ सामाजिक, आर्थिक र सांस्कृतिक वातावरण

सामाजिक न्यूनिकरण कार्यक्रम आयोजनाको निम्न तीन चरणमा कार्य योजना पारुप तयार पारी सम्पन्न गरिने छ ।

- परियोजनाको संरचना निर्माण गर्नु पूर्व
- परियोजनाको संरचना निर्माण गर्ने चरणमा
- परियोजना निर्माण कार्य तिव्र भएको चरणमा

प्रचलित नियम कानून, नेपालका अन्य जलविद्युत आयोजनाहरूको अध्ययन, सरोकारवालाहरूसंगको बैठकबाट प्राप्त सूचना, स्थानिय बजार मूल्य, आयोजना क्षेत्रको स्थलगत निरीक्षणका आधारमा वातावरणीय समूहद्वारा क्षतिपूर्ति कार्य प्रणाली, पुनर्वास योजना र सामाजिक न्यूनिकरण योजनाको पारुप तयार पारि निम्न तरिकाद्वारा उपलब्ध गराइनेछ।

- नगद क्षतिपूर्ति,
- जग्गाको सट्टा जग्गा र घरको सट्टा घर क्षतिपूर्ति

यसरी वितरण गरिने क्षतिपूर्तिको लागि एउटा निष्पक्ष क्षतिपूर्ति निर्धारण समिती गठन गरिनेछ। यो समितीले आयोजनाबाट प्रत्यक्ष प्रभावित घरपरिवार, व्यक्ति, जमिन, चलअचल सम्पत्ति, चौपाया, अन्नवाली तथा सामुदायिक क्षेत्रहरू कसलाई के कति, कसरी क्षतिपूर्ति उपलब्ध गराउनु पर्ने सो को निर्णय गर्ने अधिकार हुनेछ। यसरी उपलब्ध गराइने क्षतिपूर्ति जग्गा प्राप्ती सम्बन्धी निर्देशिका २०४५ ले दिएको अधिकार प्रयोग गरि सो को आधारमा वितरण तथा पुनर्वासको व्यवस्था मिलाइने छ। सामाजिक तथा आर्थिक पक्षलाई दिगो बनाई राख्न नगद क्षतिपूर्ति वितरण कार्य पनि प्रस्ताव गरिएका छन्। यस्तो कार्य विशेष गरी दुई किसिमबाट गरिएका छन्। जस्तो एक पटक क्षतिपूर्ति र पटक/पटक क्षतिपूर्ति। एक पटक क्षतिपूर्तिको व्यवस्था त्यस्ता व्यक्तिलाई उपलब्ध गराइनेछ, जसको थोरै जग्गा मात्र आयोजनाबाट क्षति भएको छ र ऊ केहि रकम आफ्नो आम्दानी वढाउने अरु व्यवसायमा लागानी गर्न ईच्छुक छ, लाई उपलब्ध गराइने छ। त्यसै गरि पटक/पटकको क्षतिपूर्ति आयोजनाबाट घरजग्गा नष्ट भएको र त्यसलाई अर्को स्थानमा पुनर्वास गर्नु परेमा यस्तो पटक-पटक क्षतिपूर्ति दिइने छ।

आयोजना निर्माण कार्य थालनी गर्नु अगाडि प्रत्यक्ष प्रभावित भई भत्काईएका र डुवानमा परेका भौतिक संरचनाहरू र अन्य सामुदायिक संरचनाहरू निर्माण गरिनेछ। यसरी निर्माण गरिने संरचनाहरू नेपाल सरकारका स्थानिय निकायहरू जस्तो जिल्ला विकास समिती, उपभोक्ता वितरण सेवा, नेपाल विद्युत प्राधिकरण आदी बीचमा समन्वय गरी उपयुक्त संरचना, उपयुक्त स्थानका लागि निर्माण गरिने छ।

८.० वातावरणीय व्यवस्थापन योजना

माथिल्लो सेती जलशाययुक्त जलविद्युत आयोजनासंग सवै वातावरणीय पक्षलाई एकिकृत गर्दै लैजान परियोजना क्षेत्रमा एउटा छुट्टै सामाजिक तथा वातावरणीय अनुगमन इकाई गठन गरिने छ। यस इकाईले वातावरणीय अध्ययन प्रतिवेदनले सिफारिस गरेको न्यूनिकरण तथा कार्यान्वयन भए नभएको अध्ययन गर्नेछ। यसले जनसरोकारवालाहरूलाई प्रगति र असर विषयमा पनि जानकारी दिनेछ। प्रस्तावित सामाजिक तथा वातावरणीय अनुगमन इकाईलाई दुई वटा सहायक इकाईको रूपमा विकसित गराई सोही अनुरूप कार्य विभाजन गरिने छ। प्रस्तावित सामाजिक तथा वातावरणीय अनुगमन इकाईलाई दुई भागमा विभाजन गरी कार्य गर्न जिम्मेवारी दिइनेछ। जस्तो (i) RP र SAP कार्यान्वयन सहायक इकाई (RSISU) र (ii) वातावरणीय अनुगमन सहायक इकाई विगतमा ने.वि.प्रा. अन्तर्गत रही सोही विषयमा अनुभव बटुलेका व्यक्तिहरूलाई RP र SAP को

कार्यान्वयन गर्न दिईने छ । त्यसै गरी दोश्रो सहायक इकाई अन्तर्गत विगतमा जलविद्युत आयोजनाको वातावरणीय अनुगमन कार्यमा संलग्न परामर्शदातृ संस्थाहरुलाई समावेश गरिने छ । विशेष गरी सामाजिक तथा वातावरणीय अनुगमन इकाई, परियोजनाको निर्माणको बोलपत्र खोल्नु भन्दा आठ महिना अगाडी स्थापना गरिनेछ । यो सामाजिक तथा वातावरणीय अनुगमन इकाईले परियोजना प्रवन्धकको अधिनमा रहि आफ्नो कार्यहरु गर्नेछ । त्यसै गरी, सामाजिक तथा वातावरणीय सहायक इकाई परियोजना सुपरिवेक्षण कन्सल्टेन्ट प्रति उत्तरदायि रही, (RSISU) नेपाल विद्युत प्राधिकरण, वातावरण तथा सामाजिक अध्ययन विभाग, आयोजना प्रभावित क्षेत्रका जनसरोकारवालहरु, जस्तो जि.वि.स. न.पा. गा.वि.स. गैर सरकारी संस्थाहरु, समुदायमा आधारित सामाजिक संघ, संस्थाहरुका साथै प्रभावित विभिन्न समुहहरु, दलहरु, आदीसंग समन्वय गरि कार्य गर्नेछ ।

माथिल्लो सेती जलाशययुक्त जलविद्युत परियोजनाको वातावरणीय अनुगमन क्रियाकलापहरुलाई तीन भागमा विभाजन गरी कार्य गरिने छ (i) निर्माण पूर्व गरिने अनुगमन (आधारभुत) (ii) निर्माण अवधिमा गरिने अनुगमन (संगठनात्मक) (iii) निर्माण पश्चात गरिने प्रभाव अनुगमन । वातावरणीय अनुगमन परियोजनाबाट प्रभावित सबै क्षेत्रको अनुगमन नियमित रुपमा कार्य तालिका अनुसार गरिनेछ । अनुगमन कार्य गर्ने विभिन्न विधिहरु जस्तो प्रत्यक्ष अवलोकन, निरीक्षण कार्यलयगत प्रतिवेदनको पुनरावलोकन, अन्तर्वाता तथा अन्य माध्यमद्वारा सम्पन्न गरिनेछ । त्यसै गरी वातावरणीय परिक्षण कार्य आयोजना निर्माण भएको दुई वर्ष पछि गरिनेछ । वातावरणीय परिक्षण कार्य वातावरण संरक्षण नियमावलीको अधिनमा रही वातावरण मन्त्रालयले गर्नेछ । राष्ट्रिय र स्थानिय स्तरका गैर सरकारी संस्थाहरुलाई पनि वातावरणीय परिक्षण सम्बन्धि कार्य गर्नको लागि सरकारले स्वीकृति दिन सक्नेछ ।

९.० सार्वजनिक सुनुवाइ

माथिल्लो सेती जलाशययुक्त जलविद्युत आयोजना कार्यान्वयनबाट प्रभावित क्षेत्रका जनसमुदायहरुको विचार, धारणा, प्रतिक्रिया सुन्ना, सल्लाह आदि बुझ्नको लागि वातावरणीय प्रभाव मूल्याङ्कन गर्दा सार्वजनिक सुनुवाइ कार्यक्रम सम्पन्न गरिएको थियो । यो छलफल कार्यक्रम वातावरण संरक्षण नियमावली र निर्देशिकामा उल्लेख भए बमोजिम नियम अनुसार सम्पन्न गरिएको थियो । यसैगरी वातावरण सम्बन्धि क्षेत्र निर्धारण गर्ने चरणमा छलफल कार्यक्रम आयोजना गर्ने विषयमा सार्वजनिक सुचना टाँस गरी सरोकारवालाहरुलाई जानकारी गराइएको थियो । यसरी सार्वजनिक सूचना टाँस गरी सकेपछि परियोजना क्षेत्रमा अध्ययन गर्न एउटा वातावरणीय टोलीले भ्रमण गरी क्षेत्रनिर्धारण सम्बन्धि सुन्ना, सल्लाह, विचार, प्रतिक्रिया, धारण, सुचना आदी विविध विषयमा जानकारी लिएको थियो । वातावरणीय टोलीले लिएको सूचना परियोजनाबाट प्रभावित स्थानिय जनसमुदायहरु, सामाजिक संघ संस्थाहरु, गैर सरकारी संस्थाहरु, जिल्ला विकास समिति, नगरपालिका कार्यालय आदी संग छलफल गरी प्राप्त गरेको थियो । वातावरणीय टोलिले यसरी प्राप्त सूचना, सल्लाह, सुन्ना, विचारका आधारमा क्षेत्र निर्धारण प्रतिवेदन र कार्यसूची तयार पारेको थियो ।

तनहुँ जिल्लाको सदरमुकाम दमौली (व्यास नगरपालिका)मा सन २००४ जनवरी २५ दिनका एक सार्वजनिक सुनुवाई कार्यक्रम आयोजना गरिएको थियो । सार्वजनिक सुनुवाई कार्यक्रम गर्नुको उद्देश्य प्रस्तावित माथिल्लो सेती जलविद्युत आयोजना सम्बन्धि जानकारी दिनु, परियोजनाका सम्बन्धमा स्थानिय सरोकारवालाहरुको विचार, सुन्ना र सार्वजनिक सवालका विविध विषयमा

सूचना आदान प्रदान गर्नु थियो । जाईका अध्ययन टोलिले, सम्भाव्यता अध्ययनको स्तरवृद्धि गर्ने समयमा तिन वटा सरोकारवालाहरु संग छलफल गरेको थियो । यसमा नेपाल विद्युत प्राधिकरणको टोलिले पनि सहयोग गरेको थियो । यसरी छलफलमा विशेष गरी जन सरोकारका विषयहरु जस्तो क्षतिपूर्ति दिने तरिका, वनविनास, सुरक्षाका सवाल, रोजगारीका अवसरहरु र पूर्वाधार विकाससंग सम्बन्धित थिए ।

यसरी विभिन्न चरणमा सम्पन्न गरिएका जनसरोकारवालाहरुको बैठकमा नेपाल विद्युत प्राधिकरणको अध्ययन टोलिले परियोजना र यसबाट प्रभावित क्षेत्रको विविध विषयमा पत्ता लगाएका मुख्य विषयवस्तुहरुको एउटा नेपाली भाषामा पुस्तिका तयार पारि छलफल कार्यक्रम सुरु हुनुभन्दा अगाडी एक-एक प्रति सवैलाई वितरण गरिएको थियो । पुस्तिकामा परियोजनाले प्रभाव पार्ने सवै क्षेत्र, विषय र जनसंख्या आदी विप्लेषणात्मक प्रस्तुति थियो । साथै परियोजनाको प्रभाव, न्यूनिकरण गर्ने उपायहरु, तरिकाहरु आदीको बारेमा पनि विप्लेषण गरिएको थियो ।

१०.० निति, नियम, कानून, रणनीति, योजना, ऐन तथा निर्देशिकाहरुको पुनरावलोकन

माथिल्लो सेती जलशाययुक्त जलविद्युत आयोजनाको वातावरणीय प्रभाव मूल्यांकन प्रतिवेदन तयार गर्दा प्रचलित नियम, कानून, ऐन, निर्देशिकाहरु, योजनाहरु, नेपालका अन्य जलविद्युत आयोजनाहरुको अध्ययन (माथिल्लो तामाकोशी) साथै अन्य जलविद्युत विकास सम्बन्धि निति, नियमहरुको विषयमा अध्ययन एवं छलफलबाट प्राप्त निष्कर्षको आधारमा समिक्षा गरिएको छ । विद्युत तथा जलश्रोत सम्बन्धि ऐनहरु जस्तो जलविद्युत विकास निति २००१, जलश्रोत नियमावली २०५०, जलश्रोत ऐन २०४९, विद्युत ऐन २०४९, विद्युत नियमावली २०५० आदीको सहयोग लिईएको छ । त्यसै गरी अन्य महत्वपूर्ण ऐनहरुमा जग्गा प्राप्ति ऐन, वन ऐन साथै जलचर संरक्षण ऐनहरु पनि प्रतिवेदन तयार गर्ने क्रममा पुनरावलोकन एवं अध्ययन गरिएको छ ।

११.० निष्कर्ष र सुझावहरु

वातावरणीय पक्षलाई लिएर आयोजना विकास र संरक्षणको लागि उठाईएका सवै सवालहरु वातावरणीय प्रभाव मूल्यांकन अध्ययनको क्रममा महत्वपूर्ण मानिएनन् । यस परियोजनाको सकारात्मक पक्ष पुनर्स्थापित मानिसहरुको संस्था न्यून हुनु रहेको छ । त्यसै गरी कृषि क्षेत्रमा परेको प्रभावलाई अन्य जलशाययुक्त आयोजना गरिएको अध्ययनको तुलनामा यस आयोजनामा कम परेको छ ।

यस आयोजनाबाट अधिग्रहण गरिने जग्गा १०३४ हेक्टर मध्ये १५१.२ हेक्टर जग्गा कृषि उत्पादन क्षेत्र र ४२२ हेक्टर जमिन वन क्षेत्र पर्नेछ ।

आयोजना सञ्चालन गर्न आवश्यक पर्ने जलशायको निर्माण, सो स्थानमा सरसफाई तथा अनावश्यक सामग्रीहरु हटाई ठाँउ खाली गर्ने र जलशाय बनाउँदा ४२२ हेक्टर वन क्षेत्र नष्ट हुने देखिन्छ । यसका साथै ९ वटा सामुदायिक वन क्षेत्र पनि प्रभावित हुनेछन् । विनास हुने वनस्पति, अर्को स्थानमा सरकार, निजी क्षेत्र र सामुदायिक वन परियोजनाको लागि निर्माण गरिएको बाँध र जलशाय क्षेत्रमा लगाइने छ ।



माथिल्लो सेती जलशाययुक्त जलविद्युत आयोजनाको अध्ययनको क्रममा सेती नदीमा ३६ प्रजातिका माछाहरु पाइएका छन । आयोजना निर्माण कार्य थालनी गर्दा यी माछाहरु पनि प्रभावित हुनेछन । यी ३६ प्रजातिका माछाहरु मध्ये १ प्रजातिका धेरै टाढावाट वसाई सरी आएका, ७ प्रजातिका मध्य दुरीवाट सेती नदीमा आएका र २३ प्रजातिका सेती नदीका स्थायी माछाहरु रहेको पाइयो ।

वातावरणीय दृष्टिकोणमा आयोजनावाट अति प्रभावित ८६ घर परिवारलाई पुनर्वासको व्यवस्था गरी पुनर्स्थापन गरिने छ । यस आयोजनावाट करिव १५१.२२ हे. कृषि उत्पादन क्षेत्र डुवानमा परी, उत्पादन विनास भई वार्षिक ६६० टन मूल्य वरावरको बाली नष्ट हुनेछ ।

वातावरणीय व्यवस्थापन योजना कार्यान्वयनको लागि जम्मा अनुमानित रकम रु १७ करोड ४५ लाख ७ सय प्रस्ताव गरिएको छ । यो अनुमानित रकम क्षति न्यूनिकरण, अनुगमन तथा परिक्षण खर्च आदी शिर्षकमा खर्च गरिनेछ । यो वातावरणीय व्यवस्थापन खर्च आयोजनाको जम्मा लागतको ७.६% रहेको छ ।

माथिल्लो सेती जलशाययुक्त जलविद्युत आयोजना कार्यान्वयनवाट विद्युत माग र आपूर्ति विचको अन्तरलाई घटाउन सहयोग गर्नेछ । यस आयोजना कार्यान्वयनले सरकारलाई रोयल्टी र राजश्वमा वृद्धि भई प्रत्यक्ष आर्थिक लाभ हुनेछ । यसैगरी आयोजना प्रभावित क्षेत्रका स्थानीय जनताले रोजगारी पाउने छन् । ग्रामिण विद्युतिकरणको विस्तार हुनेछ भने परियोजना प्रभावित क्षेत्रमा स्थानिय पुर्वाधारहरुको विकास हुनेछ ।

Executive Summary

1.0 INTRODUCTION

The Upper Seti Storage Hydroelectric Project with a dam height of 140 m and installed capacity of 127 MW is located in Tanahu District in the Western Development Region. A Feasibility Study was conducted by NEA and completed in July 2001. Environmental Impact Assessment (EIA) was carried out parallel to the technical studies. Subsequently, in 2004 the Government of Nepal requested the Government of Japan to implement an Upgrading Feasibility Study of the Upper Seti Storage HEP under the technical assistance of Japan International Cooperation Agency (JICA). The JICA Study Team commenced the Upgrading Study in February 2005. Additional environmental studies were carried out simultaneously by the JICA Study Team.

This report is the Environmental Impact Assessment of Upper Seti Storage HEP prepared by Environmental and Social Studies Department (ESSD) of Nepal Electricity Authority (NEA), which has been updated incorporating the results and findings from the additional study conducted by the JICA Team. The updated EIA however follows the method and approach spelled out in National EIA Guidelines, 1993, Environment Protection Act, 1996 and the Environmental Protection Rules, 1997 and its recent amendments and recently formulated JICA Guidelines.

2.0 PROJECT DESCRIPTION

The Upper Seti Storage HEP consists of 140m high Concrete Gravity Dam with the Full Supply Level at an elevation of 415 masl, 7.26 sq. km surface area of the reservoir holding 295.1 million m³, a surface intake, 927 m long headrace tunnel, 195 m long penstock, an underground powerhouse consisting of 2 x 64 MW Francis Turbines. The 3 km access road to the dam site will be connected to the road head near the village Patan confluence of Seti and Madi River.

3.0 STUDY METHODOLOGY

The EIA process follows the Environment Protection Rule, 1997, Environment Protection Act, 1997 and its recent amendments and National EIA guidelines, 1993. This EIA is prepared in accordance with the legal requirements of GoN, based on field studies and consultation with local people and officials. As the Upgrading Feasibility Study of the Upper Seti Storage HEP has been conducted under the technical assistance of Japan International Cooperation Agency (JICA), the recently formulated JICA Guidelines have also been followed.

3.1 EIA Scoping and Terms of Reference (ToR)

Scoping exercises was carried out in 2002-03 to identify the major environmental issues and inform the stakeholders about the proposed project and to receive their comments and suggestions. Based on the field visits and discussions with the local people and stakeholders,

a Scoping Document and ToR were prepared. The ToR was approved by then MoPE on B.S. 2059-09-22 (January 2003).

3.2 Project Impact Area Definition

The Upper Seti Storage Hydroelectric Project with a dam height of 140 m and installed capacity of 127 MW is located in Tanahu District in the Western Development Region. The area of the reservoir is about 7.26 km² and an underground powerhouse is located on the right bank of the Seti River in Kahushivapur VDC.

The project impact area covers eight VDCs and one Municipality, which encompasses approximately 387.53 km² of land in Tanahu district. The project affected VDCs and Municipality are Bhimad, Chhan, Jamune, Kotdarbar, Kahun Shivpur, Rising Ranipokhari, Majhkot, Pokhari Bhanjyan VDCs and Vyas Municipality. Pokhari Bhanjyung VDC will be affected only due to the downstream activities and project facilities.

3.3 Baseline Data Collection

Various literatures related with EIA study were collected and reviewed before the fieldwork. Topographical maps of scale 1:25,000 with contour interval of 20 m were studied during desk study before the site visit. GIS maps have also been prepared and used for field survey works. Information related to watershed and geological condition of the project area has been taken mostly from the Feasibility and Upgrading Feasibility Reports prepared by technical group and JICA Study Team.

Site visit was conducted to investigate the site conditions in the affected area of Tanahun district by a multidisciplinary team consisting of Environmental Engineer, Sociologist, Ecologist, Biologist, Geologist, Resettlement Expert and Fishery Expert. The impact areas including the reservoir area, dam site and powerhouse, access road and downstream of the dam were visited on foot. The stability of slopes and the presence of landslides, fan deposits and rock fall within the project area were evaluated mainly by site observation and from maps. In addition, the JICA Study Team conducted extensive fieldwork in July 2006 for Upgrading Feasibility Study.

During the field visit, direct observation was done to evaluate the different uses of forest resources by the local people. A general review of the forest types/ vegetation characteristic of the project area was done from direct field observation, maps and photos. In addition, the JICA Study Team selected twenty-seven plots (25 m x 25 m) from the project area for vegetation analysis and species identification. The project area was surveyed to obtain direct evidence of the wildlife species, their status and habitat. Indirect evidence was also observed. Consultations with local key informants were held and group discussion was organized to obtain local information on wildlife species and habitat known by local people in the project area.

A survey of fish and aquatic life was conducted as a part of an Environmental Impact Assessment (EIA) study of Upper Seti Storage Hydroelectric Project. The field survey included collection of fish specimens from different sampling locations, identification and characterization of fish habitat and collection of information about fish migration and spawning pattern. The collection of aquatic insects and planktons were also completed during

the fieldwork. Further fieldwork and investigations were in July and October 2006 conducted by the JICA Study Team during the Upgrading Feasibility Study.

For the socio economic survey cadastral maps, which are the official land use maps, showing the land and land plot numbers, were obtained from the district Survey Office via GIS consultants. Via the use of these GIS maps, Cadastral Maps and the Field Book, an inventory structure survey was carried out to collect detailed information on the affected structures, including the number of structures, the materials used, and ownership of each structure.

After identification of PAFs, two weeks field survey was then conducted for the collection of primary data in January 2003 and later by JICA Study Team in 2006.

399 households were selected randomly and surveyed using semi-structured questionnaire to obtain the baseline information in the entire project affected VDCs and Municipality. A second set of questionnaire dealing with gender issue was designed. Similarly, a separate village profile questionnaire was designed for the local administrative unit to collect information on the existing infrastructure and other facilities in the project impact area. Key informant survey and focus group discussions were organized to give special attention to issues concerning the specific target group such as women, children and farmers.

3.4 Approaches for the Public Involvement

During the EIA study phase, the environmental team visited the various offices of Tanahau District in January 2003. The consulted offices were Vyas Municipality, District Development Committee Office, District Water Supply Office, Irrigation and Agriculture Offices of Tanahau district.

A formal Public Hearing was conducted in January 25th, 2004 at Vyas Municipality of Tanahun District. The notice of the Public Hearing was published in National Daily Newspaper "Gorkhapatra". A brief project brochure was prepared in Nepali language and distributed to participants of the programme.

During the Upgrading Feasibility Study Level, the JICA Study Team involved the local public in additional field investigation. As per the JICA's Guidelines a series of stakeholders meetings need to be organized during the study process. Thus, three stakeholders meetings were organized at the project affected area and in Kathmandu.

4.0 EXISTING ENVIRONMENTAL CONDITIONS

4.1 Physical Environment

The Upper Seti Storage HEP is located in the Gandaki River Basin of Western Development Region of Nepal. The total catchment of the basin upto the intake site is 1502 km² in which about 129 km² is covered with snow. Glacier lakes are not identified on this basin. The project catchment consists of two physiographic regions, namely High Himalayas and the Lesser Himalayas. Although the watershed of the Seti River is relatively stable around the impact area and mostly along the reservoir stretch however, area along the reservoir area like Bhimad Bazar and along the tributary Wanten Khola is very poor.



The surface geology of this critical area appears to be very poor and mainly consists of cemented gravel with sandy to silty matrix with approximately about 2 m thick soil cover in the upper layer. The major portion of the reservoir is along narrow gorge with vegetation on both the banks.

The landuse in the project area especially in the reservoir is mainly forest and patches of fertile agricultural land especially at the end of the reservoir. The initial stretch of about 8 km of the reservoir lies through narrower region with steep slopes on both banks. The latter part of the stretch runs through wider area consisting of agricultural land especially in Risinpatan, Saune and Bhimad village. Extensive cultivation is being done in these places especially along the river banks. Sand bars and boulder deposits were also seen at the latter stretch of the reservoir.

The Catchment of the Seti experiences severe cold, subtropical to temperate climate. The average maximum temperatures in the project area are 28.4 ° C and the minimum temperature is 16.8 ° C. The project area is influenced by monsoon rain, which normally starts in the middle of June.

The Upper Seti Storage Hydroelectric Project belongs to Midland Metasedimentary Units of Lesser Himalayan Zone in Western Nepal. In the project area the Midland Metasedimentary Units are represented by Dhading Dolomite, Benighat Slates and Nourpul Formation comprising of dolomite, slate, phyllites, quartzite, dolomitic quartzite, quartzitic phyllite and calcareous phyllite.

4.2 Biological Environment

a) Vegetation

The physiography of the project area comprises Mahabharat Range and Midland covering entirely the tropical flora. Hills less than 1,000 m run along west to east with different patches of vegetation composition in at both side of Seti River.

As per the Forest norms, three type of forests namely National, Community and Private forest exist in the area. There are nine community forests in the project area. Similarly private forests are also found in the project site. The planted Sisso (*Dalbergia sissoo*) and Khair (*Acacia catechu*) private forests are observed along the Seti River between Bhimad and Banderkuna in the upper reservoir area.

The Sal Forest, a component of Upper Tropical Eco-Zone is well developed in the higher elevations of the Seti gorge (above 100 m from the valley floor), whereas in the river bottom and on the gorge flanks Mixed Open Forest with patches of Khair (*Acacia catechu*) forests develop which has characteristics of Lower Tropical Eco-Zone. *Shorea robusta* (Hill Sal) is dominant species, which is normally observed above EL.400 m. The associates of this forest are *Schima wallichii* (Chilaune), *Lagerstroemia parviflora* (Botdhyero), *Bauhinia vahlii* (Bhorla) and *Desmodium oojeinense* (Sadan) etc.

The mixed open forest type is spread along the river belt. Representative species are different depending upon the aspect of the hill. *Terminalia alata* (Saj), *Mallotus philippensis* (Sindhure), *Albizia chinensis*, *Albizia lebbek*, *Sapium insigne* (Khirro), *Bamboo spp.*,

Lagerstroemia parviflora (Botdhyero), *Bauhinia vahlii* (Bhorla) and *Desmodium oojainense* (sadan) are commonly found in this forest area. Other associates are *Murraya koenigii*, *Leea macrophylla* and *Dioscorea bulbifera*.

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

Total 101 plants of ethno-botanical value are recorded. Out of total record of 209 wild plants in the project area three plants fall under Nepal Government conservation categories, six (including four orchids) under CITES conservation categories and six plant species are under IUCN conservation categories.

b) Wildlife

The Upper Seti Storage Hydroelectric Project area lies in the middle mountain physiographic region of the country.

Altogether 27 species of mammals were reported from the project area during the field survey. All the reported species are common in middle mountain physiographic region of the country. The reported species are Rhesus monkey (*Macaca mullatta*), Common Longur (*Presbytes entellus*), Malsapro (*Marten flavigulla*), Jackal (*Canis aureus*), Leopard (*Panthera pardus*), Goral (*Nemorhaedus goral*), Ban biralo (*Felis chaus*), Fyauro (*Vulpes bengalensis*), Flying Squirrel (*Petaurista petaurista*), Squirrel (*Funalbus sp.*), Hare (*Lepus nigricolis*), Banel (*Sus scrofa*) and Dumsi (*Hystrix indica*).

The bird species found in project area were common and widely distributed in mid hill through out Nepal. There are 62 species of avi fauna reported in the project area. Cuckoos (*Cuculus spp*), Jungle crow (*Corvus macrorhynchos*), Gray Crowned Pigmy Woodpecker (*Dendrocopos canicapillus*) and Kalij Pheasants (*Lophura leucomelana*) are the prominent bird species reported from the area. The presence of Jungle Crow (*Corvus macrorhynchos*) and Red Billed Blue Magpie (*Urocissa erythrorhyncha*) was observed during the field visit.

c) Fish and Aquatic Wildlife

The EIA study of the fish fauna in the Seti River identified the presence of 36 species of fish. Out of 36 species recorded or reported from Seti River 6 were long distance migrant 6, were midrange migrant and 23 were residents in habit.

Thirty-five species of phytoplanktons, 13 species of zooplanktons and 23 species of insects were recorded at different sampling station along the Seti River.

4.3 Socio-economic and Cultural Environment

a) Socio-economic condition of the affected VDCs and Municipality

The Upper Seti Storage Hydroelectric Project will affect eight VDCs and one municipality of Tanahu District namely Bhimad, Chhang, Majkot, Rising Ranipokhari, Kotdurbar, Jamune, Kahun Shivapur and Pokhari Bhanjyang VDCs and Vyas Municipality of Tanahu district.

According to 2001 Census, the number of total households and population of these areas are estimated to be 16,152 and 80,884. The average family size of these areas is 5.0, almost similar to district average. The population density varies significantly between the eight VDCs and municipality. Vyas municipality, for instance has the highest population density (409 persons/km²) while Kahun Shivapur VDC has the lowest population density (92 person/km²).

With regard to the caste and ethnic composition, Magar, the indigenous ethnic group is the dominant population in these areas, which represents 36 percent of the total population followed by Brahmin (14%), Dalit (12%), Chhetri (8%) and Newar (9%) and the rest (21%) are Kumal, Darai, Thakuri and Muslim.

A large majority population of the project area is following Hindu religion (91.1%) followed by Buddhist religion (7.8%), Islam (0.7%), and Christian religion (0.1%). The populations that follow Hindu and Buddhist religion are found in all the project VDCs and municipality. Eighty percent of the population that follows Islam population is concentrated in Vyas municipality. The Christian are concentrated mainly in Pokhari Bhanjyang, Bhimad, Ranipokhari, and Vyas municipality.

There are 151 primary schools, 20 lower secondary schools, 35 secondary schools, 2 higher secondary schools and 3 campuses under the supervision of 6 Resource Centers in the affected VDCs and municipality. The literacy status of the affected VDCs is 61 percent of the total population of the area literate.

The project site has 15 bed hospital located at Damauli of Vyas municipality, one Primary Health Centre with 3 bed facility at Bhimad, one health post located at Tharpu, Chhang VDC and 6 Sub-health posts located in 6 VDCs.

Only about 52 percent of the populations in the affected VDCs are reported to be supplied with piped water. Unavailability of safe drinking water to 48 percent of the population and lack of toilet facility to 77 percent of the population indicates the poor sanitation condition of the project affected VDCs.

Only about 13.3 percent population in the project VDCs has access to electricity services for lighting.

b) Socio-economic condition of the core project area

The Household Survey was undertaken targeting randomly selected 399 households having land or assets below 425 m of reservoir FSL in affected VDC and municipality to grasp the socio-economic and cultural situation of the core project area. Eighty percent of the surveyed households are headed by male members. The total populations of 399 surveyed households are estimated to be 2839. The average family size is 7.1, which is significantly higher than the average family size of the project affected VDCs.

The sampled households are divided into 4 major ethnic/caste groups. Magar are the most dominant population (51%), followed by Brahmin (15.79%), Gurung (8.52%) and Dalit (8%). The majority of the families (86%) have adopted Hindu religion followed by Buddhist (14%) and Christian (0.3%). The followers of Buddhist and Christian religion are found only among Adibasi/Janjati.

A large number of the sampled population (79%) is reported to be literate. The literacy percentage of population is relatively better when compared to the average literacy rate of the project VDCs (61%) and district (71%).

Majority of the households in the survey area (85%) are found served with piped water supply (while 14 percent households rely on well /pond and one percent on spring. With regard to the sanitation, 63 percent of the households in the study area have toilet facilities. More than 60 percent of the sample households are connected with electricity services while 43 percent use kerosene for lighting.

The main occupation of the majority of the household members is agriculture (56%) followed by service (15%), business (13 %). The average landholding of the surveyed households is estimated to be 0.685 ha.

78% of the project affected population has reported food deficiency from their own production. The number of households facing food deficiency is reported highest among Dalit and female headed households.

The average annual household income of the surveyed household is estimated to be NRs 185,364 which is significantly higher than the district average income. The average annual expenditure is estimated to be Rs 1,19,511 of which major portion is spent in purchasing food items (57.91%) followed by health and education (13.19%), transportation and religious activities (9.22%), clothing (7.34%), and fuel (6.82%). The average expenditure is also recorded highest among the Brahmin/Chhetri community

5.0 IMPACT ASSESSMENT

5.1 Physical Environment

The main physical impacts on the environment are those associated with land take for reservoir, resettlement, potential disturbance or change in the slope stability, runoff and drainage patterns in the project facility areas, access road and temporary construction areas. Shoreline erosion around the reservoir, especially at Bhimad Bazar, along Wanten Khola and Phedi Khola may occur. Another, main adverse impact will be on the river flow as the project is a seasonal storage project. The flow regime and associated river morphology processes will be significantly affected along the newly formed reservoir with an area of 7.26 km² and an approximately length of 18 km.

The total land take for various project components damsite, reservoir and powerhouse, as well as construction borrow pits and quarries, temporary and permanent work camps and construction of access road is estimated at 1034 ha. The major portion of the land take will be for the reservoir. The reservoir area mainly consists of forest and agricultural land.

As the reservoir area is 726 ha over an approximately 18 km. stretch along Seti River some changes in the local micro-climate is expected. There will be an increase in the humidity due to evaporation from the reservoir, and a decrease in the average maximum temperature in the summer season as well as a rise in the average minimum temperatures in the vicinity of the reservoir. When the temperature cools down especially during the night, fog may be formed around the reservoir area and slopes.

The main impact during the operation phase will be the impact on the 2.0 km stretch of the river upto Madi confluence. However, the impact is expected to be moderate as the Madi River with mean average flow of $14 \text{ m}^3/\text{s}$ joins the Seti River at about 2.0 km downstream of the dam.

Another impact will be on the water quality of the reservoir. Since the project consists of a seasonal reservoir with a depth of 140 m at the damsite the change in water quality during the operational phase would be expected to be significant.

Temperature stratification and eutrophication is expected to occur in the reservoir. *Vollenweider Model* (1976) has been applied for the analysis of eutrophication, which is commonly used for initial estimation of the eutrophication in the world to confirm the possibility of the eutrophication.

5.2 Biological Environment

Loss of natural vegetation due to the site clearance from the 422 ha forest land (construction sites and reservoir submergence zone) is the major impacts due to the implementation of project.

A large number of construction workforces and their families will flow into the project area and settle in the various construction sites. Besides the direct work force, temporary migrants will increase the demand for fuel wood and timber. If there is inadequate supply of alternative fuel for the construction labourers, the pressure for fuel wood will increase. This will be another main impact.

The Hardwood Mixed Open Forest with total of 296.05 ha will be affected. Similarly, 73.92 ha of Hill Sal Forest and 52.62 ha of Khair/ Sisso Forest will be affected.

Gittha (*Dioscorea deltoidea*) of the Appendix II of the CITES categories reported in the project alignment. Similarly, Sal (*Shorea robusta*), Khair (*Acacia catechu*) and Simal (*Bombax ceiba*) reported in the alignment has been banned for the transportation, export and felling for the commercial purposes under the forest Act 1993, GoN. Vulnerable species Tatelo (*Oroxylum indicum*) and rare species Chatiwon (*Alstonia scholaris*) reported elsewhere in similar climatic region of the country are also found in the project area are likely to be affected by the implementation of project.

The natural habitats of the wildlife will be lost during the construction phase. Some of the wild animals reported in the project area such as *Panthera pardus*, *Presbytes entelus* and *Nemorhaedus goral* have been enlisted under CITES Appendix I while *Macaca mulata*, *Felis chaus* in CITES Appendix II and *Vulpes bengalensis*, *Martin flavigula*, and *Canis aerus* in CITES Appendix III. All these species are listed as susceptible (S) categories of NRDB status.

The construction and operation of Upper Seti Storage Hydroelectric Project is likely to have some impacts on local fish resources. Submergence of 7.26 km^2 riverine habitat, loss of habitat, blockage of fish migration and dewatering of approximately 2.0 km river section are the impacts likely to be appearing due to implementation of the project. The excess removal of boulders from a particular place will affect the fish habitat, upstream migration (migration with the help of adhesive disc as in *Schizothorax sp*) and provide easy place for exploitation of fishes.

Barrier effect is expected on long distance and midrange migrant species due to construction of dam about 140 m high above the riverbed. Mid range migratory fish, living their adult life in central or lower parts of Seti and spawn in upper part, will be affected mainly by reduced area for spawning and growth of fry. Any change in water quality will also affect the spawning and nursery ground more severe than the adult residence area.

5.3 Socio-economic and Cultural Environment

The main social impacts arising from the construction and operation of the storage type of hydropower project in an area where subsistence agriculture is the main economic activity and the culture is traditional can be broadly classified as:

- Relocation of the people;
- Increased pressure on community resources for water, firewoods, and agriculture lands;
- Potential concerns in health and sanitation due to pollution from construction and operations, work camps; and from the deterioration of water quality
- Potential for an increase in illegal activities resulting from the increased population and access such as illegal fishing, hunting, felling of trees;
- External pressure on social/religious traditional ways of living in the communities;
- Overburdening of the existing social infrastructure (e.g. Health services and schools) due to the influx of the construction and operations work force into a low population density area;

The project will affect 151.22 ha of the cultivated area, accounting for approximately 15% of the total affected land. It is estimated that 660 metric ton of annual production will be lost due to the implementation of the project. If we assume that average crop yields for paddy are 3.15 metric tons per ha, the annual loss of paddy production resulting from the project is approximately 285 million tones, accounting for 43 percent of the total annual production loss. Since the great majority of the local people in affected areas are engaged in agriculture, the project will bring about adverse impacts on their livelihood.

The number of total private land owners which will be affected is estimated to be 838 people. 86 families will be relocated from the project area

The positive impacts arising from the opening of the area for direct and indirect employment, job creation and introduction of facilities rural electrification power services and other social services will be highly significant.

6.0 ALTERNATIVE STUDY

During the feasibility and EIA study process a comparison of alternative project strategies, sites for facilities, technologies and designs were carried out. These alternatives were based on site conditions and practical options developed by technical and environmental team. The following alternatives were considered:

- ◆ Location and Design of Major Project Structures; (Different dam height)
- ◆ Powerhouse locations
- ◆ Location of Construction Camps;
- ◆ No project Options



Alternative studies were also conducted by the JICA Study Team during the Upgrading Feasibility Level Study. In this Study, two kinds of alternative studies were undertaken; (1) Layout study to determine optimum location of the project facilities such as powerhouse and diversion tunnel, and (2) Comparative Full Supply Level (FSL) study to determine optimum FSL of the reservoir. Those alternative studies were conducted from various aspects such as economic, financial, technical, and environmental and social.

7.0 MITIGATION AND ENHANCEMENT MEASURES

7.1 Physical Environment

The main impacts associated with the reservoir type of project will be firstly those related with land take whose mitigation measure will be to minimize of land take where feasible.

Stabilization of slopes using bioengineering works etc., controlled drainage, construction waste management are some of the measures required to mitigate the impact during the construction phase. Other concerns include the use and disposal of construction wastes and proper location and management of borrow pits. However, mitigation measures associated with the potential impact of the reservoir water level drawdown upto 27.8 m along the Seti River is not possible, except for watershed management of the catchment area, which is discussed in the enhancement measures. Watershed management should include afforestation programs to limit slope erosion and sedimentation in the reservoir and constructing check dams in tributaries, which may be transporting sediment into the reservoir.

Protection works such as retaining walls (revetment walls and gabion walls) may have to be constructed in critical areas near habitation especially in areas like Bhimad bazaar, Risin Patan and Jaruwapani and along access road where slope failures are expected. Catch drains and sub-surface drains should be provided where necessary to collect and divert surface water to stabilize gullies in areas prone to slides.

Compensation flow of 2.4 m³/s (10% minimum average flow) will have to be released downstream of the dam during non-peak hours for the survival of aquatic ecosystem. This flow will be augmented by the flow from the Madi River with average discharge of 14 m³/s.

7.2 Biological Environment

The following mitigation measures are recommended to minimize the adverse impacts on the biological environment that may arise during construction and operation phases of Upper Seti Storage Hydropower Project.

1. Revegetation of disturbed slopes
2. Minimization of Site Clearance and Revegetation of Cleared Sites
3. Protection of Forest Resources
4. Replacement Plantation
4. Community Forest Support Program
5. Control of Hunting and Trapping
6. Environmental Awareness for Conservation (EAC)

As per the "Guideline for utilization of forest land and other land use" issued in 2006 by the Forest Department to regulate the ratio of lost: planted tree is 1:25. According to this, the

total estimated number of trees affected is about 160,000 the replacement trees are required equals almost 4 million trees with Full Supply Level of 415 m. This quantity is likely to alter when the Department of Forestry undertakes a more detailed survey of the actual areas affected and the types and volumes of trees to be compensated.

Hunting and trapping will strongly be prohibited by incorporating an appropriate clause in Tender Documents (Contract document) to ban hunting in the project area. The contractors should be advised to place information and warning sign at each construction sites regarding the fauna.

The mitigation measures recommended to minimize the adverse impacts are muck disposal plan, riparian release of 2.4 m³/s, construction and operation of fish hatchery, fish trapping and hauling program and water quality protection measures. The other programs are open water stocking of exotic and indigenous carps and cage fish culture to enhance the potential of reservoir and minimize the negative impacts. The enhancement program such as training and loan assistance to fishermen and environmental awareness programs are also suggested.

7.3 Socio-economic and Cultural Environment

Social mitigation should be considered in three stages:

- ♦ *Pre-Construction*
- ♦ *Construction Phase, and*
- ♦ *Operations Phase*

The proponent will provide appropriate compensation to all of the PAFs at the prevailing market price. Based on the discussions with the local people, observations at site and from the conclusions made by the environmental team, compensation will be provided by the following two methods.

- Cash Compensation,
- Land-for-Land and House-for-House Compensation,

A Compensation Fixation Committee will be formed to make fair determination of compensation requirements for loss of land, property and other more temporary disturbance to crops, livestock and community areas. Compensation will be provided in accordance with the Land Acquisition Guidelines 2045. In order to meet concerns for socio-economic sustainability, cash compensation has been proposed to be distributed according to the following two options i.e. one-time Compensation; multiple-time compensation. The one-time compensation will be preferred for those people who lose only a small portion of their land holdings, or to households that have other forms of income generation schemes they wish to invest in. The latter type will be suitable for household who lose their houses and needs to be relocated.

The inundated and affected infrastructure and community structures will be constructed at the appropriate location in coordination with local users and local governmental bodies such as District Development Committee (DDC) and Distribution Consumers Service (DCS) of Nepal Electricity Authority (NEA), etc before the construction of the project.



8.0 PUBLIC CONSULTATION

An extensive public consultation was conducted during the EIA study phase as stipulated in the EPR. Public consultation during the scoping phase was initiated by publishing a public notice. After the publication of the notice, the environmental team visited the project site for the Scoping exercise and the suggestions, comments and information received from all the affected people, organizations, NGOs and VDCs/ Municipality offices during the Scoping phase were incorporated while preparing the Scoping report and ToR.

The Public Hearing for the project was held on January 25, 2004 at Vyas (Damauli) Municipality, Tanahun to inform the public about the project and solicit views and suggestions and public concerns. During the Upgrading Feasibility Study; three stakeholder meetings were conducted by the JICA Study Team with the assistance of the NEA Team. The public concerns during these meetings was mainly on compensation procedures, the loss of forest, safety issues, employment opportunities and infrastructure development.

In all the stakeholder meetings, a Nepali version of the EIA major findings, in the form of booklets were circulated before the meeting. The brochure was simple and easily comprehensible by the local people. It consisted of description of the project, impacts of the project and mitigation measures for the same.

9.0 ENVIRONMENTAL MANAGEMENT PLAN

A separate Environmental and social Monitoring Unit (ESMU) within the project will be established to ensure that the mitigation and monitoring actions recommended by supplemental environmental studies are duly implemented, monitored, assessed, evaluated and disseminated to the stakeholders for feedback and improvement. The proposed ESMU will comprise of two sub-units, namely RP and SAP Implementation Sub-unit (RSISU) and Environmental Monitoring Sub-unit (EMSU). The staff members of NEA with past similar experiences will be assigned for the first sub-unit to implement RP and SAP. The latter sub-unit will be managed by the consultants with the experience in environmental monitoring of the hydropower projects in the past. The project ESMU will be established at least eight months before the civil construction tender award of the project. The ESMU will function directly under the Project Manager. However, the EMSU will be responsible to co-ordinate with the project's Supervising Consultant, whereas RSISU will coordinate with NEA – ESSD and the stakeholders of the project such as Local VDCs, DDCs, NGOs, CBOs, and affected parties, DoED, MoE, and MoEnv.

Environmental monitoring activities for the Upper Seti Storage Hydroelectric Project are similarly expected to be divided in three parts baseline Monitoring, compliance monitoring, impact monitoring. Environmental monitoring will be carried out at all the project impact areas in a regular or intermittent schedule. In general methods such as observation, inspection, review of official records, interview, counting and or measurement will be used for monitoring.

An environmental audit will be required two years after the commencement of the project. The Ministry of Environment will be responsible for the auditing as mentioned in the EPR, 1997. Local NGOs and National NGOs may also be entrusted to carry out the task, if they are engaged to do so by the government.

10.0 REVIEW OF PLANS/POLICIES, ACTS, RULES/REGULATIONS, GUIDELINES, CONVENTIONS STRATEGIES AND STANDARDS

The prevailing Acts, Policies, Regulations and Guidelines which are required for the development of hydropower projects in Nepal have been reviewed while preparing the present EIA report of Upper Seti (Damauli)-Bharatpur Hydroelectric Project and some of the important Guidelines and Acts and their relevancy in hydropower development have been also been reviewed and discussed. The regulation and acts related to power and water sector like Hydropower Development Policy (1992) Water Resources Act (1992) Electricity Act (1992) Water Resource Regulations (1993) Electricity Regulation (1993) have also been referred while preparing the prepared. Important Acts like Land Acquisition Acts, Forest Acts and Aquatic Animal Protection Acts have also been extensively reviewed while preparing the report. Relevant International Conventions and Treaties have also been referred.

11.0 CONCLUSIONS AND RECOMMENDATIONS

There are no significant environmental issues that will prevent advancing the project to the detailed design phase. One of the positive aspects of this project is that the project has low number of people to be relocated. Furthermore, the impact on the agricultural production is also relatively less compared to other similar type of storage project studied.

The main impacts will be the acquisition of 1034 ha out which 151.2 ha is agriculture land and 460 ha is forest. The formation of the reservoir and site clearing activities at the project site and creation of reservoir will result in the loss of 422 ha of forest area. Altogether 9 Community Forest will be affected. The vegetation loss will be from government (dam and reservoir site), private and community forest.

There are 36 species of fish is found in the Seti river will be affected by the project construction. Seti River 6 was long distance migrant 7 were midrange migrant and 23 were residents in habitat.

The primary adverse environmental impact will be form the relocation of 86 (SPAF) households which will have to be resettled. Approximately 151.22 ha of agricultural land will be inundated which will lead to loss of crop production, which amounts to 660 tones per year.

The total cost for implementing the Environmental Management Plan is estimated to be NRs 1745007000 or US \$24957242.6. This cost includes mitigation and enhancement cost, monitoring cost and auditing cost. The total Environmental Management Cost amounts to approximately 7.6 % of the total project cost.

The implementation of this project will be able to reduce the gap between power demand and supply. The project will also accrue direct economic benefit to GoN from royalties and revenues. Other direct benefit of the project will be from employment of local people, rural electrification, and reliable power supply during peak demand and improvement of infrastructures in the project impact area.



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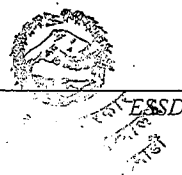


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CHAPTER ONE

INTRODUCTION

1.0 General

The present generation of the Integrated Nepal Power System (INPS) is only about 690 MW as of July 2008/09 and the peak demand is 800 MW. The deficit of peak power is mainly due to the dominance of Run-of-River projects in the Nepal Power System where the system faces acute power shortages during the dry season and surplus of energy during the wet season. This is also because the Integrated Nepal Power System (INPS) has only one seasonal storage project i.e. Kulekhani-I.

In order to meet the peak and increasing power demand in an efficient manner, there is a vital need to promote medium sized hydroelectric projects that can be implemented at the earliest. Moreover, an urgent need for a storage type of projects has been felt in order to fulfill the country's peak load demand. Thus, the Project Development Department (PDD) of Nepal Electricity Authority (NEA) conducted the Identification and Feasibility Study of Storage Projects in July 1999. The Upper Seti Storage Project was listed as the most potential storage project from a list of 102 identified potential projects through the Coarse and Fine Screening and Ranking Phase of the study.

The Upper Seti Storage Hydroelectric Project (USSHEP) with a dam height of 140 m and installed capacity of 127 MW is located in the Tanahu District in the Western Development Region. A feasibility study was conducted by NEA and completed in July 2001. An Environmental Impact Assessment (EIA) was carried out parallel to the technical studies. Subsequently, in 2004 the Government of Nepal requested the Government of Japan to implement an Upgrading Feasibility Study of the Upper Seti Storage HEP under the technical assistance of Japan International Cooperation Agency (JICA). The JICA Study Team commenced the upgrading study in February 2005. Additional environmental studies were carried out simultaneously by the JICA Study Team.

This report is the Environmental Impact Assessment of the Upper Seti Storage HEP prepared by the Environmental and Social Studies Department (ESSD) of Nepal Electricity Authority (NEA). This report has been updated incorporating the results and findings from the additional study conducted by the JICA team. The updated EIA, follows the method and approach spelled out in the National EIA Guidelines, 1993, Environment Protection Act, 1996 and the Environmental Protection Rules, 1997 audits recent amendment and recently formulated JICA Guidelines. This EIA report of the Upper Seti Storage HEP is valid only for generation and does not include transmission line components. The proposed project does not lie in any of the environmentally sensitive areas such as National Parks, Wildlife Reserves, Conservation Areas and Buffer Zones.

1.1 Rationality for Conducting the EIA Study

It is essential to consider environmental and social factors from the conceptual stage of the project for the sustainable development of every developmental project. In order to maximize the environmental and social enhancement opportunities and minimize the adverse impacts, an Environmental Impact Assessment of storage projects like the Upper Seti Storage HEP is vital. The impacts associated with the project needs to be critically analyzed, identified, and pragmatic mitigation measures need to be proposed since the project is a storage type.

As per the Schedule -2 of Environmental Protection Regulations, 1997 and its recent amendment a hydropower project with an installed capacity of 50 MW and above needs to undergo Environmental Impact Assessment prior to the implementation of the project. Considering this, an EIA study is mandatory for Upper Seti Storage Hydroelectric Project with an installed capacity of 127 MW.

1.2 Objectives of the EIA

The main purpose of the EIA is to examine the most suitable and cost effective configuration of the project that would be sensitive to the region's environment and recommend further investigations that might be needed to minimize the negative impacts, thereby enhancing the socio-economic and environmental benefits.

The specific objectives of the EIA are to:

- Document baseline conditions of the existing physical, biological, socio-economic and cultural environment.
- Identify physical, biological, socio-economic and cultural environmental impacts in terms of the magnitude, extent and duration that may be expected to occur during construction.
- Identify the environmental beneficial and adverse impacts of the project, as well as the economic and environmental acceptability to the community.
- Identify the critical environmental issues requiring further studies and/or monitoring.
- Examine and select the optimal alternative from the various relevant options available.
- Incorporate into the development action appropriate mitigation measures for negative impacts and to propose enhancement measures for beneficial impacts.
- Prepare the Environmental Management Plan.
- Involve the public in the decision-making process related to the environment.
- Advise decision makers regarding the implementation of the project.

1.3 Project Proponent

The Nepal Electricity Authority (NEA) is the Project Proponent. NEA was established on August 16, 1985 (Bhadra 1, 2042). The primary objective of NEA is to generate, transmit and distribute

adequate, reliable and affordable power by planning, constructing, operating and maintaining all generation, transmission and distribution facilities in Nepal's power system both, interconnected and isolated.

1.4 Organization Responsible for Preparing EIA

1.4.1 Environmental and Social Studies Department

The Environment and Social Studies Department (ESSD) of Nepal Electricity Authority is responsible for the EIA studies on behalf of NEA. Initially the EIA report of the Upper Seti Storage HEP was prepared and completed by the Soil, Rock and Concrete Laboratory (SRCL), one of the four departments of Engineering Services, NEA in July 2004. At present ESSD of NEA has been assigned for reviewing and upgrading the EIA report.

ESSD has the experience and capability of conducting all aspects of environmental and social studies. The experience in the field of the environment started in 1987 with the establishment of the Environmental Unit, a first of its kind in Nepal. This department has now developed into a full-fledged commercial unit, working in association with other international consulting companies in conducting EIA, IEE, VCDP and ACRP studies of hydropower, transmission line and distribution line projects.

1.4.2 JICA Study Team (Electric Power Development Co. Ltd. and Nippon Koei Co. Ltd.)

The JICA Study Team consisted of a consortium of two companies namely, Electric Power Development Co. Ltd. and Nippon Koei Co. Ltd. Nippon Koei Co. Ltd. is a multidisciplinary engineering and management consulting company with its headquarters in Tokyo. The company represents several generations of experience and expertise within various fields of activities having wide experiences in various types of development work. Nippon Koei established its office in Kathmandu in 1974 and since then it has been involved in various types of development works.

Electric Power Development Co. Ltd is an engineering company with its expertise mainly in the power sector with its headquarter in Tokyo.

1.5 Structure of the Report

This report contains eleven chapters. Chapter 2 describes the methodology of the EIA process and public involvement process. Chapter 3 contains the detailed project description whereas Chapter 4 discusses the baseline condition of the project-affected area. The baseline condition of physical, biological and socio-economic and cultural environment has been presented in detail. The baseline conditions of the socio-economic and cultural environment have been presented separately for the Project Affected Area and the Project Affected Families (PAFs). In Chapter 5, all the negative and positive impacts associated with physical, biological and socio-economic and cultural environment have been predicted and analyzed.

Chapter 6 outlines the various proposed route alternatives for the access road and assessment of the impacts. Chapter 7 describes the mitigation measures while Chapter 8 describes the public consultation procedures. Chapter 9 describes the Environmental Management Plan, Chapter 10 gives the legal framework and Chapter 11 lists the major findings of the EIA study.

CHAPTER TWO

PROJECT DESCRIPTION

2.0 Introduction

The proposed Upper Seti Hydroelectric Project is a storage type of project with an installed capacity of 127 MW. The project is located in the Tanahu District of the Western Development Region (Figure 2.1).

The Seti River is one of the major tributaries of the Trishuli River in the Gandaki basin. The proposed dam is located about 2 km upstream of the confluence of the Seti and Madi rivers, whereas the underground powerhouse is located downstream of the dam site. The dam site lies very near to Damauli Bazaar and about 7 km away from the Prithivi Highway. The project road necessary for this project is about 3.8 km.

This storage project involves the following components: 140m concrete gravity dam with the Full Supply Level at an elevation of 415 masl, 7.26 sq. km surface area of the reservoir holding 295.1 million m³, a surface intake, 195 m long tunnel type penstock, an underground powerhouse consisting of 2 x 64 MW Francis Turbines. The 3 km access road to the dam site will be connected to the road head near the village of Patan, the confluence of the Seti and Madi Rivers.

2.1 Project Location

The Upper Seti Storage Hydroelectric Project is located in the Tanahu District of the Western Development Region of Nepal. The project is located closer to the semi-urban area, Pokhara which is just 40 km away from the project site. The project dam site is located near Damauli Bazaar at Vyas Municipality and Kahu Shivapur VDC on the left and right banks of the Seti River, respectively. The reservoir extends to Vyas Municipality, Kahu Shivpur, Jamune, Rising Rani Pokhari, Kot Durbar, Chhan, Majhkot, Bhimad VDCs. The powerhouse is located at Vyas Municipality and Kahu Shivpur VDC. The access road runs through the Vyas Municipality.

The proposed camp areas, borrow areas and quarries are located mainly in the Vyas Municipality, Pokhari Bhanjyang, and Kahu Shivpur VDCs. Figure 2.2 shows the layout of the project.

2.2 Salient Features

The salient features of the Upper Seti Storage Hydroelectric Project scheme developed during the Feasibility Study shown in Table 2.1.

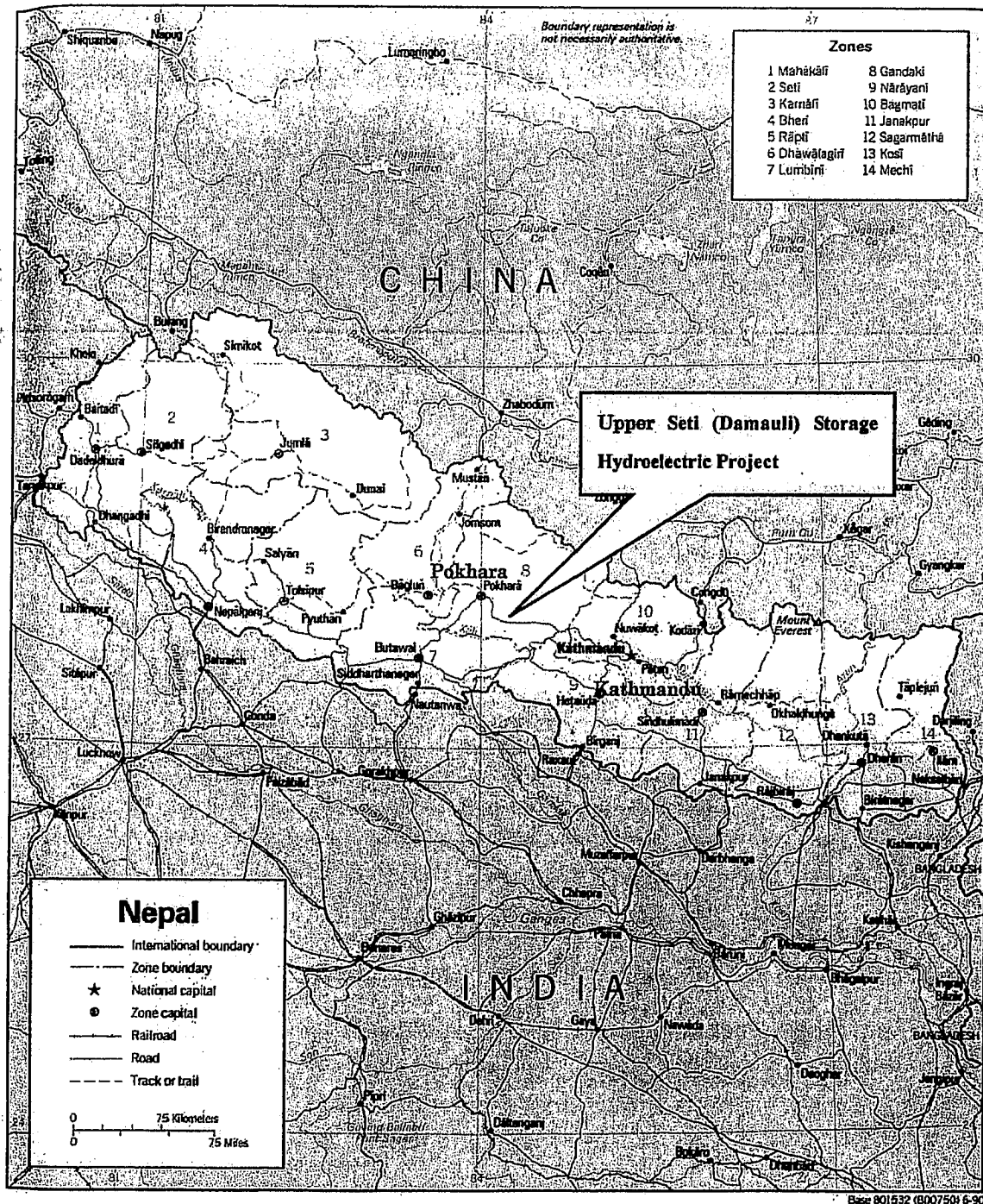


Figure 2.1 Location Map

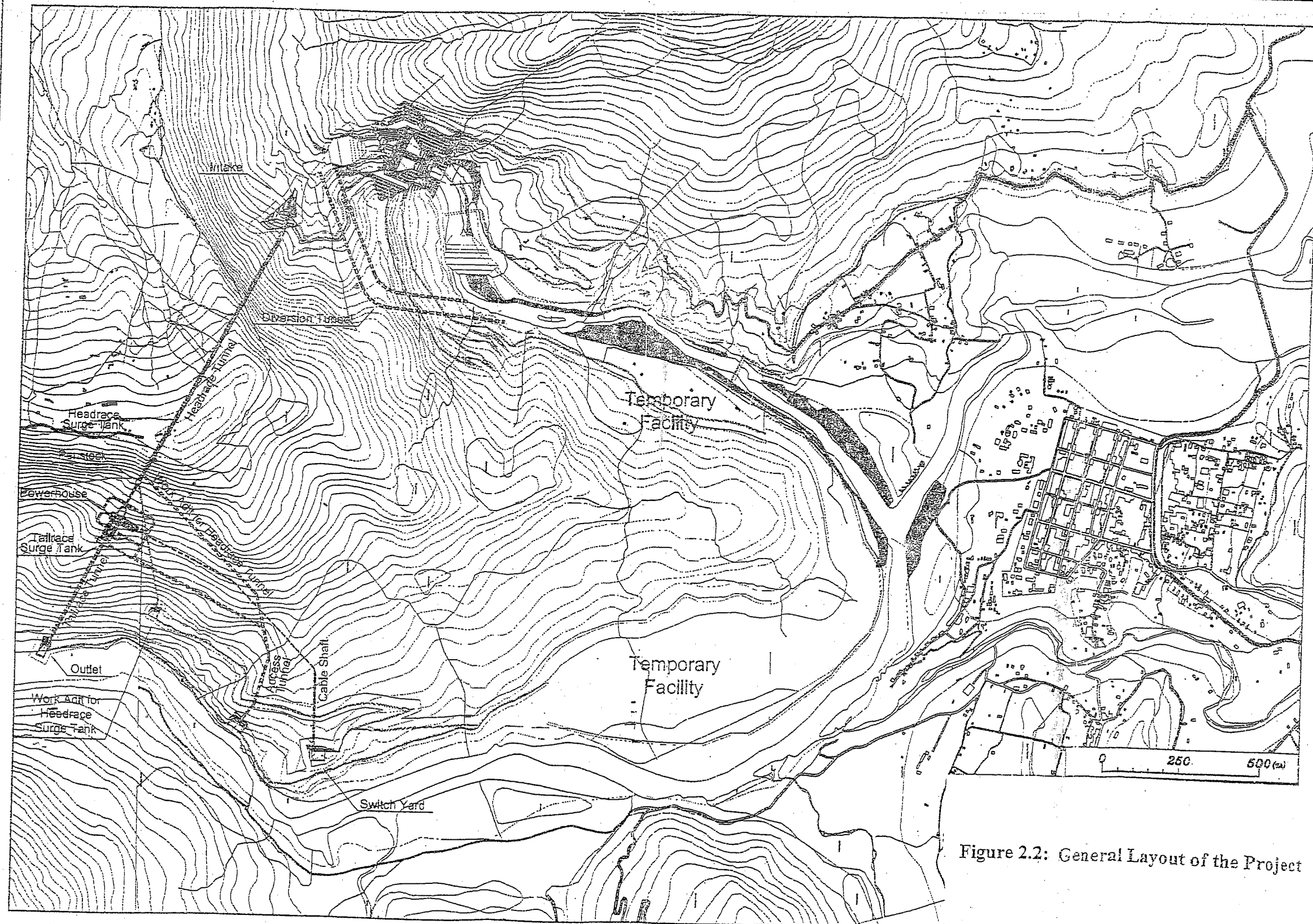


Figure 2.2: General Layout of the Project

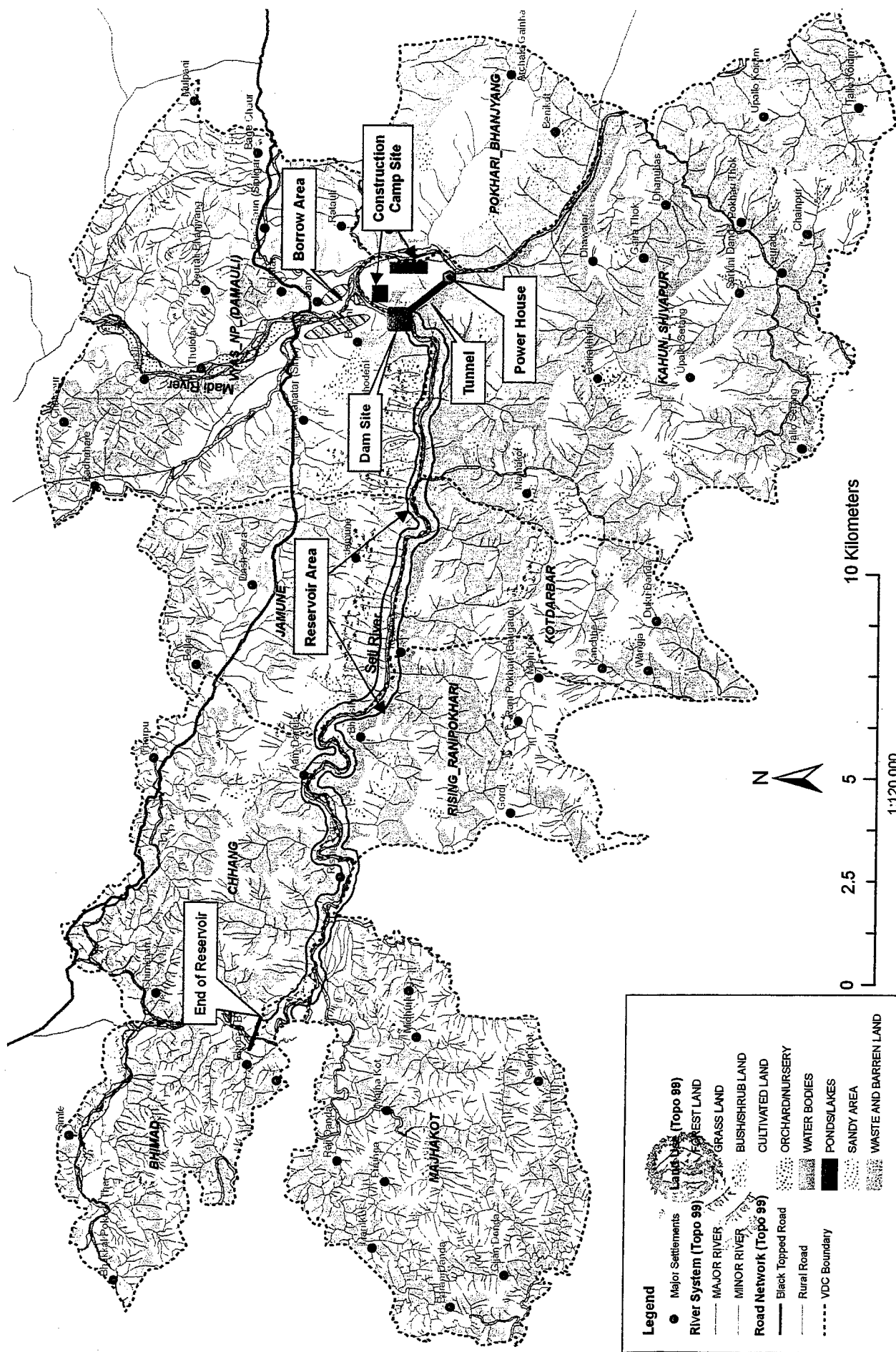


Table 2.1: Description of Technical Components of the Upper Seti Storage Hydroelectric Project

Component	Summary Description
Reservoir	A 7.26 km ² reservoir, which will stretch 18 km along the Seti river, the FSL is 415 masl, the Low Water Level is 387.2 masl. The gross volume is 295.1 million m ³ ; live storage volume is 167 million m ³ . Seasonal draw down will be 27.8 m.
Dam	140 m high Roller Concrete Gravity Dam, crest width 6.6 m and length of 170 m at the dam crest, elevation of 420 masl.;
Spillways	Main spillway: Chute type, gated spillway with 6 radial gates; designed for the discharge of 7377 m ³ /s (PMF), Elevation of overflow crest EL. 403 m. Width of overflow crest 75 m. Energy Dissipater Ski jump.
Intake	A single surface intake sloping type; invert elevation is 371.6 masl.
Headrace Tunnel	927 m in length, 7.8 m in diameter
Diversion Tunnel	Design flood- 994.6 m ³ /s, 2 tunnels length of 712 m, 881m, diameter 6.6 m, concrete lining
Penstock	Underground, tunnel type, single, inner diameter 5 m to 3.1 m, total length 195 m
Powerhouse	Underground powerhouse of 90 m(L) x 22 m (W) x 42 m (H) m size in rock comprising of 127 MW vertical axis Francis turbines operating at a rated head of 113 m;
Tailrace Tunnel	Tail water level 289.2 m, Shotcrete and concrete lined tunnel length 320 m, diameter 8.2 m
Turbine Type	Max. Design discharge 127.4, Vertical axis Francis turbine, Numbers 2
Generator	Three-phases, Synchronous Generator, Rated output 74,700 kVA per unit Revolving Speed 300 r/min, Frequency 50 hz, Voltage 13.2 kV, Power Factor 0.85 lag
Main Transformer	Type indoor three phase, Forced oil air type, 2 numbers, capacity 74,700 kVA, Voltage Primary 132 kV, Secondary 220 kV
Switchyard	Type GIS (Gas Insulated Switchyard), Bus System (Single Bus), Voltage 220 kV
Transmission line	A 40 km double circuit, 220 kV transmission line, Conductor type 380 m ³ x ASCR (Bison)
Annual average energy	607 GWh
Access Road and Project Road	3 km access road from village Patan to the dam site, and another 3.8 km project road in the project area
Design Discharge	127.4 m ³ /s
Project Cost	341 X 10 ⁶ US \$
Economic/Financial Evaluation	Benefit Cost Ratio 1.24 % EIRR 12.3 % FIRR 10.3 %



Fig. 2.4: Affected VDCs and Location of Dam, Power House, Borrow Area and Camp Sites of Upper Seti HEP



2.3 Project Components

A description of the main physical components of the project is described in the following sections:

2.3.1 Dam and Auxiliary Structures

A Concrete Gravity Dam has been proposed. The maximum dam height is 140 m, as measured from the bedrock to the dam crest, and the dam concrete volume is approximately 870,000 m³. A stability analysis for the dam was carried out to study the basic dam shape. The upstream dam slope gradient is 1:0.1 with fillet and the downstream slope gradient is 1 : 0.8. The dam crest elevation is at EL.420.0 m which is determined by adding the hydraulic freeboard such as the wave height at the time of wind and earthquakes to the Full Supply Level. The excavated rocks in the dam area will be used for the concrete aggregates required to construct the dam and other structures. This excavation will not disturb the environment and will minimize the volume of the spoil banks.

The spillway type is the center overflow type with the gates designed against the design flood of 7,377 m³/s. Six radial gates will be installed on the spillway arrest. The ski-jump type dissipater is adopted.

Due to the concrete dam, flood during construction should be treated not only by the coffer dam and diversion tunnel system but also by the outlet installed in the dam body. Based on the general idea, 994.6 m³/sec of a 2-year return period flood discharge has been considered for design purpose.

2.3.2 Intake

The intake of USSHEP will be constructed 400 m upstream of the dam. MOL is set at 1 m above the sediment level, in order to lower FSL as much as possible in consideration of the effective use of the reservoir water.

2.3.3 Headrace Tunnel

A 927m long headrace tunnel has been designed as a single lane pressure tunnel with a circular section. It is planned to be located along the right bank of the Seti River.

The internal diameter of 7.8 m was selected as the optimum diameter of the headrace tunnel.

2.3.4 Penstock

The 195 m long steel penstock has been designed as an underground type in a single lane tunnel. A circular section is adopted for the vertical shaft and a circular section with a flat bottom for the horizontal tunnel for construction convenience. It is bifurcated at the upstream of the powerhouse to accommodate two steel penstock lines. The diameter of the penstock steel pipes will range between 3.1 to 7.8 meter.

2.3.5 Headrace Surge Tank

The underground surge tank has been designed as a restricted orifice type, which is generally the most economical type for medium scale hydropower projects. The following are the main features of the surge tank designed based on the surging calculation.

Orifice diameter:	3.7m
Diameter of chamber:	17.0m

2.3.6 Powerhouse

The underground powerhouse is located in the sound dolomite layer on the right bank of the Seti river in Kahushivapur VDC. The powerhouse cavern is selected as a bullet type to make the construction work easier. The turbine level is set at EL. 280.0 m to secure a draft head enough to avoid cavitation. The size of the cavern is 22 m width, 42 m height and 90 m length which will house 2 units of generating equipment and the main transformer.

2.3.7 Tailrace Surge Tank

Water used for generation is released to the Seti River through the pressure type tailrace tunnel. The tailrace surge tank has to be provided at the conjunction of the tailrace tunnel and draft tunnel to prevent the negative pressure at the load rejection. The section of the tailrace surge tank is bullet shape, being 15 m in width, 32.5 m in height and 40 m in length

2.3.8 Tailrace Tunnel

The tailrace tunnel leads the water from the tailrace surge tank to the tailrace outlet. The total length is 365 m and the tunnel section is circular shape with a shotcrete concrete lining. The internal optimum diameter of the tunnel will range between 7.8 m to 8.6 m .

2.3.9 Tailrace Outlet

The tailrace outlet is located at 3km downstream from the confluence of Seti and Madi Rivers. Tail Water Level is set at EL.289.2m from the condition of the Electro-mechanical Equipment. The width of the outlet is set at 25 m to secure the required Tail Water Level. The alignment of the outlet channel is arranged in parallel with the Seti River flow to prevent debris from entering into the tailrace outlet.

2.4 Electromechanical Equipment

Generally, a turbine-generator is considered as larger unit capacity which has the merit that is more economical. However, the optimum unit size of turbine-generator is determined in consideration of the "Influence caused by the unit capacity to the power system", "Transportation route for heavy parts of the equipment", etc.

It is obvious that item a. "Influence caused by the unit capacity to power system" is the most important factor to be considered for the examination of the unit capacity in this project. It is

thus concluded that the number of units should be two with a unit capacity of 64 MW.

2.4.1 Hydraulic Turbine

The rated turbine output is designed as 65.4 MW per unit at 100% gate open with a rated effective head of 113.0 m.

Generally, the turbine type is determined on the effective head and output. The vertical-shaft, single-runner, Francis type has been selected. The revolving speed of the turbine is obtained as 300 *r/min* based on the specific speed of N_s 208 m-kW.

2.4.2 Generator

The generator with the rated capacity of 74,700 kVA is a vertical shaft, 3-phase synchronous generator, brush less exciter with AVR (Automatic Voltage Regulator). The generator stator and rotor windings are provided with epoxy insulation of class F type. The generator ventilation is performed with a heat exchanger and self circulation.

2.4.3 Main Transformer

The power transformer of two units will be installed in the transformer room in the underground powerhouse.

A three phase transformer is selected which has 74,400 kVA capacity.

The transformer type has been selected in considering the transportation limitation of the weight, efficiency and installed spaces, etc. The proposed transportation route to the project site is capable of carrying a maximum load of 24.8 tons (including weight of the trailer).

2.4.4 Switchyard Equipment

The switchyard is located outdoors at EL. 370 m and connected with 220 kV power cables of approximate 680 m in length from the main transformer secondary terminal in the underground transformer room. The administration office including the control room is located near the switchyard.

The Gas Insulated Switchyard consists of 220 kV single bus system including gas circuit breakers, disconnecting switches and necessary apparatus.

2.5 Transmission Line

2.5.1 Transmission Line Route

The electric power generated from USSHEP is to be evacuated with a new 40 Km long 220 kV transmission line to Bharatpur.



2.5.2 Access Road

An access road of approximately 3 km is required to reach the project site from the nearest road head at Patan, the confluence of the Madi and Seti rivers. The proposed access road lies in Vyas Municipality. Likewise, a bridge will be required over the Seti River on the right bank to reach the powerhouse site.

2.6 Construction Planning

The construction of the project involves two separate operations, one operation from the headworks area and the other from the powerhouse. The access road, bridge, diversion tunnel, cofferdams, the main dam with spillway and adits will be constructed in the headwork area. Similarly, the access road and adit will be constructed in the powerhouse site.

In order to provide necessary access to the work areas, camp sites, borrow areas and disposal area, an access road to the disposal areas and proposed campsite will be constructed.

Construction planning has been made considering an eight hours shift. The access road, bridge and construction camp are assumed to be completed prior to the contract award of the hydropower component and construction work on the dam will be carried out in two shifts.

The river diversion activity will be carried out in four stages as follows:

- Pre-diversion
- First Stage Diversion
- Second Stage Diversion
- Third Stage Diversion

Prior to the award of the main contract, detailed engineering, financial arrangements and construction of the access road, bridge, rehabilitation of existing roads and camp facilities are to be completed. Some of the activities will be done in parallel. The total time required for the completion of the above mentioned tasks is estimated to be 30 months. One year has been estimated for the detailed engineering. The construction of the access road, bridge, upgrading of the existing road and camp facilities will require 12 months and will be commenced 6 months after the completion of the detailed engineering. Hence, the total duration of the project construction from the commencement of the detailed engineering is 72 months. The construction schedule is given in Figure 2.3.

2.7 Construction Camps

The construction work force is estimated to be up to 2500 persons during peak construction. Approximately 10 ha of land will be required for the work camps. The total construction workers have been categorized as unskilled, semi-skilled and skilled human resources. The primary locations for the work camps identified are Huksetar, Beteni, Patan, and Damauli.

Table - 2.2 Human Resources Requirements for the Project

Types of manpower	Numbers of human resources		
	NEA	Contractor	Total
Skilled	100	100	200
Semi skilled	50	75	125
Unskilled	0	2175	2175
Total	150	2350	2500

2.8 Borrow Areas

Ten possible borrow areas have been identified within 5 km from the dam site during the feasibility study. These borrow areas are mostly located along the Seti River, and in Madi River bed. It has been estimated that 14,200,000 m³ of aggregates can be borrowed from 10 different sites. The borrow areas have been shown in Figure 2.4.

The river bed material could be considered as a source for concrete aggregates. Dolomite distributed along the left bank upstream of the damsite was investigated for the use as concrete aggregates. The quality of this material is almost equivalent to the river deposit of the Seti and Madi rivers.

2.9 Construction Power Supply and its Source

As the 33 kV Damauli Substation owned by NEA is located near the site the construction power supply will be used from this substation. For this purpose, a 33 kV, 3 km length distribution line will be used to transmit power from the Damauli Substation upto Jhaputar. A temporary transformer will be installed in Jhaputar for this purpose. The contractors will receive power for construction works at the temporary transformer.



CHAPTER THREE

STUDY METHODOLOGY

3.0 Introduction

The EIA process follows the Environmental Protection Rules, 1997 and its recent amendments, Environmental Protection Act, 1996 and the National EIA Guidelines, 1993. This EIA is prepared in accordance with the legal requirements of GoN, based on field studies and consultation with the local people and officials. As the Upgrading Feasibility Study of the Upper Seti Storage HEP has been conducted under the technical assistance of Japan International Cooperation Agency, the recently formulated JICA Guidelines have also been followed.

The overall approach to the EIA process is described below.

3.1 EIA Scoping and Terms of Reference (ToR)

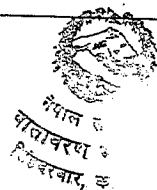
The Soil, Rock and Concrete Laboratory carried out EIA Scoping in 2002-03 to identify the major environmental issues and inform the stakeholders about the proposed project and to receive their comments and suggestions. Based on the field visits and discussions with the local people and stakeholders, a Scoping Document was prepared. Secondary data sources, maps and other relevant information on the physical, biological, demographic, socio-economic and cultural environmental conditions prevailing in the project area were also referred while preparing the report.

Based on the Scoping Document, the ToR for the Upper Seti Storage HEP was prepared as per schedule-4 of the Environmental Protection Rule, 1997 pertaining to Rule-4 and Rule-5. The comments, suggestions and critical issues identified during the Scoping Document were incorporated in the draft ToR and submitted to the Department of Electricity Development (DoED) and then the Ministry of Population and Environment (MoPE) for approval. The documents were approved by the then MoPE on B.S. 2059-09-22 (January 2003). The approved TOR is presented in Appendix A.

3.2 Project Impact Area Definition

The Upper Seti Storage Hydroelectric Project with a dam height of 140 m and installed capacity of 127 MW is located in Tanahu District in the Western Development Region. The area of the reservoir is about 7.26 km² and the underground powerhouse is located at rightbank of the Seti River in Kahushivpur VDC. The study region for the impact identification and impact evaluation of the proposed project has been categorized as follows:

High Impact Area: This impact area covers the inundated areas of seven VDCs and one Municipality in Tanahu District. The project affected VDCs and Municipality are Bhimad, Chhan, Jamune, Kotdarbar, Kahun Shivpur, Rising Ranipokhari, Majhkot, Pokharibhanjyan VDCs and Vyas Municipality. Among them Pokhari Bhanjyung VDC will be affected only



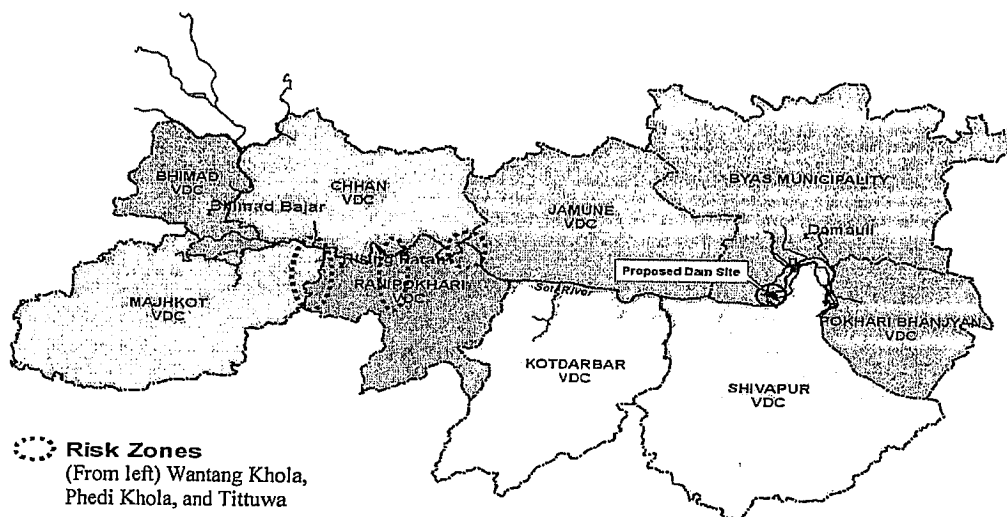
due to the downstream activities and project facilities. Based on the Optimization Study carried out by JICA Study Team the optimum FSL of the reservoir has been fixed at 415m. An additional 10m vertical distance has also been added to the FSL as the risk zone for safety purposes. Therefore, the reservoir area will cover the area that would be submerged by the reservoir. This zone covers the area of seven VDCs (except Pokhari Bhanjyang VDC located at downstream) and one Municipality in Tanahau District. The affected VDCs and Municipality are shown in Figure 3.1.

Moderate Impact Area: The Moderate Impact area will be the upstream watershed of the affected VDCs and the upstream watershed of the Seti river and Project facility areas (Shivpur, Pokharibhanjyang and Vyas Municipality)

Project Facility Areas: It comprises of project facility structures required for the construction of the project such as access roads, camps, batching yards and spoil disposal yards etc. Similar to the project components it involves effects related to land and property acquisition besides loss of natural resources and community properties.

Low Impact Area: This impact area will cover mainly the downstream of Pokharibhanjyang, Shivpur VDC and Vyas Municipality. The impact comprises of the downstream effects associated with river water fluctuation twice a day below the dam wall and tailrace outlet of the proposed project.

Figure 3.1: VDCs and Municipality Affected by the Project



2.3 Baseline Data Collection

The methodology adopted for the field survey and analysis of the collected data related to physical, biological and socio-economic & cultural environment is described in the following sub-sections.

3.3.1 Physical Environment

3.3.1.1 Literature Review

Various literatures associated with the EIA study of the proposed project were reviewed. EIA studies of other similar projects were also reviewed to develop the frame for data requirement.

Information on climate, watershed and geology has been taken from existing sources, literature and data files. Topographical maps of scale 1:25,000 with contour interval of 20 m were studied before the site visit. GIS maps have also been prepared and used for field survey works. Information related to watershed and geological conditions of the project area have been taken mostly from the Feasibility and Upgrading Feasibility Reports prepared by technical group and JICA Study Team.

3.3.1.2 Field Survey

Site visits were made by the EIA team consisting of an aquatic biologist, forester, botanist, sociologist, economist, environmental engineer and hydropower engineer. Extensive fieldwork was conducted on January 2003 to fulfill the data gap by SRCL. In July 2006, the JICA Study Team conducted additional fieldwork in July 2006 for the Upgrading Feasibility Study.

The main impact areas including the reservoir area, dam site and powerhouse, access road and downstream of the dam were visited. The stability of slopes and the presence of landslides, fan deposits and rocks falling within the project area were evaluated mainly by site observations and from maps.

3.3.1.3 Climate, Meteorology and Air Quality

Climatological information of the project impact area has been taken from the station at Khairanitar of Tanahu District and hydrological information from 24 stations in and around the project impact area. Temperature, maximum daily precipitation and humidity of the project site are summarized from the index station at Khairanitar. The precipitation of the basin has been determined by the isohyetal method. The 24 precipitation stations within the basin have been used to compute the average annual precipitation.

3.3.1.4 Hydrology, Sediment and Water Quality

Data recorded from the 24 meteorological stations in and around the impact area have been considered. Water quality sampling was done at four sites, which have been shown in Figure 3.2. Water quality sampling was carried out only in dry season (January). The parameters such as temperature, pH, DO and specific conductivity were measured *insitu*. Four sets of samples taken for water quality analysis from four different sites were:

- Dam Axis
- Dewatered Section
- Bhimad Bazar (reservoir area)
- Madi Khola (downstream of dam)



DT

LEGEND



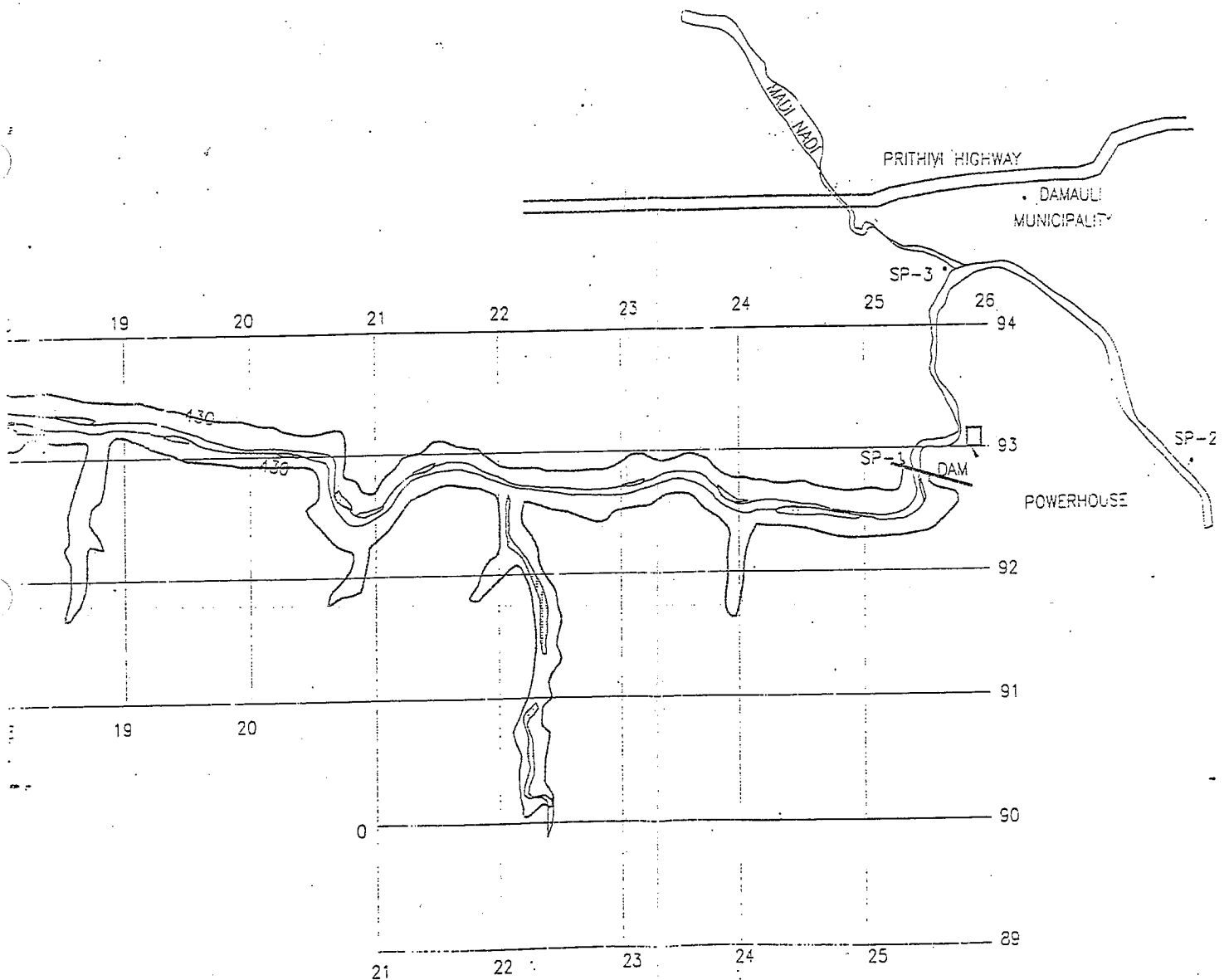
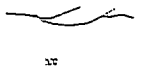
RIVER

CONTOUR

SAND DEPOSIT

SAMPLING SITES

P/H POWERHOUSE

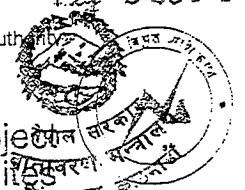


0 75 150 225 300 375m

SCALE 1:75000

Fig 3-2

Nepal Electricity Authority



Upper Seti Storage Project
Water Sampling Sites

The use of river water in the upstream of the dam, especially near the reservoir area and downstream of the powerhouse was investigated.

In addition, the JICA Study Team carried out further tests on water quality in the dry and wet seasons at four different locations, which were downstream of Damauli Bazaar, downstream zone affected by releases (dam site to Madi River confluence), proposed dam site and Bhimad Bazaar. Furthermore, the JICA Study Team used the Vollenweider Model to evaluate the possibility of eutrophication and predict the condition of the water quality after impoundment.

Discussions were also held with the local people to get information on the intensity of floods, their occurrences, frequencies and damages.

3.3.2 Biological Environment

The following methods were used to assess the impacts on wildlife, avifauna, forest resources and bio-diversity:

3.3.2.1 Literature Review

Relevant information from various sources were collected and reviewed to understand the type of the project and to identify the relevant issues to be considered during the preparation of the study. Relevant literatures like EIA of Bara Forest Management Plan, Environmental Study of Nepal's Begnas and Rupa lakes and EIA of various hydroelectric projects were reviewed for the biological environmental study of the proposed Upper Seti Storage HEP. Similarly topographic and land use maps (1:25,000) of the project site were reviewed prior to field survey.

3.3.2.2 Field Survey

An extensive field survey was conducted by the ecologist and biologist/botanist to collect biological baseline information of the project area. The reservoir site of the project area was traversed by foot and necessary information collected. An appropriate herbarium was prepared to identify the voucher plant species, which could not be identified in the field. During the field visit, direct observation was done to evaluate the different uses of the forest resources by the local people. Information on forest resources were also collected by an anthropological field technique similar to RRA (Rapid Reconnaissance Appraisal). Furthermore during the upgrading phase the JICA Study Team conducted an in-depth field survey to prepare the baseline data of the project area.

The following methodology was applied to collect the baseline information and impact prediction for the biological environment.

3.3.2.2.1 Vegetation/Forest Resources

A general review of the forest types/ vegetation characteristics of the project area were done from direct field observation, maps and photos during the feasibility study. Following this 13 forest samples, plots were selected at key locations in the project impact area for detailed

vegetation analysis and species identification. The sample plots are shown in Figure 3.3.

The numbers of plots at different locations with their sizes are as follows:

- 10 plots of 25 m. x 25 m. at the Dam and Reservoir Site
- 1 plot of 25 m. x 25 m. at the Intake Site
- 2 plots of 25 m. x 25 m. at the Powerhouse Site

In addition, during the upgrading feasibility study the JICA Study Team selected twenty-seven plots (25 m x 25 m) from the project area for vegetation analysis and species identification. The plots were mainly selected from Damauli, Huksetar, Patan, Geruwatar, Risingpatan and Bhimad area. The additional vegetation plots selected by the JICA Study Team are shown in Figure 3.4.

A measuring tape was used to mark the plots and an altimeter was used to verify the elevations of the plots. The forest resources data were quantitatively analyzed for Basal Area, Basal Area Ratio, Relative Density of the tree species. The following methods were used to determine these parameters.

I. Density Measurement

The density of the tree species in the study area were calculated and expressed as number per hectare by the direct counting method, the.

$$\text{Density of tree/ha} = \frac{\text{Total number of individual of saplings.}}{\text{Total number of plots sampled x area}}$$

II. Basal Area and Standing Wood Volume

The breast height was determined at a height of 1.4 m above from the base of the tree to measure the basal area and trunk size. Trunk sizes were expressed as its circumference (cbh) or diameter (dbh). Therefore, the Breast Height Circumference was measured to calculate the cbh.

Diameter = dbh


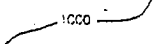



Circumference = cbh

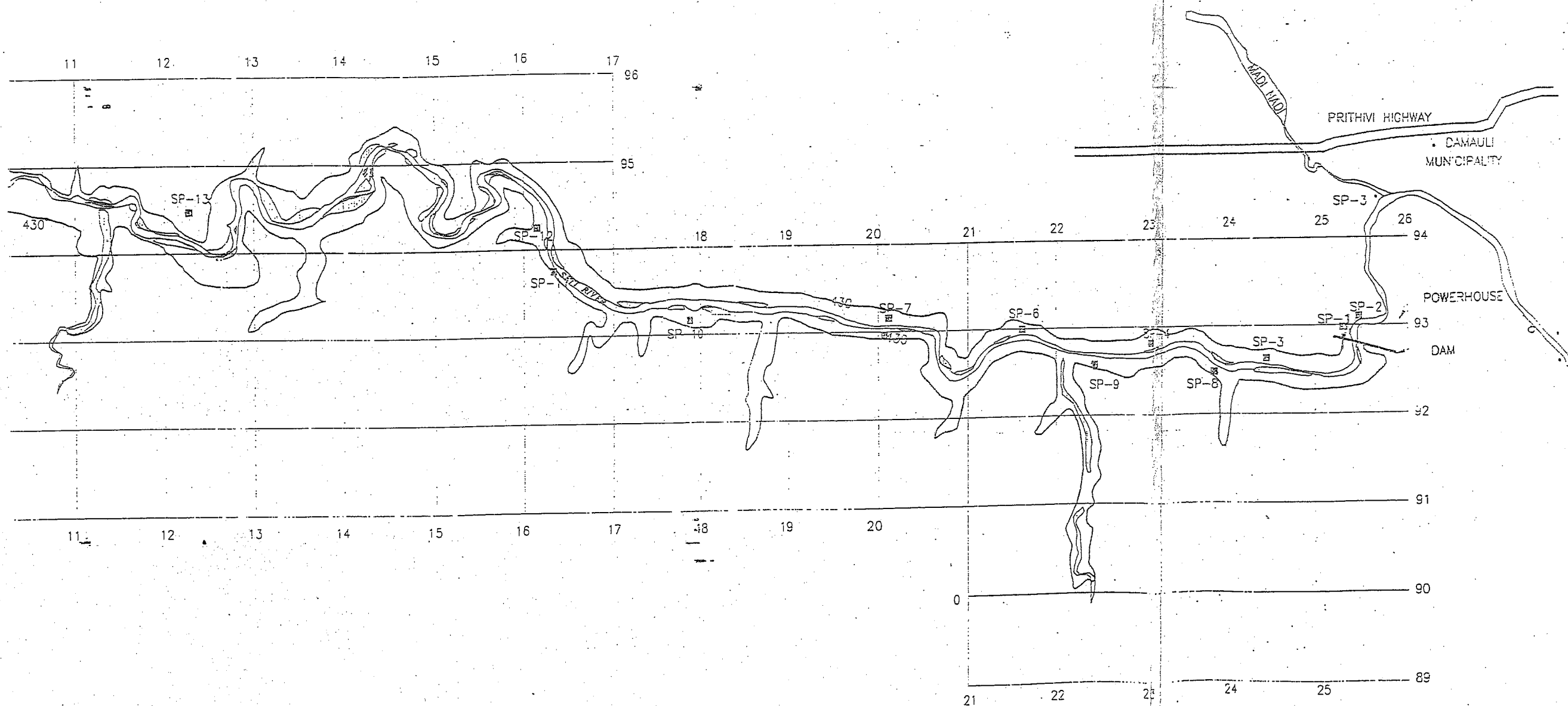
$$\text{Diameter breast height (dbh)} = \frac{\text{cbh}}{\pi} \quad (\text{Where } \pi = 22/7)$$

Tree trunk size is expressed as the area of its cross-section at the basal area (BA) calculated as:

$$\begin{aligned} \text{BA} &= \pi r^2 \\ &= \frac{\pi (\text{dbh})^2}{2^2} \quad (\text{where } r = \text{dbh} / 2) \\ &= \frac{\pi (\text{dbh})^2}{4} \end{aligned}$$

TANAHU DISTRICT

- LEGEND
-  RIVER
 -  1000 CONTOUR
 -  SAND DEPOSIT
 -  SP SAMPLING PLOT
 -  P/H POWER HOUSE



0 75 150 225 300 375m
SCALE 1:75000

Fig. 3.2

Upper Seti Storage Project



dbh is usually expressed in cm and therefore BA in cm^2/tree and m^2/tree , the sum of BA of all individual trees in the sample were given in m^2/ha .

Wood volume of standing trees was calculated by using the Quarter Girth Formula, which is also mentioned in the Forest Rules, 1995.

Volume = $(\text{Girth}^2 / 16) \times \text{Timber Height}$

While using this formula the breast height is taken at 1.4 m (4.5 ft)

III. Measurement of Canopy Coverage and Canopy Height

Visual estimation was done to estimate the canopy coverage. Photographs were also taken for estimation. The topographical map number 19927 of scale 1:25,000 was used to estimate the forest area to be inundated by the reservoir and affected by the construction of the powerhouse and dam.

3.3.2.2.2 Fauna

The project area was surveyed to obtain direct evidences of the wildlife species, their status and habitat. Consultations with local key informants were held and group discussions were organized to obtain local information on wildlife species and habitats known by the local people in the project area.

3.3.2.2.3 Fish and Aquatic life

A survey on fish and aquatic life was conducted as a part of the Environmental Impact Assessment (EIA) study of the Upper Seti Storage Hydroelectric Project. The fisheries component of the EIA was sub-contracted to a Nepali Fisheries Expert and the findings have been attached in Appendix E. The objective of this work was to establish baseline data on the aquatic system, the likely effect of the project on the habitat and fish populations and provide preliminary recommendations on mitigation and enhancement measures.

The field investigation in April 2003 lasted 12 days. Field surveys were conducted in the Seti River and its major tributaries. The field surveys included collection of fish specimens from different sampling locations, identification and characterization of fish habitats and collection of information on fish migration and spawning patterns. The collection of aquatic insects and planktons were also completed during the fieldwork. Further fieldwork and investigations were carried out in July and October 2006 by the JICA Study Team during the "Upgrading Feasibility Study".

The following methodology was applied to conduct the survey of fish and aquatic life of the proposed project.

I. Habitat Characterization

The river habitat was studied by using the visual method (observation). The topographical map available for the area was used for river habitat characterization. Possible spawning

habitat conditions such as type, cover and shelter were recorded by walking along the banks of the rivers.

Sampling Locations and Sampling Methods

Fish, aquatic life and water quality samples were collected from the Seti River. Madi Khola was also sampled for fish and water quality. The Seti River was divided into 8 different sampling stations/locations to collect detailed information on fish distribution, composition and food availability of the river (Murphy and Wills 1996). The sampling stations were set along the stretch of the Seti River from Bhimad Bazar to the downstream of the powerhouse, locally known as Pratap. Approximately 1 km area in length (500 meter upstream and 500 downstream) was covered at each sampling site. Distribution and abundance of fish and aquatic life. The following locations were sampled to provide specific information on the status.

Table 3.1: Fish/Aquatic Life/Water Quality Sampling Locations/Stations

Sampling Station	Location
1	Seti river at Changthadi (upstream of Bhimad Bazar)
2	Seti river near Chan Patan (Downstream of Bhimad Bazar)
3	Seti river at Bandarkuna (Rising Patan area)
4	Seti river at dam site (Dule)
5	Seti River at powerhouse site and dewatered section (Area from powerhouse to Seti Madi confluence)
6	Seti river at Madi Seti confluence area
7	Seti river at Pratap approximately 4 km downstream of powerhouse
8	Seti river approximately 5 km downstream of powerhouse site

II. Aquatic Life/Water Quality

Samples of aquatic insects and other invertebrates were collected from stations 1-8 along the Seti River and preserved in formalin (10%). The insects and zooplanktons were collected by D-net and plankton net, respectively. Phytoplanktons were collected by collecting the residue of water samples using lugol solution. The aquatic insects and planktons were identified in the Fisheries Development Division Laboratory at Balaju, Kathmandu. Water quality was analyzed at the site using the Hach water analysis kit (heck kit).

III. Fish

Cast net was used for fish sampling and eight hours was spent at each sampling site. The local fishermen were hired to collect fish specimens from the river and its tributaries. Fish species caught at each site/station were identified, measured and weighed. The types of species present per catch, composition of each species and level of effort were recorded (Murphy and Wills 1996). The standard data sheet was used for data collection. The Fish species caught during the field visit at each sampling site were identified using the standard method of taxonomy (Jayaram 1981 and Shrestha 1994, Toward & Jhingran 1991). Some fishes were dissected and stomach contents and gonads were removed and preserved in formalin solution for microscopic study. The collected fish were preserved in formaldehyde solution for further study. A map was prepared showing aquatic habitats and spawning areas.

Survey in the market centers like Bhimad and Damauli were conducted to collect information on fish diversity of the Seti River. Fish species available at the local market and fish caught by the local fishermen were also purchased to document information regarding local fishery resources.

IV. Interview and Focused Group Discussion with Local Fishermen

The local fishermen of Chanpatan, Malebagar, Bhimad Bazar, and Patan were interviewed using structured questionnaires to document their knowledge on the distribution status, availability, spawning sites and migratory behavior. The information on catches, sale and consumption and population trend of fishes was collected. Focused Group Discussions were conducted at Chanpatan (reservoir area) and Patan villages to obtain information on the local fishery resources, fishing practices, catch and consumption patterns among different ethnic groups. Approximately 10-15 people participated at each site.

3.3.3 Socio-economic and Cultural Environment

3.3.3.1 Literature Review

Various literatures related with the EIA study were collected and reviewed. Publications made by the Central Bureau of Statistics and various Government and Non-Governmental Offices were reviewed and data gaps identified. Publications such as Population Census Data, Nepal Living Standard Survey, Tenth Plan Documents, District Profile of Tanahau District, Poverty Mapping Report of Tanahau, etc were reviewed to collect the secondary information. Basically, publications of various government offices such as the Central Bureau of Statistics, Department of Hydrology and Meteorology, Ministry of Agriculture, and district level offices such as the District Development Committee, District Agriculture Office, District Forest Office and District Women Development Office were reviewed extensively.

3.3.3.2 Field Survey

The majority of the social data collected by the NEA Study Team in 2003 has been replaced and upgraded with the data collected from the questionnaire survey by the JICA Study Team 2006. The JICA Study Team followed the following techniques for the collection of primary data.

I. Identification of Project Affected Families (PAFs)

The cadastral maps, which are the official land use maps, showing the land and land plot numbers, were obtained from the district Survey Office via GIS consultants. These cadastral maps were prepared some 30-35 years ago, and the divisions of land plots have been updated every 5 years. They do not include information on forests, barren areas, river corridors, shrub-land and grasslands and do not, in fact, precisely represent the current reality. Thus, the obtained cadastral maps have been superimposed onto the GIS mapping in order to specify the affected areas, including land parcels. Furthermore, the Field Book (namely the listed land plots of cadastral maps) was used to identify the ownership of respective land plots and the land area. With the use of these GIS maps, cadastral maps and the Field Book, an

inventory structure survey was carried out to collect detailed information on the ownership of the affected structures, including the number of structures, the materials used, and ownership of each structure. The results were also used to estimate the loss of affected structures. Besides the review of the cadastral and GIS maps, direct field observation was very useful as a basis to identify and estimate the number of residential structure affected owners without legal holdings and affected cultivated land without legal registration. 838 households were identified as PAFs. Among the PAF, 86 households are from the inundation and risk zone of the project. Thus, 86 households are considered as relocatees.

II. Socio-economic Survey

After the identification of PAFs, a two weeks field survey was then conducted for the collection of primary data in January 2003 and later by the JICA Study Team in 2006. The following methods were used for this purpose.

- Questionnaire Interview;
- Checklist;
- Focus Group Discussion;
- Site Observation.

a. Questionnaire Interview

i) Household Surveys

Out of the 838 households, 399 households were selected randomly for the sampling purposes. Sampled households in the entire project affected VDCs and Municipality were surveyed using a semi-structured questionnaire to obtain the baseline information. The questionnaire had been designed especially to cover the demographic characteristics, basic health condition, income and expenditure, availability of facilities, water and energy related issues, information about the project, compensation, attitude towards settlements and expectations from the project. The household level questionnaires were filled in the site by enumerators who were trained. The sampled household questionnaire is given in Appendix B. Efforts were made to include all the relocates from the reservoir area.

ii) Survey with Women Member of the Sampled Household

A second set of questionnaire dealing with gender issues was also designed. This questionnaire was also surveyed in the sampled households especially with women members of the household. The questionnaire for gender issue was used in the field survey to analyze the status of women, their attitude towards the project, the possible impacts on women due to the implementation of the project and other gender issues.

b. Checklist Survey***i) Village Profile Questionnaire***

A separate village profile questionnaire was designed for the local administrative unit to collect information on the existing infrastructure and other facilities in the project impact area.

ii) Key Informant Survey

The key informant survey was the major survey instrument employed during the field visit to gather information on the socio-economic and cultural activities. This survey was conducted in all of the project impact area. The checklist was designed to collect information on basic demographic and migration patterns, food sufficiency and cropping patterns, existence of user's group/committees, public facilities and infrastructure, labour force availability, existence of archaeological and religious places and existence of disadvantaged groups and ethnic minorities.

iii) Focus Group Discussion

Group discussions were organized to give special attention to issues concerning the specific target group such as women, children and farmers. The local elites and other knowledgeable persons were also included in the discussion. The other occupational caste groups, ethnic minorities and disadvantaged groups were also included in the discussion, which gave opportunity for the people in the project area to voice their questions and concerns regarding the project. The VDC's district offices were visited to obtain relevant information.

c. Observation of the Site

Observation of the site was made to obtain information on different socio-economic and cultural activities of the impact area. Religious and archaeological sites of the impact area were also identified to assess the impact on religious and archaeological sites within the high, moderate and low impact zones.

The field data were compiled in the Kathmandu office and the draft EIA report was prepared.

3.3.3.3 Approach for the Public Involvement

Public Consultation programmes were conducted at various stages of the study in various forms. Details of the public consultation programmes are discussed in the following sub-sections.

I. Public Consultation during the Scoping Phase

A Public Notice was published in National Daily Newspaper "Gorkhapatra" on 4th February 2001 for the Scoping study. The main objectives of the notice were:

- To inform the public about the project itself and the VDCs/ Municipality to be affected

- To request the local people, organizations, NGOs and VDCs/ Municipality and other stakeholders to send comments and suggestions regarding the project.

After the publication of the notice, the environmental team visited the site for the Scoping study. The suggestions, comments and information received from all the affected people, organizations, NGOs and VDCs/ Municipality offices during the Scoping study have been incorporated while preparing the report.

II. Public Participation during the EIA Study

During the EIA study phase, the environmental team visited the various offices of Tanahun District in January 2003. The consulted offices were Vyas Municipality, District Development Committee Office, District Water Supply Office, Irrigation and Agriculture Offices of Tanahun district.

Likewise, interaction with the project-affected persons and local residents in the project impact area were also done through:

- Household Questionnaire Surveys;
- Key Informants Survey;
- Community Level Focus Group Discussions.

III. Public Consultation

A formal Public Hearing was conducted on January 25th, 2004 at the Vyas Municipality of Tanahun District. The notice of the Public Hearing was published in the National Daily Newspaper "Gorkhapatra". The same notice was developed in A4 size paper and pasted in various settlements of the project-affected area. More than 200 local people attended the hearing. A brief project brochure was prepared in the Nepali language and distributed to participants of the programme.

During the Upgrading Feasibility Study Level, the JICA Study Team involved the local public in additional field investigations. As per the JICA's Guidelines a series of stakeholders' meetings were organized during the study process. Thus, three stakeholders' meetings were organized at the project affected area and in Kathmandu. The details of the Public Consultation programme are given in Chapter Eight.

The local and National media highlighted about the Public Hearing, public response and outcome of the hearing positively. The news published in the various newspapers both during the Public hearing conducted as per EPR and Stakeholder meeting conducted by JICA Study Team is given in Appendix C.

3.4 EIA Report Preparation

The analysis of the field and secondary data were done to prepare the EIA report. The report follows the format of the Environmental Protection Rules, 1997 and its amendment Environmental Protection Act, 1996 and the National EIA Guidelines, 1993.

3.5 Limitations of the Study

The field investigation work was conducted in January 2003. Projections of observations during this period are assumed to hold for other seasons. For example, water quality analysis tests were made in the dry season and these values obtained do not fully represent the potential seasonal variations. Parameters such as DO, pH, specific conductivity were assessed at the site. Tests for other parameters were performed in the laboratory. Due to the time lag between sample collection and analysis in the laboratory, the results of the tests are subjected to some error especially for parameters like fecal coliforms for which the value was nil. During the Upgrading Feasibility field study conducted by the JICA Study Team water quality samples were taken both for the dry and wet seasons. The results have been included and discussed in this report in Chapter 4.

During JICA field survey cadastral maps were used for the social survey. These maps were prepared some 30-35 years ago and did not include information on forests, barren areas, river corridors, shrub lands and grasslands. In fact, they do not exactly reflect the existing condition of the project area. As the cadastral maps for Jamune VDC was not available, the information on affected land plots, affected land owners and affected structures including residential structures of Jamune VDC were collected and confirmed through the inventory structure survey. Wantang Khola, Phedi Khola and Tittuwa were not covered in the inventory structure survey since these areas were identified as Risk Zones after the completion of the field survey. The GIS map was the only source available to estimate the number of affected structures and their owners. It is proposed that all the limitations mentioned need to be taken into consideration during the Detailed Design Phase.

The sample size, findings and conclusions drawn from this study on the socio-economic environment may not represent the whole district. Therefore, the data may not fully represent the real and current situation of the impact area. However, it is considered to be sufficient for the purpose of this EIA.

CHAPTER FOUR

EXISTING ENVIRONMENTAL CONDITIONS

4.0 General

The following sections outline the baseline conditions for the physical, biological, socio-economic, and cultural environments of the project impact area.

4.1 Physical Environment

4.1.1 Watershed Condition

4.1.1.1 General

The Upper Seti Storage HEP is located in the Gandaki River Basin of the Western Development Region of Nepal. The total catchment of the basin upto the intake site is 1502 km² out of which about 129 km² is covered with snow. Glacier lakes are not identified on this basin.

The project catchment consists of two physiographic regions, namely the High Himalayas and the Lesser Himalayas. The catchment is located in the eastern region between latitudes 27° 45' 00" N and 28° 30' 00" N and between longitudes 84° 00' and 85° 00'. The project site itself is located in the Lesser Himalayan Physiographic Region, which is classified as a sub-tropical region. The project includes a reservoir extending upstream to the Seti River.

4.1.1.2 River System

The total length of the Seti River from the dam site to the source is about 120 km. The main stem of the Seti River drains the southern flank of the Higher Himalayan range and the central part of the catchment. At the upstream of the dam site, the river meets many small tributaries like Jyamdi, Kynadhi, Saraudi, Khudi, and Yangdi Kholas etc. At the upstream of the Pokhara valley, the river meets Mardi Khola at Lahachowk. The gradient of the Seti River upstream of the Mardi and Seti confluence is steep.

At about 2 km downstream of the proposed dam site, the Madi River a major tributary joins the Seti River. The river flows in a narrow gorge almost all along the reservoir stretch except at the end of the reservoir in Bhimad Bazaar, where the river spreads out to form sand beaches.

4.1.1.3 Physiographic Regions

The Seti River basin may be divided into two physiographic regions as follows:

- High Himalayas
- Lesser Himalayas

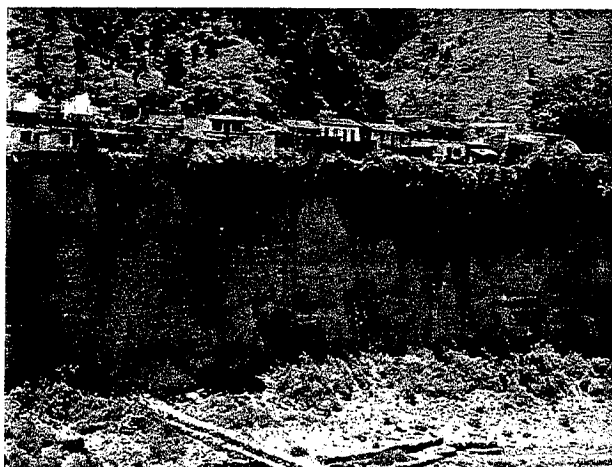
The land types in the Seti catchment area are divided into the following proportions:

Table 4.1: Physiographic Description of the Project Area.

Land Type	Km ²	%
Snow cover	129	8.6
Forest cover	721	48
Agriculture lands	476	31.7
Sandy soil	22	1.5
Water Bodies (lakes & rivers)	30	1.9
Bush & Grasses	124	8.3
Total	1502 Km²	100%

4.1.1.4 Watershed in the Immediate Project Impact Area

The general watershed condition of the Tanahu District is indicated as moderate in the GIS data base document published by ICIMOD. Although the watershed of the Seti River is relatively stable around the impact area mostly along the reservoir stretch, the area along the reservoir area like Bhimad Bazaar and along the tributary of the Wanten Khola is very poor. The surface geology of these critical areas appear to be very poor and mainly consist of cemented gravel with sandy to silty matrix with approximately about 2 m thick soil cover. These layers are permeable and a big escarpment is observed along the riverbank, which indicates the risk of collapse of the riverbank. The erosion process in these areas is more pronounced in the monsoon season. The formation of the reservoir and fluctuation of the water level will further aggravate the risk of bank collapse. The critical areas are mostly found in places like Bhimad Bazaar, Chore Patan and along Wanten Khola. Extensive cultivation is being done in these places, especially along the riverbanks.



Soil slide on the river terrace at Bhimad Bazaar

As mentioned earlier, the major portion of the reservoir is along a narrow gorge with vegetation on both banks. The immediate watershed of the dam and powerhouse sites is stable although minor slides were seen near the intake portal. This slide mostly consists of loose materials and soil, which is saturated with percolating water. Likewise, the topography of the access road is steep and stable with natural vegetation cover. The watershed downstream of the dam site is relatively stable. No major slides were seen in the downstream sections. The river Madi joins the Seti River at about 2.0 km downstream of the dam site. The river expands to form sand beaches at the end of the reservoir and along the dewatered section. Patches of agricultural land and

settlements were also observed along this stretch of the river. The watershed of the access road is stable and consists of steep area covered with forest. It was learnt from the District Soil Conservation office in Tanahu that soil conservation programs are being carried out in the watershed of Chabdi Khola and Buldi Khola upstream of the dam site. Gabion walls and plantations have been successful in these fragile areas to control gully erosion. These programs are being implemented from the financial assistance of GoN and the Government of Denmark.



Rockslide on the left bank of Seti River near Bhimad Bazaar

4.1.2 Topography and Landuse

The core project area lies in the hilly region with mild undulations. The altitudinal variation of the project area ranges between 450 and 300 m and the dam site is located at a very narrow section of the Seti River, where the left and right banks are vertical. The width of the river at the dam site is approximately 30 m.

The landuse in the project area, especially in the reservoir is mainly forest and patches of fertile agricultural land, especially at the end of the reservoir. The initial stretch of about 8 km of the reservoir lies through a narrower region with steep slopes on both banks. The latter part of the stretch runs through a wider area consisting of agricultural land, especially in Risinpatan, Saune and Bhimad villages. Extensive cultivation is being done in these places especially along the riverbanks. Sand bars and boulder deposits were also seen at the latter stretch of the reservoir. Considering the topography and landuse, the project area is divided into four separate zones:

- **“The Project Facility Sites”** including dam site, powerhouse, construction facilities such as access road, borrow areas, batching plants and spoil banks centered on the rural lands, communities located on both sides at the confluence between the Seti and Madi Rivers.
- **“The Lower Reservoir”** (downstream part of the reservoir), an approximately 15 km Seti River stretch from the dam site to Geruwatar, that has limited habitation with forested, narrow gorges, and steep cliffs.
- **“The Upper Reservoir”** (upstream part of the reservoir), an approximately 12 km Seti River stretch from Geruwatar to Bhimad Bazaar, that is relatively flat and spread out, with fertile *Tar* (*Nepali* = highly fertile stream alluvial areas, usually located at a higher level than Nepal’s main rivers at the terminus of subsidiary smaller rivers and streams and used for rice paddy), scattered settlements and, at its far end, the semi-urban Bhimad Bazaar community
- **“Downstream Zone”** of the Seti River, consisting of the river course and its various gravel bars, gorge sections and elevated tars used for agricultural purposes to the river’s confluence with the Trishuli River to the East.

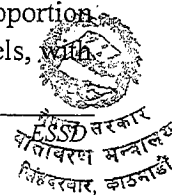
Table 4.2 Landuse Reservoir Area

S.No	Landuse Types	Land Use under FSL 415 m (ha)
1	Cultivation	69.36
2	Built up	0.85
Total cultivation/built up		70.21
3.1	Grazing Land	84.59
3.2	Shrubs	17.94
Total grazing/shrub		102.53
3.3	Hill Sal Forest	29.46
3.4	Khair/Sissoo Forest	52.62
3.5	Mixed Open Forest	271.81
Total Forest		353.89
4	Barren Land	0.28
5	Escarpment	5.38
6	River	91.44
7	Sand	111.74
Grand Total		735.41

Table 4.3 Landuse Project Facility Sites

	Landuse Types	Landuse in Project facility sites - ha
1.	Cultivation	35.28
2.	Hill Sal Forest	44.46
3.	Khair/Sissoo Forest	0
4.	Mixed Open Forest	24.24
5.	Barren Land	0
6.	Built up Areas	0.245
7.	Escarpment	0
8.	Grazing Land	7.35
9.	River	7.01
10.	Sand	9.28
11.	Shrubs	4.67
	Grand Total	133.08

More than 50% of landuse in the reservoir area under the Full Supply Level of 415 m is forest (including shrubs and grasslands). The proportion of forest increases with the decrease in the reservoir Full Supply Level, while the proportion of the built-up area decreases. The proportion of agricultural land in the reservoir varies between 20 to 4% at lower Full Supply Levels, with



the higher reservoir levels showing a higher proportion of agricultural land being inundated. Riverine areas (wet channel and river flood plain) constitute 9 to 19% of the inundation area under various reservoir FSLs that is the higher the reservoir FSL the lower the riverine area in proportion to the total area inundated.

An additional 13.4 ha is required for securing the risk zones in erosion prone areas associated with the nominated reservoir of FSL 415 m in places near the Wanten Khola, Phedi Khola and Tutuwa khola. This is made up mainly of cultivation (6.5ha), grazing land (2.2 ha), shrubs (2.3 ha) and Sal forest (2.3ha); accounting for over 90%.

In the project facility sites, nearly 64% of the area is forestland (including shrub land and grassland). The cultivated land occupies about 27% of the total land required for the project facilities and the rest for barren land and sand beaches.

4.1.3 Climate, Meteorology and Air Quality

The catchment of the Seti experiences severe cold, subtropical to temperate climate. The average maximum temperature in the project area is 28.4 °C and the minimum temperature is 16.8 °C. A typical temperature record for the year 1964 to 1999 from meteorological station No. 815 at Khairenitar is given in Table 4.4 .

The project area is influenced by the monsoon rain, which normally starts in the middle of June. The region receives approximately 80% of the annual rainfall during this period. The average annual precipitation at Upper Seti dam site has been computed as 3157 mm.

The maximum and minimum monthly relative humidity at the project location is 94% and 28%, respectively.

The dam site of the project lies in a rural setting. There are no industries and the area is completely devoid of industrial emissions. In a normal situation, the ambient air quality is not a problem in the project area and will naturally be within the WHO Guidelines value for all criteria. However, in the dry season (February–April), the overall atmospheric dry condition, less ground moisture, intensive loosening of dry agricultural soils for the preparation of soil and relatively windy weather conditions degrade the air quality in terms of particulate matters.

Table 4.4: Temperature and humidity at Station: 815 (Khairini Tar)

Year	Month	Air Temperature(°C)		Relative Humidity (%)		
		Absolute Extreme		Month	8:45	17:45
		Max & Date	Min & Date			
1975	April	38.9 / 8		February	92	
	February		4.2 / 7	April		22
1976	April	35.0 / 10		Jan/June	77	77
	Jan		6.9 / 10	Mar		21
1977	Sep	36.7 / 8		February	91	
	February		7.0 / 9	May		60
1978	Aug	37.8 / 14		Dec	93	
	Jan		4.6 / 10	Mar		40
1979	Jun	40.0 / 2		February	95	
	Mar		5.6 / 11	Mar		45
1980	April	38.2 / 26		Jan	98	
	Jan		6.7 / 8	April		53
1981	Jun	35.2 / 13		Dec	98	
	Jan		4.1 / 11	Mar		47
1982	May	37.1 / 27		Jan/Dec	97	
	Dec		5.8 / 25	Mar		50
1983	Jun	37 / 22		Jan	98	
	Jan		3.0 / 8	April		53
1984	Jun	36.7 / 1		Jan/Nov/ Dec	99	
	Jan		4.2 / 7	Mar		56
1985	April	39.3 / 27		Dec	100	
	February		4.2 / 25	April		70
1986	Jun	37.1 / 5		Jan/Dec	98	
	Dec		6.2 / 19	Mar		52
1987	May	37.1 / 19		Jan	98	
	February		5.3 / 2	April		57
1988	April	38.5 / 7		Jan/ Dec	97	
	Jan		5.4 / 27	April		61
1989	May	40.6 / 6		Jan	98	
	Jan		4.0 / 13	April		42
1990	Jun	37.5 / 26		Jan/Dec	97	
	Jan		5.4 / 3	April		55
1991	April	37.8 / 23		Jan	99	
	February		4.0 / 4	April		55
1992	April	40.7 / 14		Jan/Nov/Dec/Oct	96	96
	February		3.8 / 25	April		63
1993	Jun	37.5 / 15		Dec	96	
	February		5.0 / 22	Mar		61
1994	May	41.1 / 5		Dec	97	
	February		6.0 / 23	April		40
1995	May	38.5 / 3		Dec	98	
	Jan		1.5 / 2	Apr		43
1996	April	36.5 / 20		Jan/Dec	99	
	Jan		7.0 / 14	April		55

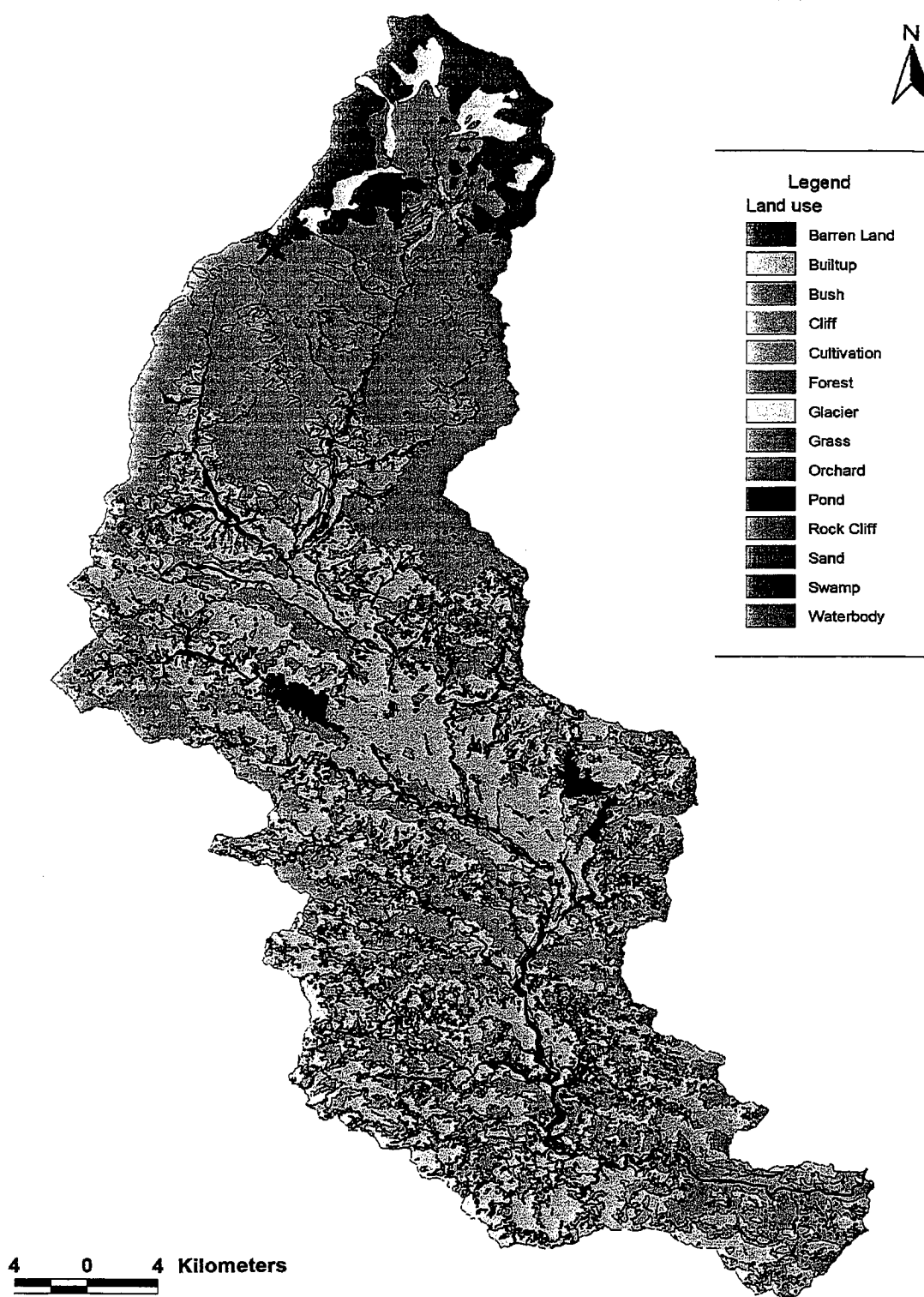


Figure 4.1 Land Use Map of the Seti Watershed

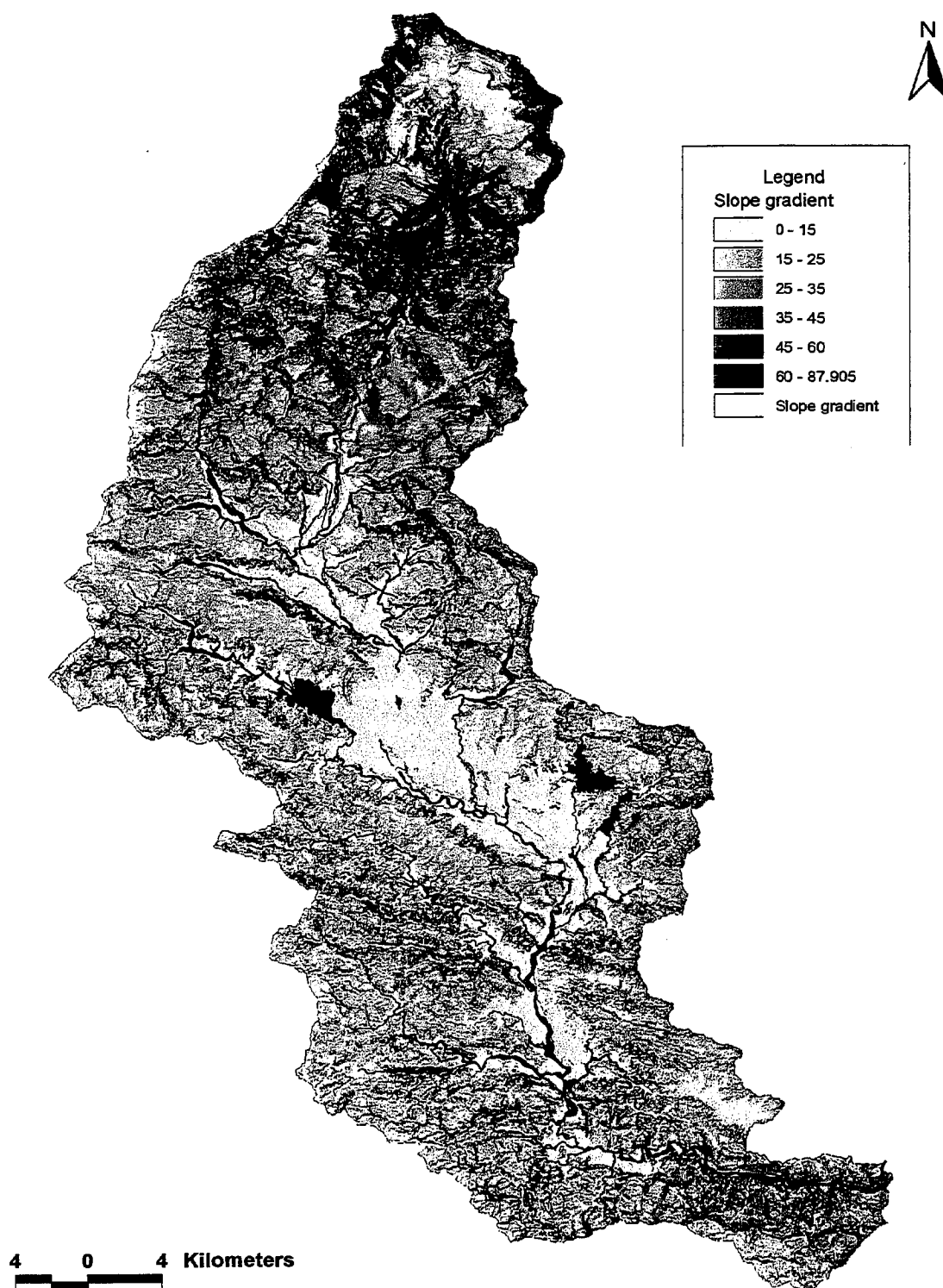


Figure 4.2 Slope gradients Map of the Seti Watershed

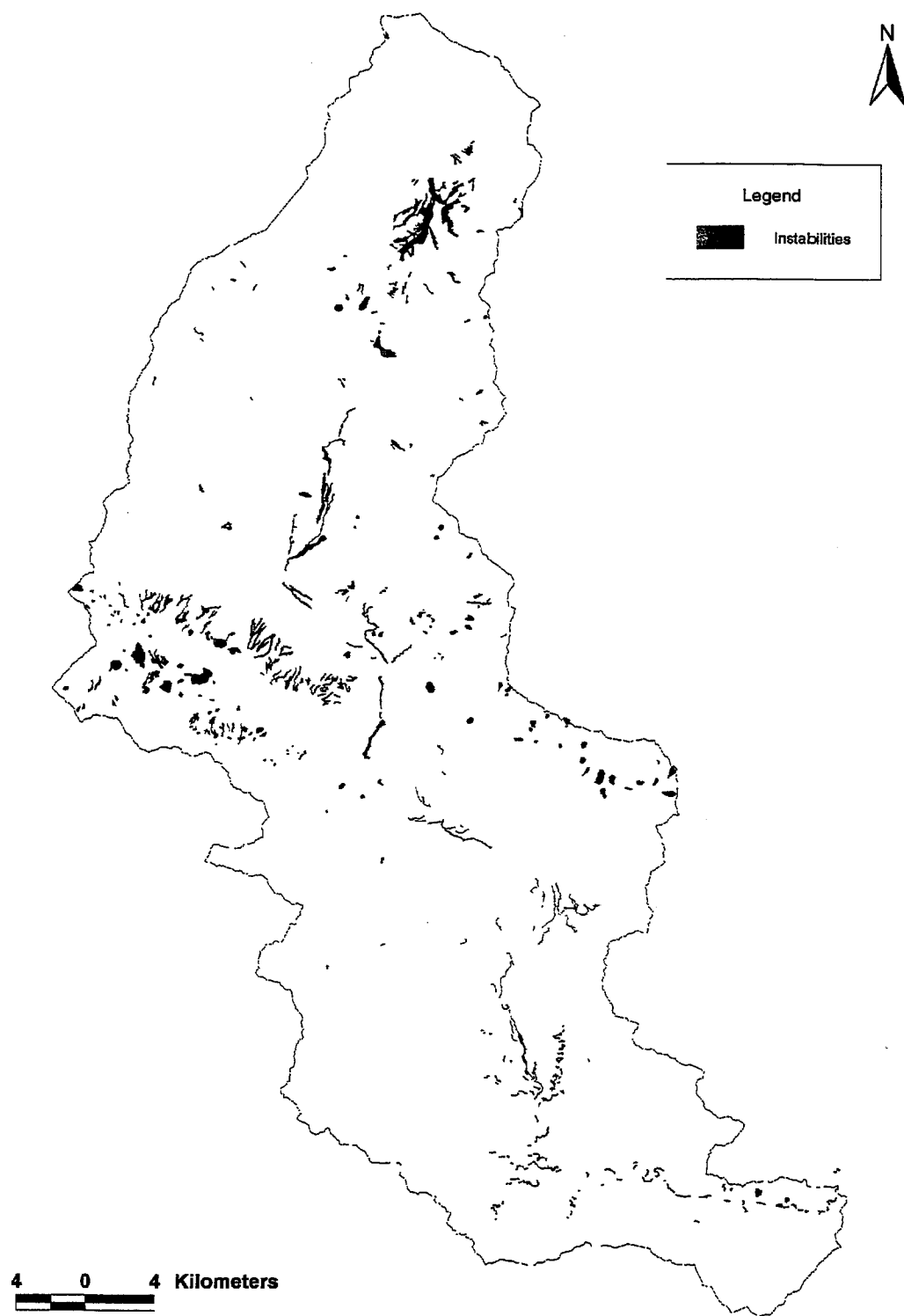


Figure 4.3 Distribution of Instabilities in the Seti Watershed

4.1.4 River Hydrology and Morphology

The Seti basin has a catchment area of 1502 km² at the dam axis. The annual average flow in the Seti River has been estimated by considering the data from two stations 430 and 438. The mean annual run-off has been estimated as 107.21 m³/s, which is about 3335 million m³ a year. The mean monthly flow generated at dam site (1964-1999) is given in Table 4.5.

The peak annual flows in the Seti River normally occur during the months of June to October and the lowest flows were observed in the month of February. The Probable Maximum Flood (PMF) simulated by HEC-1 is 8306 m³/s.

At about 2.0 km downstream of the dam site Madi Khola joins the Seti River. The mean monthly flow of Seti in the dry season is more than 15 m³/s.

4.1.4.1 River Morphology

Seti River is one of the main rivers of the Sapta Gandaki river system. The river flows in a narrow gorge in the reservoir area and expands between the dam sites. At some places, the river has steep side slopes with more than 75°. The slope at the dam site is almost vertical and the width of the river at the dam axis is not more than 30 m.

There are small tributaries like the Wanten, Phedi, Pirun, and Jyagdi Khola that joins the Seti River almost at the end of the reservoir. There are other small tributaries like Lima Khola that joins the reservoir near the dam site. Considerable flow was seen in tributaries like Wanten and Phedi even in the dry season of May.

At the end of the reservoir near Bhimad Bazaar and Risin Patan, the river widens to more than 200 m. In this area, the slopes are flatter, evidence of mass wasting can be observed and sand beaches with boulder deposits can be seen. The left bank of the river was observed to be more stable than the right bank.

Sand beaches and boulder deposits were also seen at the immediate downstream of the dam site where the river widens between 100-150 m.

The river then flows in a narrow gorge downstream of the powerhouse site almost upto the Trishuli Confluence.

4.1.4.2 Sedimentation

The project site lies in the Middle Mountains, which experiences a wide range of erosion causing events from landslides and surface erosion. The Seti River, which originates from the Annapurna Range, contains high sediment. It makes deep gorges upstream of the dam site near Pokhara generating a high quantity of sediment. However, the lakes at the upstream of the Seti River basin such as Phewa Lake, Begnas Lake, Rupa Lake, Dipang Lake, Maidi Lake, and Khasti Lake are the sediment trap reservoirs of the Seti River basin.

Approximately 10 km of the Upper Seti reservoir stretch flows through a narrow gorge. Landslides and soil erosion are not evident at this stretch however; at the end of the reservoir stretch from Badarkuna to Bhimad Bazaar, landslides were observed. In this narrow stretch of the reservoir, the topography is steep with rocky cliffs. The latter section is a sediment prone

and the banks consist of loose cemented materials. These materials are permeable which indicates that in the long run after the formation of the reservoir the bank may collapse. The banks especially the right bank is cultivated in this area.

These types of formation consisting of loose materials can be seen in populated areas like Bhimad Bazaar, Risin Patan, Chhore Patan and Jaruwapani. The sediment from this area is expected to be transported and deposited in the reservoir. The critical areas which will contribute significantly to sedimentation of the reservoir are shown in Figure 4.3

The recommended total sediment yield at the dam site for design purpose is 6407 t/km²/y

4.1.5 Geology and Soil

The Upper Seti Storage Hydroelectric Project belongs to the Midland Metasedimentary Units of the Lesser Himalayan Zone in Western Nepal. In the project area, the Midland Metasedimentary Units are represented by Dhading Dolomite, Benighat Slates and Nourpul Formation comprising of dolomite, slate, phyllites, quartzite, dolomitic quartzite, quartzitic phyllite and calcareous phyllite. All the rock types belong to the Nuwakot Complex of Lesser Himalayas. The Main Boundary Thrust (MBT) is located at about 30 km south of project area and the Main Central Thrust (MCT) is located at about 40 km north of the project area. A local faulted contact between slate and dolomite runs parallel to the Seti River in the reservoir area.

Soil tests have revealed that two types of soil is found at the dam site, mainly alluvium deposits in the river channel and colluvium on the left bank slopes have been identified. The alluvial materials consist of gravel with cobbles and boulders, while the colluvium consists of sand and gravel with cobbles and boulders. The alluvium has been confirmed as 20 m deep in the river.

The soil of the agricultural area consists of sandy soil, silty clay, and red clay, grey and brown in colour.

4.1.5.1 Dam

The Upper Seti dam site is located in a narrow gorge on the Seti River about 2 km upstream from the Madi River confluence. The river width is approximately 30 m with steep slopes on both the banks near the dam axis. The rocky slope at both the banks at the dam site area is sub-vertical to vertical. The average slopes of the river valley up to the FSL on both banks are about 75° - 80°. The bedrock distributed in the dam and headrace tunnel area is the Dhading Dolomite belonging to the Nuwakot Complex.

The predominant rock of the dam site is grey coloured dolomite. The dolomite is slightly to moderately weathered, medium strong to strong, highly jointed, blocky to seamy to locally fractured in nature. The exposed dolomite rock is medium to thick bedded, hard to very hard and compacted. The joints are mostly tight occasionally 5 cm open, rough, irregular, moderately spaced with moderate persistence.

A recent alluvium deposit is also observed along the bank of the Seti River in and around the dam axis. The recent alluvium deposit in the dam axis is flood plain deposit. In this area recent alluvium is well formed by the river along the left and the right banks. The deposit is composed of boulders, cobbles and pebbles of dolomite, quartzite, slate, phyllite and schist with traces of

granite and gneiss in a silty and sandy matrix. However, the rock seems to be sound and is suitable for the construction of any type of dam structures at present; dolomite is susceptible to react with water and in the long run it creates small caves forming a karstic structure. The geology of the access road consists of similar formation as the dam site.

4.1.5.2 Reservoir

The reservoir of the Upper Seti Storage HEP project with Full Supply Level at an elevation of 415 m will extend up to Bhimad Bazaar. The reservoir would extend into all tributaries of Seti River up to the Full Supply Level.

About 11 km of the immediate upstream reservoir stretch of the dam axis is confined within a deep gorge formed by the Seti River. The rock along the left bank of the Seti River is represented by medium to thick bedded, SW dipping dolomite with fractured rock at places and the rock along the right bank is represented by SW dipping phyllitic slate to slate. The dip amount on both rock types along the two banks ranges from 30-60°. No major karst feature was observed during the present investigation. A fault traverses almost parallel and along the river in this stretch. This is a faulted contact between dolomite and slate. The strike of the rock is almost parallel to the river course. The general trend of flow of the river is west to East. The talus deposit is distributed in an area lower than the FSL, EL. 415 m except for the several sites in the middle to upstream area of the reservoir. Terrace deposits are found in the area from Geruwa, which is located in the upstream area, to Bhimad Bazaar near the upstream end of the reservoir. Bhimad Bazaar exhibits a typical vertical bank erosion of loosely consolidated terraces at some places.

No major issues regarding the reservoir tightness were observed during the present geological mapping. The dolomite, slate and phyllitic slate are technically impervious rocks. The minor seepage from the faulted contact between slate and dolomite may be anticipated, however no study has been made at this level to check the leakage from this contact. This can be checked by drilling and water pressure testing at the contact. The present investigation observed that the contact between these rock formations is tight. Hence major leakage problems would not be expected. The surficial deposits of colluvial and alluvial soil in general can be considered to have low permeability. At some places several seepage zones were noticed. Such seepage zones are mostly along the foliation planes/joint planes indicating a permeable rock. Therefore, it can be concluded that no major seepage caused by active faults and thrusts have been found during the present study. The reservoir boundaries in general can be considered as water tight within the technical limit.

4.1.5.3 Intake

The intake portal is located on bedrock along the right bank. Phyllite and slaty phyllite are distributed at the intake site. The slope where the intake is planned is relatively gentle, with an inclination of about 40°, but no thick talus deposits and landslides are found in this area.

4.1.5.4 Diversion Tunnel

A single diversion tunnel is proposed. The diversion tunnel is located at the right bank. The inlet portal of the diversion tunnel is located in dolomite. The exposed dolomite is slightly to

moderately weathered. They are highly jointed and blocky to massive in nature. The rock exposure is medium to thick bedded, hard to very hard and compacted. The surface geological mapping showed fair to good RQD. The diversion tunnel passes through gray dolomite. The outlet portal of the tunnel lies in colluvial soil. The colluvial soil consists of angular to sub-angular boulder and gravel of dolomite and quartzite in silty sandy matrix.

4.1.5.5 Penstock and Powerhouse

The penstock and the underground powerhouse are composed of dolomite, with a layer thickness of 300 m. to 350 m. near the underground powerhouse site and the width of the dolomite layer in the horizontal plane is about 350 m- 450m. The dolomite in this area is hard and relatively modestly jointed.

4.1.5.6 Tailrace Tunnel

As the outlet of the tailrace is composed of relatively sound slate and slaty phyllite, there appears to be no significant problem for the construction works.

4.1.5.7 Spillways

The site for the main spillway consists mainly of colluvium and quartzite rock. The auxiliary spillway site comprises of mainly phyllite.

4.1.6 Seismicity

Nepal has experienced several large earthquakes over the past several years, which has caused substantial damages to property and life. Considering this, the seismic study has been done for the Upper Seti Storage Hydroelectric project. The seismic data used in the study are based on those from 1994 to 2004 by the National Seismological Center in Nepal and those from 1905 to 1995 by the NOAA (National Oceanic and Atmospheric Administration), United States Department of Commerce. The above data include details of around 4,000 earthquakes which had their epicenters located within a 1,000 km radius of the Upper Seti Project Site (84° 15' 30" in East Longitude 27° 57' 14"")

The seismic data shows that epicenters are distributed in the Himalayan Tectonic Zone. The seismic map also suggests that Far Western Nepal is seismically more active than Eastern Nepal..

Seismic Risk Analysis has been done for the Upper Seti project to forecast the seismic characteristics. The following table show seismic characteristics in the project site and its surrounding based on the collected data.

1) Epicenter Distribution by Magnitude

Table 4.5 shows the frequency occurrence of magnitude among the collected data:

Magnitude	Number data	Amount
<3	69	69
<4	137	206
<5	2479	2685
<6	1010	3695
<7	315	4010
<8	50	4060
Total	4060	

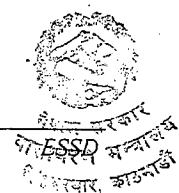
- Earthquake with epicenters located in Nepal, of magnitude 4 to 5, are overwhelming.
- Almost all epicenters located in Nepal are distributed in the Himalayan tectonic zone
- No earthquake exceeding 7 in magnitude occurred near the project site.

Water samples were collected from 4 locations around the reservoir, dam site area, powerhouse area, at the end of the dam (Bhimad Bazaar) and Madi River during the EIA field visits. Figure 2.2 in Chapter 2 gives the location of the sampling spots. The sampling was carried out in January 2003. Tests for parameters such as temperature, dissolved oxygen, specific conductivity and pH were done insitu. The analysis of parameters such as BOD, COD, hardness, alkalinity, acidity, fecal coliform, iron etc., were performed in a laboratory in Kathmandu.

The pH of the water is above 8 indicating the basic nature of the water. The pH should be within the range of 6.5 to 9 to support an aquatic environment. The dissolved oxygen varies between 7.5-7.7 indicating that the river water is not polluted. The dissolved oxygen below 4 mg/l produce detrimental effects on most aquatic organisms. The turbidity of the water was found to be very low. The value was slightly high in Bhimad Bazaar than in other areas which may be due to the erosion around the banks of the river. Similarly, parameters like calcium, total alkalinity were also higher in Bhimad Bazaar where mass wasting and instability was observed along the Seti river banks.

During the Upgrading Feasibility Study the JICA Study Team conducted additional water quality sampling tests at four locations. Parameters necessary for projecting reservoir eutrophication such as dissolved phosphate and total phosphate were measured. Table 4.5 shows the variation from the end of the dry season (June) to the wet season (October) with respect to parameters such as turbidity, total suspended solids and settleable solid.

The results of the water quality tests conducted by the JICA Study Team showed similar results. Concerning biological oxygen demand and chemical oxygen demand values, the river water is in the state of self-cleansing status. The low BOD/COD rating shows that the water is in the state of least contamination by other organic pollutants. The ammonia values range from 0.04 mg/l to maximum of 0.12 mg/l at the upstream dam site, which are low.



4.1.8 Noise Quality

The dam site and the power house site are located in the interior rural setting of the Tanhu District. There is no industry or road traffic in the immediate project area and therefore there is no noise pollution in the core project area.

Table 4.5: Generated Monthly flow at the dam site (in cumec)

Catchment Area 1502 Km² (modified)

Year	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sep	Oct	Nov	Dec
1964	31.8	30.4	30.1	31.9	68.9	78.0	134.3	460.6	313.1	112.4	82.0	53.8
1965	34.0	29.5	29.7	32.7	36.3	151.0	293.4	368.5	190.3	62.6	46.9	31.3
1966	24.6	22.2	21.0	19.4	22.2	63.5	228.4	259.6	159.8	66.0	38.6	25.5
1967	20.6	20.7	20.1	22.8	24.5	57.8	231.3	213.2	185.8	77.2	43.5	33.8
1968	24.9	20.5	24.7	25.2	34.9	141.9	336.1	286.9	222.6	146.5	42.1	23.7
1969	18.3	14.6	15.2	15.0	16.6	34.4	128.0	315.1	264.0	79.5	40.3	26.1
1970	20.2	17.3	16.3	24.6	35.3	91.2	380.9	412.1	202.1	106.1	56.8	33.4
1971	23.7	18.7	18.7	29.1	39.6	187.7	291.2	300.6	212.8	145.7	67.7	40.0
1972	25.7	20.3	19.4	20.5	52.9	106.6	325.7	362.5	251.6	108.5	51.4	33.5
1973	25.1	17.6	18.0	25.8	39.2	176.3	244.0	388.9	265.3	259.4	74.4	39.1
1974	36.8	33.7	32.6	40.8	39.0	91.7	343.4	411.6	254.4	131.7	43.8	34.1
1975	33.0	32.1	30.2	22.8	24.0	84.9	427.0	328.5	305.5	139.1	54.1	30.4
1976	22.3	23.1	19.8	24.9	40.9	190.2	380.2	342.3	216.0	88.4	43.6	33.8
1977	22.7	20.4	20.7	30.2	46.9	92.4	288.4	409.0	248.4	111.8	74.8	43.3
1978	32.3	29.6	27.2	29.4	68.7	162.2	381.0	349.6	215.6	106.0	64.3	47.7
1979	37.7	33.7	29.8	37.7	51.9	84.7	315.0	447.0	239.3	107.2	57.5	34.6
1980	25.2	23.2	25.3	26.6	37.1	107.9	425.1	446.5	313.7	82.5	43.8	26.2
1981	18.4	14.9	15.9	28.7	41.0	95.9	412.7	380.9	242.7	97.9	50.2	37.3
1982	33.5	31.2	36.3	40.8	49.2	98.2	259.4	338.1	207.7	86.4	55.4	45.6
1983	39.8	36.6	35.3	34.5	47.2	93.4	210.4	270.5	276.8	143.2	54.7	39.7
1984	28.0	21.5	21.7	24.0	62.8	152.0	445.0	287.2	243.4	96.1	58.6	41.3
1985	36.9	33.5	33.0	39.1	61.1	114.9	333.4	197.5	202.9	126.2	56.5	36.0
1986	24.7	19.8	21.4	28.5	27.9	117.6	260.7	259.8	280.2	147.9	59.2	30.7
1987	23.5	20.4	21.4	23.6	31.1	72.1	279.9	279.5	183.6	87.2	54.2	39.2
1988	30.2	26.9	27.0	28.8	40.7	111.7	264.5	320.5	238.9	102.6	52.9	38.6
1989	33.9	27.8	27.8	30.5	59.4	146.6	251.6	310.7	240.2	113.9	53.8	36.4
1990	28.1	24.8	26.0	35.9	55.2	152.9	271.9	237.4	194.1	102.7	44.5	27.3
1991	20.0	17.6	16.8	20.3	33.4	114.9	281.0	320.4	250.1	117.2	56.2	39.0
1992	31.1	27.8	26.5	25.1	35.7	82.0	188.9	289.7	197.4	124.8	50.3	30.5
1993	23.2	20.6	14.5	14.7	30.0	97.8	218.4	321.3	215.5	122.4	56.8	33.3
1994	29.3	27.5	29.8	30.1	37.0	103.5	184.2	234.0	142.8	37.7	17.7	12.9
1995	10.5	9.9	11.3	11.9	28.3	255.9	314.9	194.0	175.9	129.9	85.9	52.7
1996	30.1	21.8	30.9	31.0	37.6	69.2	227.0	319.8	252.2	107.6	45.8	31.5
1997	27.1	24.0	28.4	32.6	38.4	74.9	229.5	258.9	141.6	61.8	35.0	33.1
1998	24.2	21.5	24.9	29.1	48.7	149.4	288.1	452.5	207.3	64.2	35.6	26.0
1999	21.3	18.5	17.0	18.8	34.8	93.1	264.8	238.7	174.3	67.4	23.1	15.3
Mean	27.0	23.7	24.0	27.4	41.1	113.8	287.2	322.6	225.8	107.4	52.0	34.4

Mean annual flow 107.2 cumecs

Parameters	Dam site	Dewatered Section	Bhimad Bazaar	Madi Khola
pH	8.3	8.3	8.3	8.8
Turbidity NTU	6	5	14	3
Total dissolved Solid mg/l	154	118	165	75
Suspended Solid mg/l	<1	<1	1.4	<1
Settleable Solids mg	<1	<1	<1	<1
Non Settleable Solid mg/l	<1	<1	1.4	<1
T. Alkalinity mg/l	124	99	138	57
T. Acidity mg/l	<1	<1	<1	<1
Total Hardness	113	76	68	50
Calcium (Ca)	22	22	27	15
Magnesium (Mg)	14	5	<1	3
Sulphate (So4)	17	14	18	11
Ammonia (NH3)	0.02	0.015	0.05	0.05
T. Phosphate (PO4)	< 0.01	<0.01	<0.01	0.01
Chloride (Cl)	76.4	7.4	7.4	7.4
Sodium (Na)	5.4	4.8	5.6	4.6
Potassium (K)	3.8	3.5	4.1	3.3
Iron (Fe)	0.02	0.02	0.07	0.02
Dissolved Oxygen	7.7	7.5	7.7	7.7
COD mg/l	4.1	4.1	5.9	6.9
BOD mg/l	1.6	1.5	2.0	2.4
Total Coliform col/100 ml	Nil	Nil	Nil	Nil

S.N.	Parameters	Observed Values			
		Range 04-06-06		Range 09-10-06	
		Low	High	Low	High
1.	Water Temperature	20	24	20	22
2.	pH at 25°C	8.1	8.1	8.1	8.2
3.	Turbidity, (NTU)	120	230	19	34
4.	Total Dissolved Solids, (mg/l)	131	175	104	162
5.	Total Suspended Solids, (mg/l)	206	501	33.6	66.8
6.	Settleble Solids, (mg/l)	206	497	33.3	65.9
7.	Non Settleble Solids, (mg/l)	<1	3.7	0.34	0.94
8.	Total Hardness as CaCO ₃ , (mg/l)	135	149	90	160
9.	Total Alkalinity as CaCO ₃ , (mg/l)	133	144	89	160
10.	Total Acidity, (mg/l)	2.6	7.7	2.6	11.8
11.	Chloride, (mg/l)	1.5	3.0	2.0	13.4
12.	Ammonia, (mg/l)	0.10	0.14	<0.05	0.05
13.	Sulphate, (mg/l)	14.8	18.5	9.1	16.9

S.N.	Parameters	Observed Values			
		Range 04-06-06		Range 09-10-06	
		Low	High	Low	High
16.	Calcium, (mg/l)	35.3	37.7	22.4	38.1
17.	Magnesium, (mg/l)	9.7	14.8	8.3	15.1
18.	Iron, (mg/l)	2.31	6.07	0.78	1.0
19.	Sodium, (mg/l)	1.93	2.14	2.21	2.99
20.	Potassium, (mg/l)	2.02	2.14	2.13	2.73
21.	Dissolved Oxygen at 15°C, (mg/l)	8.6	8.8	7.3	7.8
22.	Chemical Oxygen Demand, (mg/l)	2.0	3.5	1.5	4.5
23.	BOD ₅ , (mg/l)	0.42	0.78	0.75	0.91

Note : Sample - 1 : Upstream Dam site
Sample - 3 : Upstream, Bhimad

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

4.2 Biological Environment

The existing terrestrial and aquatic ecosystems in the project area have been discussed in this section.

4.2.1 Vegetation

The physiography of the project area comprises the Mahabharat range and Midland covering entirely the tropical flora. Hills less than 1,000 m run along west to east with different patches of vegetation composition at both sides of the Seti River. Vegetation is prominent at the lower altitudes. In general, moisture is retained much on north and west facing slopes and south and east faces remain drier due to longer exposure to the sun. Except for shrubs and cultivated areas at the hill tops in both sides of the river show virgin and undisturbed vegetation in its steep and inaccessible slopes particularly between the dam site to Geruwatar at the Seti gorge.



There are no remarkable changes in the vegetation and its composition on both sides of the river. The vegetation is more or less the same. However, the left bank is comparatively disturbed due to recent encroachments of forest land for farming by the rural people along the river in Betini, Seti Bhagar and Belbot. The forest is very sparse from Geruwatar along the right bank up to Bhimad, while forest is conserved up to Jhakkas on the left bank.

The right river bank has a higher biodiversity value than the left bank due to the presence of threatened plants such as wild varieties of banana (*Ensete glaucum*) and Screw pine (*Pandanus nepalensis*). These species are also occasionally found on the steep slopes of the left bank too.

There is no difference in the vegetation composition of the forest in the project area along the Seti River. The proposed area is a part of the Central Nepalese Biogeographic Region (Dobremez, 1976). However, the area, from altitudinal consideration, is a part of the Upper Tropical Eco-Zone (300 to 1000 m), have forests vegetation characteristics of the Lower Tropical Eco-Zone (70 to 300 m) in the deeply entrenched river gorge of the Seti river. The Sal Forest, a component of the Upper Tropical Eco-Zone is well developed in the higher elevations of the Seti gorge (above 100 m from the valley floor), whereas in the river bottom and on the gorge flanks

Mixed Open Forest with patches of Khair (*Acacia catechu*) forests are present which have characteristics of the Lower Tropical Eco-Zone. Three types of vegetation can be described based on small forest patches seen at different aspects of the hills on both sides of the river.

4.2.1.1 Forest Types

The following types of forest were recorded in the project area:

Hill Sal Forest

Shorea robusta (Hill Sal) is the dominant species, which is normally observed above EL.400 m. The associates of this forest are *Schima wallichii* (Chilaune), *Lagerstroemia parviflora* (Botdhyero), *Bauhinia vahlii* (Bhorla) and *Desmodium oojeinense* (Sadan) etc.

Mixed Open Forest

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

Khair/Sisoo Forest

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

4.2.1.2 Forest Management

The forests in Nepal are divided into five forests: National Forest (Protection Forest), Community Forest, Leasehold Forest, Religious Forest and Private Forest. Out of this, three National Forest, Community Forest and Private Forest exist in the project area.

The area, distribution and responsibility for Forest Management are illustrated in Tables 4.8 (a) and 4.8(b). The area of community forest is increasing with nine affected forest with a total area of 88.8 ha. About 5.3 ha of Private Forest is affected at Full Supply Level of 415 m. In addition it is to be noted that most of the reservoir area, area affected by the construction works and access road to the project site consists of National Forest.



Table 4.8 (a) Forest Area Affected at FSL 415 m in the Reservoir Area

SN	Types of forest	Area (ha)
1	National Forest (Protection Forest)	259.84
2	Community Forest	88.77
3	Private Forest	5.29
Total		353.89

Source: Supplemental EIA Survey, JICA Study Team, 2006

Table 4.8 (b) Forest Area in the Project Facility Site

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

Source: Supplemental EIA Survey, JICA Study Team, 2006

Tanahu district has a total forest land of 62,654 ha. Out of it, 20,292 ha of forest are transferred to 320 Community Forest User Groups by 2004. A total of 31,313 households with a population of 182,504 are directly involved in the community forest management. The profiles of Community Forests affected in the project area are presented in Table 4.8 (c)

There are nine Community Forests in the Project area. Among seven forests will be affected by inundation due to the formation of the reservoir.

Table 4.8 (c) Profiles of Community Forests At Reservoir Site

S.N	Name of Community forest	Total User HHs and Population	Total area CF (ha)	Location
1.	Sisneri Tapu CF	96 (294)	8.75	Bhimad VDC
2.	Banchare Danda CF	86 (457)	18.78	Chhnag VDC
3.	Sangu Pokhara CF	24 (154)	20.3	Chhang VDC
4.	Bhadaure Danda CF	110 (848)	83.5	Rising Ranipokhari VDC
5.	Ghumaune Danda CF	59 (269)	53.95	Risisng Ranipokhari VDC, Ward 9
6.	Shidhabatasan CF	125	104	Jamune VDC, Ward 6
7.	Bansghari CF	218 (1488)	63.75	Rising Ranipokhari VDC, Ward 1 and 2
8.	Bajar Thumki CF	95 (859)	80	Kot Durbar VDC, ward 7
9.	Salbas CF	248 (1626)	65.5	Kahun Shivapur VDC, Ward 1
Total			498.53	

Source: District Forest Office Tanahu (2006)

Similarly, private forests are also found in the project site. The planted Sisso (*Dalbergia sisoo*) and Khair (*Acacia catechu*) forests were observed along the Seti River between Bhimad and Banderkuna in the upper reservoir area. Details of the private forests are presented below:

Table 4.9 Private Forests in the Reservoir Area

S N	Location	Name of owner	Tree species	Area (ha)
1.	Chhang (left bank of Seti) Thandiphan	Shiva Kumar Hirachan	Sisso	0.50
2.	Chhang (Left bank of Seti) south of Bhimad Bridge	Bhim Bahdur Lalchan	Sisso	0.50
3.	Bhimad (Right bank of Seti) Khanaltar	Janajyoti Higher secondary School	Sisso and Khair	4.50
4.	Chhang (Left bank Seti River) below Chhang Patan	NI	Sisso and Khair	0.25
5.	Bhimad (Right bank of Seti) below Khanaltar	Resting place (temple)	Sisso	0.25
6.	Wantan Khola (Right bank of Seti)	Land belong to government	Sal Chilaune	0.50
7.	Rising Patan (Right bank of Seti) Lower terrace	Land belong to government	Sisso / Khair	0.50
8.	Jhakas (Left bank of Seti)	Land belong to government	Sisso / Khair	0.50
9.	Jalbire	Land belong to government	Sal /Chilaune	1.00
10.	Bandarkuna	Land belong to government	Khair	0.25
11.	Upstream Dam (Left bank of Seti)	K.B. Gurung	Bamboo (75 clumps)	3.15
Total				11.9

Source: Field survey, 2006

4.2.1.3 Ethnobotany

An ethnobotanical survey revealed that the Magars who reside in the local community in the project area have rich indigenous knowledge of wild plants. They utilize the plants for various purposes such as medicine, food, timber, fermentation material, fish poisoning etc. A total of 101 plants of ethno-botanical value were recorded, out of them 58 plants have been recorded for their medicinal values, 29 plants of food value, 17 plants are used as timber, 9 plants are preferred fodder, 7 plants are used to brew local wine, 5 plants are preferred by the local people to make farming implements, 4 plants are used in religious ceremonies, 4 plants are recorded as fiber yielding, 3 plants used as fish poisoning, and 2 plants each used for fencing and roof thatching.

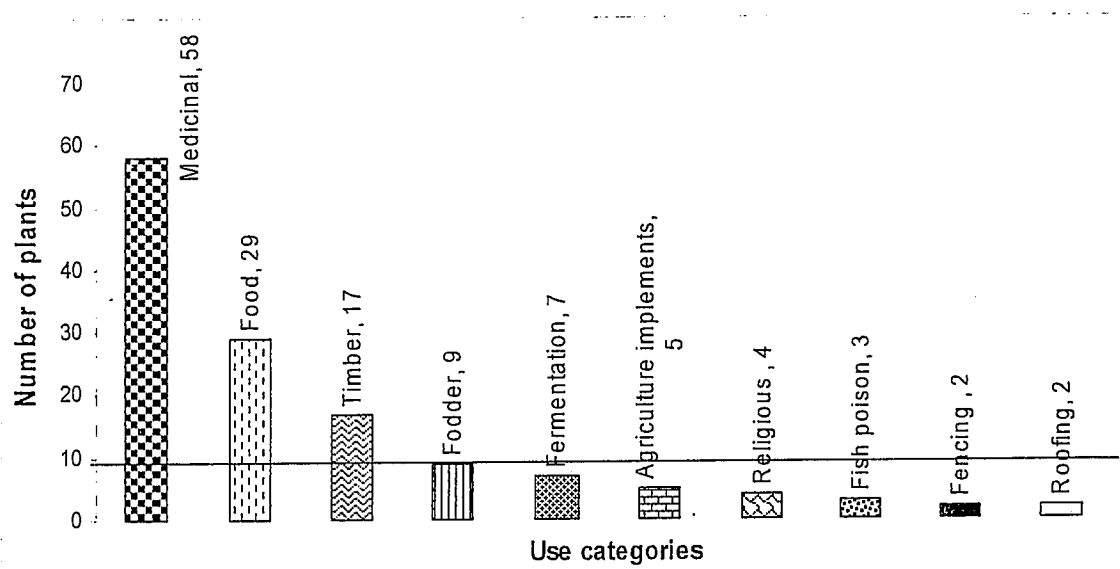


Figure 4.4 Number of Plants with Different Use Values Recorded in Project Area

4.2.1.4 Conservation Status of Plants

Out of total record of 209 wild plant species in the project area 3 plant species fall under the Nepal Government Conservation Categories, 6 (including 4 orchids) under CITES and 6 plant species are under IUCN conservation categories. The Plant species found inside the project area which are listed under different conservation categories are presented below:

Table 4.10 Plants of Project Sites under Different Conservation Categories

SN	Plant Species	Status	
		CITES	IUCN
1	<i>Acacia catechu (L.f.) Willd.</i>		T
2	<i>Alstonia scholaris (L.) R. Br.</i>		R
3	<i>Dioscorea deltoidea Wall. Ex Grises</i>	II	T
4	<i>Oroxylum indicum (L.) Kurz.</i>		V
5	<i>Rauvolfia serpentina (L.) Benth.</i>	II	E
6	<i>Shorea robusta Gaertn.</i>		E

Note:

CITES = Convention on International Trade in Endangered Species of Wild Fauna and Flora which defines Appendix I, II & III as follows:

- I Appendix I shall include all species threatened with extinction which are or may be affected by the trade. Trade in specimens of species must be subject to particularly strict regulation in order not to endanger further their survival and must only be authorized in exceptional circumstances.
- II Appendix II shall include (a) all species which although not necessarily now threatened with extinction may become so unless trade in specimens of such species is subject to strict regulation in order to avoid utilization incompatible with their survival and (b) other species which must be subject to regulation in order that trade in specimens of certain species referred to in sub-paragraph (a) of this paragraph may be brought under effective control.
- III Appendix III shall include all species which any party identifies as being subject to regulation with in its jurisdiction for the purpose of preventing or restricting exploitation, and as needing the cooperation of other parties in the control of trade.

IUCN Definition:

Endangered (E) – Taxa in danger of extinction and whose survival is unlikely if casual factors continue operating.

Vulnerable (V) – Taxa believed likely to move in to the endangered category in near future if the casual factors continue operating.

Rare (R) – Taxa with small world population that are not at present endangered or vulnerable, but are at risk.

Intermediate (I) – Taxa known to be endangered or vulnerable or rare but there is not enough information to say which of three categories is appropriate.

Insufficiently Known (K) – Taxa that are suspected but not definitely known to belong to any of the above categories, because of lack of information.

4.2.1.5 Plant Biodiversity

Due to the difficult access and complex geography, the forests on the steep slopes along the Seti River are disturbed to a very small extent and the rich biodiversity is maintained, especially, in the lower reservoir area. Floristic exploration in the project area reveals 209 wild flowering plant species. The present survey enumerated highest number of herbs (69 spp.) followed by trees (62 spp.), shrubs (53 spp.) and climbers (25 spp.). The detailed lists of the wild flowering plants found in the Seti river gorge between Damauli and Bhimad are presented in Appendix D, Table 1.

4.2.2 Wildlife

The Upper Seti Storage Hydroelectric Project area lies in the Middle Mountain physiographic region of the country. The smaller patches of forests in the project area do not support diverse species of wild life. However, 27 species of wildlife, 62 species of avi fauna were reported in the project area during the field survey period. The distribution of wildlife species is not uniform in the project area because wildlife species are influenced by different factors such as proximity to human settlements, habitat degradation and topographical features.

Generally, the dense forest, shrubby land provides favorable habitats for many wildlife species which use the natural forest floor for their habitat. The wildlife reported or seen from the project area are as follows:

4.2.2.1 Mammals

Altogether 27 species of mammals were reported from the project area during the field survey. All the reported species are common in the Middle Mountain physiographic region of the country. The reported species are Rhesus monkey (*Macaca mullatta*), Common Langur (*Presbytes entellus*), Malsapro (*Marten flavigulla*), Jackal (*Canis aureus*), Leopard (*Panthera parodus*), Ghoral (*Nemorhaedus goral*), Ban biralo (*Felis chaus*), Fyauro (*Vulpes bengalensis*), Flying Squirrel (*Petaurista petaurista*), Squirrel (*Funalbus sp.*), Hare (*Lepus nigricolis*), Banel (*Sus scrofa*) and Dumsi (*Hystrix indica*). The natural forest habitat in the reservoir area hardly favors wildlife like ghoral. However, during the questionnaire survey the local old people confirmed the presence of ghoral in the project area. The local people confirmed frequent calls of

wild animals which provide the evidences for the existence of this species around the project area. The list of mammals found in the project area is given in Appendix D.

The mixed hardwood forest in the dam and reservoir area provides a suitable habitat for local wild animals. According to local information Rhesus monkey, Common langur and Dumsi are responsible for raiding crops. Besides crop damage and the loss of domestic animal is also occasionally reported in the project area.

4.2.2.2 Birds

The diversity of birds in Nepal is high and the country has more than 860 species. Mixed hardwood forest, bamboo grooves, field and structure associated with village, Khola, streams and cliffs provide suitable habitats for a number of bird species. Some 62 bird species belonging to 14 orders and 34 families are recorded in the Project area. However, the bird species found in project area were common and widely distributed in midhill through out Nepal. Cuckoos (*Cuculus spp*), Jungle crow (*Corvus macrorhynchos*), Gray Crowned Pigmy Woodpecker (*Dendrocopos canicapillus*) and Kalij Pheasants (*Lophura leucomelana*) are the prominent bird species reported from the area. The presence of Jungle Crow (*Corvus macrorhynchos*) and Red Billed Blue Magpie (*Urocissa erythrorhyncha*) was observed during the field visit.

Out of recorded species, Vulture (*Gyps sp.*) is categorized into "Globally Threatened" and Spot Billed Ducks (*Anas poecilorhyncha*) and in Appendix I and Eurasian Golden Oriole (*Oriolus oriolus*) in Appendix II of CITES. The list of Birds found in the project area is listed in Appendix D.

4.2.2.3 Reptiles and Amphibians

Distribution of reptiles in midland Nepal is rather limited (Majpuria, 1981). Reptiles prefer to live in shady areas where leaves, litter and rotten logs are found. A total of 17 reptiles and amphibian species are reported in the project area and all are found in the lower reservoir area. The local people reported the presence of Rat snake (*Ptyas mucosus*), Green Pit Viper (*Trimeresurus graminus*), and Garden lizard (*Calotes versicolor*). The other reptiles found in the area are common lizard (*Hemidactylus flavirides*) and Monitor lizard (*Varanus monitor*). The presence of Frog (*Rana cyanophlyctus*) and Toad (*Bufo melanostictus*) were also noted in ditches and pools at the intake site.

4.2.2.4 Rare Endangered and Threatened Species

Due to the destruction of natural habitats and over harvesting, some animals have become rare and endangered in Nepal. In response to this, the Government of Nepal has signed the CITES convention, banning the trade on listed species and has promulgated a list of protected species. In addition, GON has ratified and implemented the Biodiversity Convention. The fauna of Nepal is particularly rich and include more than 141 species of mammals, 860 birds, 150 reptiles and amphibians (Shrestha, 1994).

Panthera pardus, *Presbytes entelus* and *Nemorhaedus goral* have been enlisted under CITES Appendix I while *Macaca mulata*, *Felis chaus* in CITES Appendix II and *Vulpes bengalensis*, *Martin flavigula*, and *Canis aerus* in CITES Appendix III. All these species are listed as susceptible (S) categories of NRDB status. Four mammal species having national and

international significance are found in the project area. Although listed by international organizations some of these species are relatively common in Nepal. For example the Rhesus monkey and Common langur are widespread in Nepal as well as in project area.

4.2.2.5 Biodiversity

After reviewing the Biodiversity Profile of Nepal (DNPWC, 1996) the following conclusions can be drawn that there is very little detailed scientific data on the Biodiversity of Nepal. The biodiversity of the project area is less disturbed, primarily due to the low population density. The biodiversity of this region does not appear to be unique and the species are commonly found in other parts of the country.

4.2.3 Fish and Aquatic Life

Volume 2 of the EIA report provides the detailed report on fisheries and aquatic baseline conditions.

The Seti river is one of the major tributaries of the Gandaki River System, which is both snow fed and rain fed. The gradient of the river varies considerably from section to section and differences in river morphology affect fish habitat, distribution pattern and diversity. As a consequence, a series of run, riffle and pools have been developed along the Seti course. The population status of different fish species in the Seti river throughout the year is not clearly known. However, based on field observation and sampling torrent minnows and copper mashers are the most common species in the Seti river.

Further field work and investigations conducted by the JICA Study Team have revealed more species, different impacts and degrees. The July and October 2006 sampling conducted by the JICA Study Team reported that approximately 23 species are found in the Seti River.

The description of the fish habitat and its species, spawning area are given below:

4.2.3.1 Fish Fauna

i) Description of Aquatic Habitat

During the EIA study the spawning and aquatic habitats of the fauna were explored and the findings have been tabulated below.

Table-4.11 Summary of Aquatic Habitats

River Section	Impact Zonation	Habitat Type	Major Spawning Areas	Species Occurrence	Remarks
Seti river app 2 km upstream of Bhimad bazaar	Indirect Impact Zone	Run, riffle and deep to shallow pool areas	Seti river at left bank	Snow trout, copper mahseer, mahseer and rewa species. Fry and fingerlings of Buduna was observed at both the banks	Major habitat in upper reaches
Bhimad to Bandarkuna (Reservoir area)	Direct Impact Zone	Run and riffle habitat dominated by Pool	1 km stretch of Seti Khola from Jhakas to Geruwatar. Jidi and Phendi Khola	Copper mahseer, mahseer and minor carps species. Fry and fingerlings of torrent minnows was observed at right bank	Major habitat and spawning area in reservoir stretch
Bandarkuna to Dam site(Dule)	Direct Impact Zone	Run and riffle habitat dominated by Pool	Pocket of spawning area in Seti near Likindi confluence area, Likindi and Limna Kholas	Torrent minnows and copper mahseer	Low to moderate habitat for spawning and rearing
Dule to Madi Seti Confluence	Direct Impact Zone	75% pool habitat and 25 % run and riffle	3 spawning and 4 rearing sites in Seti river.	Copper mahseer, mahseer, minor carps and catfishes are the major species. Fry and fingerlings of Buduna and torrent minnows were observed about 400 meter downstream of dam	Moderate habitat
Pratap approximately 4 km downstream of the powerhouse	Indirect Impact Zone	Riffle and runs (40%) dominated by pools (60%)	Rearing site is found at left bank in 1x400 m just below the Seti Madi confluence. 6 spawning sites are noted.	High species diversity (12 sp.) Mahseer, Copper mahseer, minor carps, torrent minnows and Stonerollers are the commercially important species noted in this stretch of river.	Madi Khola is major spawning and rearing ground for migratory species. This stretch of river has high potential in terms of species diversity, spawning area and great importance for the income generation (fishing).
Approximately 5 km downstream of powerhouse	Indirect Impact Zone	Riffle, runs and pools	River section is wide and covers with gravels sand and pebbles. Rearing site is noted approximately 3 km downstream of Seti Madi confluence	Moderate species diversity. Fry of torrent minnows and stone roller was noted	This section of river is moderate potential in terms of species diversity, spawning area and importance for the income generation (fishing)

Source: Field Survey, 2003

ii) Spawning Grounds

The Seti river and its tributaries provide suitable habitats for both resident and migratory species. The major spawning sites identified in the project area are as follows:

Table-4.12 Major Spawning sites in the Project Area

S No	Khola Stretch	Spawning and Rearing Ground	Suitable for the Species
1	Bhimad to app. 2 km upstream area	Seti river at left bank	Snow trout, copper mahseer, mahseer & stone roller
2	Bhimad to dam site	1 km stretch of Seti Khola from Jhakas to Geruwatar. Jidi and Phendi Khola. Seti near Likindi confluence area, Likindi and Limna Kholas	Copper mahseer, mahseer and minor carps & torrent minnows
3	Dam to Seti Confluence	3 spawning and 4 rearing sites in Seti river.	Copper mahseer, mahseer, minor carps and catfishes are the major species.
4	Madi Seti confluence to approximately 2 km downstream	Rearing site is found at left bank in 1x400 m just below the Seti Madi confluence. 6 spawning sites are noted.	High species diversity (12 sp.) Mahseer, Copper mahseer, minor carps, torrent minnows and Stonerollers are the commercially important species noted in this stretch of river.
5	Madi Seti confluence to approximately 3 km downstream	Proposed powerhouse	Torrent minnows, loach, spiny eel and stoneroller

iii) Species Occurrence/Distribution Pattern and Diversity

Fishes of the Himalayan water are biologically diverse. The Seti River along the project area provides a suitable habitat for copper mahseer, mahseer minor carps, and torrent minnows and stone rollers. Fish sampling at 8 different locations along the Seti River, previous studies and local information collected in the field reveal the presence of 36 species of fish.

A total of 471 fish of 19 different species were collected during the present survey (April 2003). Torrent minnows contribute about 35% of the total catch. The composition of Copper Mahseer and Mahseer throughout Seti River are 25.26% and 13.8 % respectively. Stoneroller and Baghi contributes 12.31 % and 5.73 % of the total catch (Table-4.13).

Table 4.13 Fish Species Composition

S.N o.	Scientific Name	English Name	Local Name	No. Fish Caught in July	No. Fish Caught in October	Total	%
1.	<i>Anguilla bengalensis</i>	Torrent catfish	Raj Bam				
2.	<i>Amblyceps mangois</i>	Fresh water Eel	Bidur	1		1	0.56
3.	<i>Barilius barila</i>	Minor carp	Faketa	22	8	28	15.00
4.	<i>Barilius bendilisis</i>	Minor carp	Faketa		13	13	7.30
5.	<i>Barilius barna</i>	Minor carp	Pate Faketa				
6.	<i>Bagarius bagarius</i>	Gaint Catfish	Gouch				
7.	<i>Botia almorhae</i>	Loach	Baghi	1	2	3	1.68
8.	<i>Chagunius chagunio</i>	Carp	Gadeni	5	5	10	5.61
9.	<i>Channa strius</i>	Murrels	Hile				
10.	<i>Channa punctatus</i>	Murrels	Hile	1		1	0.56
11.	<i>Channa gachua</i>	Murrels	Hile		2	2	1.12
12.	<i>Crossocheilus latius</i>	Stone roller	Lohare				
13.	<i>Garra annandalei</i>	Stone roller	Lohari, Buduna	3		3	1.68
14.	<i>Garra goytila</i>	Stone roller	Buduna	2	11	13	7.30
15.	<i>Glyptothorax trilineatus</i>	Catfish	Kavre	1		1	0.56

S.No.	Scientific Name	English Name	Local Name	No. Fish Caught in July	No. Fish Caught in October	Total	%
16.	<i>Glyptothorax telchitta</i>	Catfish	Kotle	14		14	7.86
17.	<i>Glyptothorax cavia</i>	Catfish	Kataga	1		1	0.56
18.	<i>Glyptosternum blythii</i>	Catfish	Tilkabre				
19.	<i>Labeo dero</i>	Minor carp	Gardi	9	13	22	12.35
20.	<i>Labeo angra</i>	Minor carp	Gardi, Thed/Handey	2	3	5	2.80
21.	<i>Mastacembelus armatus</i>	Spiny eel	Bam	4	1	5	2.80
22.	<i>Mystus aor</i>	-	Tanger	1			0.56
23.	<i>Neolissocheilus hexagonolepis</i>	Copper Mahseer	Katle	13	11	23	12.92
24.	<i>Noemacheilus rupicola</i>	Stone loach	Gadela	8		8	4.49
25.	<i>Noemacheilus rupicola var inglish</i>	Stone loach	Gadela		2	2	1.12
26.	<i>Noemacheilus botia</i>	Stone loach	Gadela				
27.	<i>Noemacheilus beavani</i>	Stone loach	Gadela				
28.	<i>Pseudocheneis sulcatus</i>	Catfish	Katanga, Kabre	2		2	1.12
29.	<i>Puntius conchoniis</i>	Barbs	Karange	1	3	4	2.24
30.	<i>Clupisoma garua</i>	-	Jalkapoor	1	2	3	1.68
31.	<i>Semiplotus semiplotus</i>	-	Khurpe				
32.	<i>Schizothorax plagiostomus</i>	Snow trout	Buche Asala				
33.	<i>Schizothoraichthys progastus</i>	Snow trout	Chuhhe Asala				
34.	<i>Schizothorax richarsonii</i>	Snow trout	Asala		1	1	0.56
35.	<i>Tor putitora (Ham)</i>	Golden Mahseer	Pahelo Sahar	10	1	11	6.17
36.	<i>Tor Tor (Ham)</i>	Mahseer	Sahar	1*			
	Total			100	78	178	100

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

* observed only

The principal groups of fishes of the Seti river are:

Carps- Snow trout (*Schizothorax plagiostomus*), long nose trout (*Schizothoraichthys progastus*) Copper Mahseer (*Neolissocheilus hexagonolepis*) and Mahseer (*Tor putitora* and *Tor tor*), minor carps (*Labeo dero* & *Labeo angra*) and Sucker head (*Garra gotyla* & *Garra annandali*)

Fresh water Eel - (*Anguilla bengalensis*)

Loaches - Stone loach (*Nemacheilus botia* & *Nemacheilus beavani*)

Torrent Minnows - (*Barilius barila*, *B. benedesis* & *B. barna*)

Catfishes - Torrent catfish (*Glyptothorax sp.*) river catfish (*Bagarius bagarius*)

Barbs - (*Puntius conchoniis*)

It is found that diversity of fish progressively increases downstream. Nine species were recorded at the upstream section whereas 12 species were recorded downstream (Table 4.13). Torrent minnow is the dominant species of the Seti river in the dry season sample in terms of number. Copper mahseer, mahseer, spiny eel and stonerollers are the other dominant species of Seti River. The species diversity is high in the wet season compared to dry season. The local people reported the presence of 36 species of fish in wet season. Gounch, Sahar, Katle, Jalkapoor, Raja bam, Thed, Gardi, Titae and Kabre are the common species. According to the field study out of 36 species of fish that are found in the Seti River will be affected due to the project construction.

Out of 36 species recorded or reported from the Seti river 6 were long distance migrants, 7 were midrange migrants and 23 were residents in habit

4.2.3.2 Aquatic Invertebrates

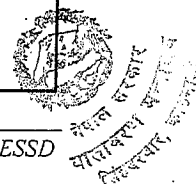
Aquatic invertebrates are the most important resources which are the links in the production process of the aquatic ecosystem because they include both the primary consumers and carnivorous. They form the matured food source of several fishes. The overall aquatic production in moderate or fast flowing water takes place in the river bottom. Samplings revealed the presence of 35 species of Phytoplanktons like Cyanophyceae, Chlorophyceae and Bacillariophyceae. Similarly, 13 species of zooplanktons of 3 different groups are found in the Seti river, the major groups of zooplankton recorded from the project area are consisted of Rotifers, Cladocera and Copepoda. The aquatic invertebrates including phytoplanktons, zooplanktons and aquatic found in the Seti river none have been classified as rare or endangered species.

Nine species of blue green algae were recorded from the downstream part of Seti River *Chaetophora inclassata*, *Cladophora glomerata*, *Oedogonium sp.* and *Ulethris sp.* are the dominant species of algae recorded from Seti River. The other species are *Spirogyra*, *Stigeoclonium*, *Compsopogon*, *Audounilla* and *Genicularia elegans*. Among the recorded species *Ephemeroptera sp.*, *Canis sp.*, *Hydropsyche*, *Nemoura sp.* *Tanypus* is common.

Even though the fish species are not important from the conservation point of view, some of them are valuable for the economic activities of the local fishermen. The economic importance of the fish species is given in Table 4.14.

Table 4.14 Economic Value of the Fish Species of the Project Area

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



S.N	Scientific Name	English Name	Local Name	Economic importance
23.	<i>Neolissocheilus hexagonolepis</i>	Copper Mahseer	Katle	1,H
24.	<i>Noemacheilus rupicola</i>	Stone loach	Gadela	1,L
25.	<i>Noemacheilus rupicola</i> <i>var english</i>	Stone loach	Gadela	1,L
26.	<i>Noemacheilus botia</i>	Stone loach	Gadela	1,L
27.	<i>Noemacheilus bevani</i>	Stone loach	Gadela	1,L
28.	<i>Pseudocheneis sulcautis</i>	Catfish	Katanga, Kabre	1,M
29.	<i>Puntius conchoniis</i>	Barbs	Karange	1,M
30.	<i>Chupisoma garua</i>	-	Jalkapoor	1,H
31.	<i>Semiplotus semiplotus</i>	-	Khurpe	1,H
32.	<i>Schizothorax plagiostomus</i>	Snow trout	Buche Asala	1,H
33.	<i>Schizothorax richarsonii</i>	Snow trout	Asala	1,H
34.	<i>Schizothoracichthys progastus</i>	Snow trout	Chuhhe Asala	1,H
35.	<i>Tor Putitora (Ham)</i>	Golden Mahseer	Pahelo Sahar	1,H, 2, 3
36.	<i>Tor Tor (Ham)</i>	Mahseer	Sahar	1,H, 2, 3

Source:

Note: 1 = Food Value: L = Low food value H = High food value M = Medium food value
2 = Medicine 3 = Aquarium

4.3 Socio-economic and Cultural Environment

The socio-economic and cultural baseline profile of Tanahu district and the project affected VDCs and Municipality has been prepared by using the secondary information published by the various offices of Tanahu district, and other Government Publications such as the publication made by Central Bureau of Statistics. Similarly, the baseline condition of the project affected families has been prepared using the sampled questionnaire and the information collected from affected people and communities.

This sub-section has been classified in three parts. Section 4.3.1 discusses the baseline condition of Tanahu district, Section 4.3.2 documents the baseline condition of the project affected VDCs and Municipalities and Section 4.3.3 explains the baseline situation of Project Affected Families.

4.3.1 Tanahu District

4.3.1.1 Demographic Characteristics

According to 2001 Census, the total population of Tanahu District is estimated to be 315,237, which accounts for 1.36% of the total population in the country and 11.3% of the Western Hill. The average household size of the district is 5.01 that are slightly lower than the national average figure of 5.44. The total household number of Tanahu is 62,898. The population density of the district is reported to be one of the highest among the hill district (204 persons/km²), which is significantly higher than the average density of the Western Hills (152 persons/km²) and national average density (157 persons/km²). The demographic status of Tanahu District is shown in the Table 4.15.

Table 4.15: Population Status of the Tanahu District

1991 Census			2001 Census			Av. Family Size	Growth Rate (1991-2001)	Density (Person/Km ²)
Female	Male	Total	Female	Male	Total			
140,761	127,312	268,073	168,449	146,788	315,237	5.01	1.8	204

Source: CBS, Population Census, 2001 (National Report): CBS/UNFPA June 2002

4.3.1.1 Caste/Ethnicity

Tanahu District is dominated by ethnic groups such as Magar (27%) and Gurung (13%), Newar (8%), Dalits (14%), Chhetri/ Thakuri (14%) and Brahmin (13%). A small number of other indigenous groups such as Kumal (2.2), Dairai (1.2%), Barahmu (0.4%), Dura (0.3%), Jirel (0.1%), etc have been residing in Tanahu district. Table 4.16 shows the distribution of population by caste/ethnic.

Table 4.16 Ethnic/Caste Group of Population in Tanahu District

Caste/Ethnicity	Magar	Brahmin	Gurung	Chhetri/Thakuri	Dalits	Newar	Kumal	Darai	Tamang	Muslim
Number	84332	41497	39418	44800	45160	25145	6915	3747	3216	3229
%	26.75	13.16	2.50	14.21	14.33	7.98	2.19	1.19	1.02	1.02
Caste/Ethnicity	Sannyasi	Rai	Dura	Jirel	Brahmu/Baramu	Sonar	Marawadi	Gharti/Bhujel	Others	Total
Number	2097	439	781	26	1398	2022	555	7523	2702	315237
%	0.66	0.14	0.25	0.08	0.44	0.64	0.18	2.39	0.86	100.0

Source: Population Census: Caste/Ethnicity by Districts, CBS

Regarding languages spoken by the people of Tanahu, Nepali language dominates the other languages (63%) followed by Magar (16%), Gurung (10%), Newari (5%) and Rai/Kirat (2%).

The Hindu religion by far dominates the other religious group (91%) followed by Buddhist (7%), Muslim (1.7%) and Christian (0.2%). The other religious groups are represented by few tens of households only.

4.3.2 Education

Seventy percent population of Tanahu district above 6 years of age is reported to be literate. The male population has a higher literacy rate (79%) compared to females (56%). The literacy level of the district is higher compared to the national average literacy rate (60.2%), male literacy (71.6%) and female literacy (48.9%). However, among the literate population, the majority has obtained only primary level education (43.6%) and lower secondary level education (20.2%). Only about 5% population has obtained education above the certificate level, according to CBS 2001 Population Census (Table 4.17).

Table 4.17: Level of Education of the Literate Population in Tanahu District

	No Schooling	Primary (1-5)	Lower Secondary (6-7)	Secondary (8-10)	SLC & Equiv.	Certificate & Equiv.	Graduate & Equiv.	Post Graduate & Equiv.	Others	Level Not Stated	Total
N	17,651	72,450	33,639	17,394	12,480	5,743	2,424	665	504	3,148	166,098
%	10.6	43.6	20.2	10.5	7.5	3.5	1.5	0.4	0.3	1.9	100

Source: CBS, Population Census, 2001.

Tanahu district has 425 primary level schools, 59 lower secondary level schools, 96 secondary level schools and 12 higher secondary level schools. In addition, there are 7 campuses in this district. The details of the educational facilities in Tanahu District are shown in Table 4.18. 10% of the total schools are privately owned and 90% public owned. Altogether 90,278 students are enrolled at different levels out of which 48% students are females. The percentage of the female teachers is 22. The teacher student ratio is 1:33.

Table 4.18 : Educational Facilities in Tanahu District

Level School Type	Primary Level			Lower Secondary	Secondary	Higher Secondary	Total
	I-V	I-III	Total				
Number of Government	218	179	397	54	75	8	534
Number of Private	20	8	28	5	21	4	58
Total Number	238	187	425	59	96	12	592
Boy Enrollment	33187			9573	3613	254	46627
Girls Enrollment	32595			7957	2927	172	43651
Number of Male Teacher	1401			342	308	NA	2051
Number of Female Teacher	598			51	18	NA	667
Teacher/Student Ratio	1:35			1:58	1:30	NA	1:33

Source: District Education Office, Tanahu, 2006.

The Gross Enrollment Ratio (GER) and Net Enrollment Ratio (NER) of the students at different levels of schools are shown in Table 4.19. It reveals that the enrollment ratio is quite encouraging at the primary level of schools but declines rapidly when the students have to be get enrolled at the higher levels. In spite of relatively high enrollment ratio at the primary school level, the average completion ratio remains at only 26.7%. It indicates that a number of enrolled students drop out of the primary schools or fail in examinations.

Table 4.19: Gross and Net Enrollment Ratio of the Students in Tanahu District

Enrollment ratio at different Level (%)	Gross Enrollment Ratio (%)		Net Enrollment Ratio (%)	
	Male	Female	Male	Female
Primary	120.4	118.50	91.0	90.4
Lower Secondary	95.2	80.8	54.9	45.9
Secondary	61.8	51.6	32.5	29.2

Source: District Health Profile, Tanahu, 2004/05; District Health Office

4.3.3 Health

The district has 2 hospitals with 15 beds each, one Primary Health Center with 3 beds, 13 health posts, and 31 sub-health posts (Table 4.20). However, health services within the district are still

very poor due to inadequate number of health personnel available at the health centres.

Table 4.20: Health-related Institutions in Tanahu District

Institution Type	Number	Remarks
Hospitals	2	Bandipur and Damauli (15 beds each)
Primary Health Centre	1	Bhimad (3 beds)
Health Posts	13	Located at 13 VDCs
Sub-health Posts	31	Located at 31 VDCs
Primary Health Care/Out Reach Clinic	143	
Expanded Program. On Immunization Clinics and Others	215	
Measles Campaign Posts	436	

Source: District Health Profile, 2061/62.

The ratio of doctor, nurse, Health Assistant (HA)/Community Maternity Assistant (CMA), Mother Child Health Worker (MCHW), Primary Care Health Volunteer (PCHV) and TBA to the population is 1:56686, 1:12146, 1:4929, 1:10,921, 1:804, and 1:1818 respectively. Table 4.21).

Table 4.21: Ratio of Population Served by Health Professionals

Indicator	Doctor/ Population	Nurse/ Population	HA/CMA/ Population	MCHW/ Population	PCHV/ Population	TBA/ Population
Ratio	1:56,686	1:12,146	1: 4,929	1:10,971	1: 804	1: 1,818

Source: District Health Office, 2006

Among the common diseases prevalent in the district are skin diseases followed by Acute Respiratory Infection (ARI), pyrexia of Unknown Origin (PUO) and diarrhea. A significant number of patients also suffer from diseases such as intestinal worms (6.2%), gastritis (6.1%), fall injury /fracture (3.8%), Chronic Obstructive Pulmonary Diseases (COPD) (3.7%), ear infection (3.1%) and abdominal pain (2.7%). The details of the main diseases prevailing in Tanahau district are shown in Table 4.22.

Table 4.22: Common Diseases in Tanahu Districts

Diseases	Skin Diseases	ARI	PUO	Diarrhea Disease	Intestinal worm	Gastritis	Injury/ Fracture	COPD	Ear Infection	Abdominal Pain
Number of Patients	22515	13932	11407	10009	8106	7911	4938	4880	4039	3336
%	17.3	10.7	8.8	7.7	6.2	6.1	3.8	3.7	3.1	2.7

Source: District Health Office, 2006

4.3.4 Water Supply and Sanitation

According to DDC, about 74% of the population of the district has access to piped drinking water facility, while almost 20% populations rely on wells, springs, spouts, river springs etc (Table 4.23). Approximately, 4% of people also practice rain-water-harvesting.



Table 4.23 Population Using Drinking Water Sources

Drinking Water Sources	Percent (%)
Pipe	74
Well	20
Rain Water	4
Other	2

Source: District Development Committee, 2006.

The sanitation condition of the district is generally poor as only about 31% of the population use toilets. The household percentage of toilet user in the rural area is lower (20%) while it exceed to 80% in the urban centers like Damauli, and Bandipur. 34% of the households use pits for solid waste disposal and 50% population are aware of hygienic food. Lack of landfill site in the Damauli Bazaar and use of riverbanks as urban waste disposal have created many issues related to sanitation of the district. The storm drainage system is also not sufficient in all the urban centers of the district.

4.3.5 Energy Use

According to the DDC record, only about one third of the population has electricity. Approximately, 71% of the total electricity supply is distributed from the central grid of Nepal Electricity Authority (NEA), while 16% is by the individual Bio-Gas plant, 8% from micro-hydro power and 6% from the solar system. Nearly 66% of households use fuel wood and 16% use kerosene for cooking, 10% use LP gas while 8% use animal dung.

4.3.6 Economic Activities

According to the 2001 Census, almost 64% of the population of Tanahu district (10 years and above) is economically active which is similar to the national average of economically active population. Among the economically active population, the percentage of female is greater (34%) compared to male (30%). Table 4.24 shows the details of economically active population above 10 years of age.

Table 4.24. Economically Active and Inactive Population in Tanahu District (10 Years and above age).

	Economically Active			Economically Inactive		
	Male	Female	Sub-total	Male	Female	Sub-total
Number	70,171	80,006	150,177	36,360	48,561	84,921
%	29.9	34.0	63.9	15.5	20.6	36.1

Source: CBS, 2001.

The economically active population is engaged in different occupation like farming (67%) that includes both skilled and unskilled agricultural, forestry and fishery. The second, third and fourth highest category of occupations are elementary occupation (10%), craft trade workers (9%) and service holders (8%), respectively.

Table 4.25: Occupation of the Economically Active Population (10 years of age and above)

	Legislator/ Officials	Professionals	Technicians	Clerks	Service Holders	Farm Workers	Craft Trade Workers	Plant/Machine Operators	Elementary Occupations	Not Stated	Total
Number	323	3,567	1,979	2,233	11,332	93,552	12,233	1,029	13,242	128	139,618
%	0.23	2.55	1.42	1.60	8.12	67.01	8.76	0.74	9.48	0.09	100.0

Source: Population Census, CBS 2001.

Only 1% of the households of Tanahu district (449 households) are landless while 99% (53773 households) own certain land. Almost 50% of the landowners hold less than 0.5 ha of land, 30% households own land between 0.5-<1.0 ha, 12% between 1-<2 ha and 1.1% between 2.0-<3.0ha. Only 0.2% of the households own 3-<4 ha of land. The average land holding size is 0.54 ha and the number of parcel is 2.9. The land holding size and parcel size varies greatly among the large and small holders indicating larger size among the large holders (Table 4.26).

Table 4.26: Landholders and Landholding Size

Landholding Size	Family No.	%	Av. Land area/ HH	Av. Number of Parcel
< 0.1Ha	3,693	6.9	0.05	1.4
0.1-0.2 Ha	6,005	11.2	0.14	1.7
0.2-0.5 Ha	20,467	38.1	0.33	2.5
0.5-1.0 Ha	16,152	30.0	0.68	3.4
1.0-2.0 Ha	6,765	12.5	1.31	4.3
2.0-3.0 Ha	587	1.1	2.21	6.1
3.0-4.0 Ha	104	0.2	3.36	6.0
Total	53,773	100	0.54	2.9

Source: Agricultural Census, 2001 CBS

The district produces all types of cereals such as paddy, maize, wheat, millet, barley etc and cash crops such as sugarcane, tobacco, ginger, cardamom, vegetables and fruits. The area, production and yield of major crops grown in the district are shown in Table 27.

Table 4.27 Area, Yield (Metric ton/ha) ,Production(Metric ton) of Major Crops in Tanahu District (2004/05)

Crops		Area (Ha)	Yield (Million ton/Ha)	Production (Million ton)
Cereals	Main Paddy	13,400	3.1	41,891
	Maize	21,960	2.6	57,096
	Wheat	2,300	1.55	3,956
	Barley	10	0.75	7.5
	Buckwheat	175	0.90	158
	Millet	6,550	1.23	8,089
	Potato	700	8.12	6,188
Cash Crop	Sugarcane	36	10.22	620
	Tobacco	7	0.88	6
	Ginger	450	9.775	4,399
	Cardamom	4	0.75	3
Spices	Haledo	90	5.3	474
	Garlic	140	4.37	612
	Chilli	75	2.99	224
Oilseed		524	0.88	462
Pulses/Beans		3,768	0.83	3,141
Vegetables	Summer	1004	8.203	8236
	Winter	1715	8.205	14070
	Off Season	206	8.176	1668
Fruits	Citrus	1462	5.618	8214
	Winter	105	7.410	778
	Tropical	1164	6.87	7998
Others	Coffee	40	1.25	11
	Sericulture	15	0.20	2.95
	Fish	7	2.286	16
	Beehives	1313 (no.)	3.74/kg/hive	4.910

Source: District Agriculture Profile (2061/062); District Agriculture Office, Tanahu Falgun 2062.

Despite a variety of crop production with a reasonably a good yield rate, the district is reported to be a food deficit district, according to the District Agriculture Office, Tanahu. According to its estimate, the district faces an annual deficit of approximately to 1,000 metric tons of cereals when considering the edible production of the district (Table 4.28).

Table 4.28: Food Balance Situation of Tanahu District (in metric ton)

Total Production of Cereals*	Total Edible Production*	Requirement of the District***	Balance/Deficit
139,130	69,973	70,928	955

Source: District Agriculture Profile (2061/062).

Note: * Includes total production of six major cereals namely paddy, wheat, maize, millet, buckwheat and barley.

**Estimated based on the requirement of seeds, storage loss, processing loss etc.

*** Estimated based on 2001 Population, i.e. 315,237 and per capita/year cereal requirement of 225 grams.

As elsewhere in other parts of rural Nepal, livestock rearing is an integrated part of the rural livelihood system of the Tanahu district. The district has 0.455 million of livestock and 0.317 million poultry. The number of buffalos, goats and ducks have increasing trend while the size of

cattle, sheep, horses and chickens are decreasing (Table 4.29).

Table 4.29: Total Number of Livestock in Tanahu District

Livestock Type	F.Y:2003/04			F.Y: 2004/05			Change%
	Hybrid	Local	Total	Hybrid	Local	Total	
Cattle	496	96406	96902	560	95725	96285	-0.64
Buffalos	10319	90088	100407	9868	91432	101300	0.89
Goats	9444	206265	215709	9605	207980	217585	0.87
Sheep	390	3848	4238	341	3814	4255	-1.96
Pig	3556	32431	35987	3741	32163	35904	-0.23
Horse	0	298	298	0	165	165	-44.63
Total Animals	24205	429336	453541	24115	431279	455494	0.43
Hen/Cocks	59280	260546	319826	53720	261197	314917	-9.28
Duck	532	2036	2568	546	2056	2602	1.32
Total Birds	59812	262582	322394	54266	263253	317519	-1.51

Source: District Livestock Office, Tanahu 2006

As Table 4.30 indicates, the district produces livestock products such as milk, meat, egg, wool etc equivalent to NRs 842 million annually. It is estimated that approximately 5% of the total products are exported to other districts and 95% are sold within the district.

Table 4.30: Annual Production of Livestock Products (2004/05)

Description		Unit	Production	Per Unit Rate	Total Value (000,Rs)
Milk	Cow	Metric .Ton	5336	15/kg	80,040
	Buffalo	Metric .Ton	16532	20/kg	330,640
Meat	Goat	Metric .Ton	666	200/kg	133,200
	sheep	Metric .Ton	14	200/kg	2,800
	Chicken	Metric .Ton	203	130/kg	26,390
	Buffalo	Metric .Ton	2248	100/kg	224,800
	Pork	Metric .Ton	176	90/kg	15,840
Wool-Sheep		Kg	1492	150/kg	224
Egg-Hen/Duck		,000 No.	7031	4/no	28,124
Total					842,058

Source: District Livestock Office, Tanahu 2006

There are 930 different types of industries in Tanahu district. Among the total running industries 65% are production oriented, 28% service oriented, 5% agriculture livestock related and remaining related to energy, mines and tourism. More than 6,000 people are reported to be employed in these industries (Table 4.31).

Table 4.31: Type and Number Industries in Tanahu Districts

Type	Number	Running	Closed	Employee
Production Oriented	653	472	181	2849
Service oriented	204	204	0	2769
Agriculture and Livestock	57	37	20	581
Mine Industry	4	3	1	30
Energy oriented	9	9	-	149
Tourism Industries	3	3	-	54
Total	930	728	202	6432

Source: District Profile of Tanahu District, DDC, Tanahu, 2001.

According to UNDP (2004), the average per capita income of the district is estimated to be 218 US\$ (NRs 16,071), which is lower than that of 220 US\$ (NRs 16,203) of the western Hills and US\$ 240 (NRs 17,722) of Nepal. Table 4.32 shows that more than half of the households fall far below the average per capita income.

Table 4.32: Households in Different Income Category (NRs/HH/Yr) , 2001

Income Range	Up to 5,000	5,001-10,000	10,001-20,000	20,0001-30,000	30,001-40,000	40,001-50,000	Above 50,000	Total
No. of Households	17,966	4,510	4,888	5,945	2,729	2,119	4,653	42,810
%	42.0	10.5	11.4	13.9	6.4	4.9	10.9	100

Source: District Profile of Tanahu District, DDC, Tanahu, 2001

4.3.7 Cultural, Aesthetic and Archeological Value

The Tanahu district has a number of historical, cultural and religious places described in Table 4.33.

Table 4.33: Cultural and Religious Places in Tanahu District

Place	Features
Devghat	Religious place of Hindu Community, Mela (gathering) at 1st of Magh
Chhabdi Barahi	Famous temple of Chhabdi goddess, Daily pray by religious people
Dhorbarahi	Famous temple of Barahi goddess, daily pray by religious people
Vyas Cave	Meditated place of Vyaas a writer of religious holy book Bedh, Situated at the confluence of two holy river Seti and Madi
Thanithan Mai Temple	Bunch of followers will serve to goddess for the sake long life
Birth Place of Bhanu Bhakta	Home of Nepali great poet Bhanu Bhakta Acharya kept in its natural condition
Tanahusur Durbar	Capital city of Tanahu state. Sen empire
Ghanshi Kuwa	Water pond by poor farmer (Ghansi), an inspire person to Bhanubhakta acharya
Siddha cave (bandipur)	A Cave where about 1000 peoples can reside
Siddha cave (Bhimad)	A Cave have six floors but can visit on five floor only
Bandipur	Naturally beautiful place where northern himalayan ranges can clearly observe, Temples like Bhagbati, Khadkadevi Mai also remains.
Chinkeshworikota	Temple of Chinkeshwori Mai. Place from where trekking route can develop
Bandipur	Place for Gurung and Newar community. Famous in Nepali folk dance Kauda and others
Dhorphirdi, Phirphire, Raipur	Route for developing village tourism, Rich in Folk Music and Songs (Dohari geet, Panche Baja, Chuttala etc), Some beautiful places like Rajasthalkot, Milinium cave, RaipurKot etc

Source: District Profile of Tanahu District, DDC, Tanahu, 2001

4.4.1 Affected VDCs/Municipality

The Upper Seti Storage Hydroelectric Project will affect eight VDCs and one Municipality, namely Bhimad, Chhang, Majkot, Rising Ranipokhari, Kotdurbar, Jamune, Kahun Shivapur, Pokharibhanjyang VDCs and Vyas Municipality of Tanahu district. This section describes the socio-economic situation of these affected VDCs and Municipality.

4.4.1.1 Demographic Characteristics

Eight VDCs and one Municipality accounts for 24 percent of the total land area and 26 percent of the total population of Tanahu district. According to 2001 Census, the number of total households and population of these area are estimated to be 16,152 and 80,884. The average family size of these area is 5.0, almost similar to the district average. The ratio of male female population is 1:1.13. The average population density of the project site is 215, which is higher than the district and national average.

The population density varies significantly in the eight VDCs and Municipality. Vyas Municipality, for instance has the highest population density (409 persons/km²) while Kahun Shivapur VDC has the lowest population density (92 person/km²). The population of the project site has been increasing by 3.2% per annum. The population of the affected VDCs and Municipality was 61433 in 1991 to 80,884 in 2001 according to the district profile of Tanahu. The growth rate varies distinctly among the different VDCs and Municipality. Vyas Municipality has the highest population growth rate (6.1% /annum) while the population has been decreased in some of the VDCs such as Pokhari Bhanjyang (0.81%/annum). Better access of roads, services, economic opportunities and security are reported to be the key factors for the higher population growth rate and density (Table 4.34). The major settlements and market center are Vyas Municipality and Bhimad VDC.

Table 4.34: Household and Population of the Project Affected VDC/Municipality (2001)

VDC/Municipality	Population (Number)			Households (HHs)	Area (Km ²)	Population Density (Km ²)	Population Growth Rate (1991-2001)
	Male	Female	Total				
Bhimad	2895	3250	6145	1382	23.8	258	3.8
Chhang	2859	3478	6337	1318	34.48	104	0.62
Majhkot	3683	4238	7921	1378	50.41	157	3.2
Rising Ranipokhari	1930	2247	4177	740	29.76	140	4.0
Kotdurbar	2850	3496	6346	975	25.86	245	1.41
Jamune	4438	5127	9565	1929	27.85	343	1.5
Kahun Shivapur	4031	4035	8066	1087	87.45	92	3.09
Pokhari Bhanjyang	1902	2180	4082	832	28.14	145	-0.81
Vyas Municipality	13449	14796	28245	6511	69.01	409	6.1
Total	38037	42847	80884	16152	376.76	215	3.2

Source: District Profile of Tanahu District, 2001.

Regarding the caste and ethnic composition, Magar, the indigenous ethnic group is the dominant population in these areas, which represents 36 percent of the total population, followed by Brahmin (14%), Dalit (12%), Chhetri (8%) and Newar (6%) and others. The caste wise composition of population is shown in Table 4.35

Table 4.35 population by Caste/ Ethnic Group in the Project VDCs/ Municipality

V.D.C	Magar	Brahmin	Gurung	Chhetri	Newar	KDS	Thakuri	Kumal	Darai	Muslim	Others	Total
Bhimad	1231	1357	59	155	999	797	48	254	0	92	1153	6145
Chhang	2379	424	556	324	921	1177	73	297	0	7	179	6337
Majhkot	4400	591	494	11	305	1005	581	293	0	0	241	7921
Rising Ranipokhari	1725	551	471	128	898	233	0	0	0	0	171	4177
Kotdurbar	5058	44	0	260	162	551	0	0	0	0	271	6346
Jamune	2866	1365	133	1400	1529	1594	146	27	0	21	484	9565
Kahun Shivapur	6064	63	9	33	11	927	884	0	0	0	75	8066
Pokhari Bhanjyang	1724	737	104	273	8	850	60	7	30	0	289	4082
Vyas Municipality	3896	5922	2081	3523	2716	2728	470	619	2939	472	2879	28245
Total (No)	29343	11054	3907	6107	7549	9862	2262	1497	2969	592	5742	80884
%	36.3	13.7	4.8	7.6	9.3	12.2	2.8	1.8	3.7	0.7	7.1	100

Source: Population Census, 2001.

A large majority of the population of the project area are Hindus (91.1%) followed by Buddhists (7.8%), Muslims (0.7%), and Christians (0.1%). People that follow Hindu and Buddhist religions reside in the entire project VDCs and Municipality whereas the population following Islam is concentrated in Vyas Municipality. The Christians are concentrated mainly in three VDCs; Pokhari Bhanjyang, Bhimad and Ranipokhari and Vyas Municipality.

4.4.1.2 Education

There are 151 primary schools, 20 lower secondary schools, 35 secondary schools, 2 higher secondary schools under the supervision of 6 Resource Centers in the affected area. There are 3 campuses in the affected area. Ninety percent of these educational institutions are public and 10 percent are private, which is similar to the overall district status (Table 4.36).

Table 4.36: Access to Different Types of Schools in the Affected VDCs/Municipality

Resource Centre/ VDC/Municipality	Government Managed							Private Managed						Number of Total Schools
	Primary		LLS	SS	HSS	Total	Campus	Primary		LSS	SS	HSS	Total	
	I-V	I-III	I-VIII	I-X				I-V	I-III	I-VIII	I-X			
Nirmal MA Bi./ Vyaas Municipality	13	7	4	8	0	32	3	5	6	1	5	1	18	50
Keshabtar, MA Bi./ Pokhari Bhanjyang	14	8	2	3	0	27	0	0	0	0	0	0	0	27
Sahidganga Ma. Bi/ Kahun Shivapur,	13	12	4	3	0	32	0	0	0	0	0	0	0	32

Sringa Ma.Bi/ Kotdurbar Rising	13	7	2	5	0	27	0	0	0	0	0	0	0	27
Min Ma Bi, Jamune, Chhang.	14	14	4	5	0	37	0	0	0	1	1	0	2	39
Janjyoti Uchha Ma Bi./Bhimad	15	9	2	3	1	30	0	1	0	0	2	0	3	33
Total	82	57	18	27	1	185	3	6	6	2	8	1	23	208

Source: DEO, Tanahu, 2006

The literacy status of the affected VDCs is shown in Table 4.37, which reveals that 61 percent of the total population of the area is literate. The female literacy rate is significantly lower compared to the male literacy rate. According to the Census 2001, the average literacy rate of Vyas Municipality is estimated to be more than 75 percent.

Table 4.37: Literacy Status of Affected VDCs

Affected VDCs/ Municipality	Literacy rate			Adult Literacy (15+yrs)		
	Male (%)	Female (%)	Total (%)	Male (%)	Female (%)	Total (%)
Bhimad	39.8	30.25	70.06	43.6	30.98	74.58
Chhang	40.98	25.98	66.96	40.57	23.22	63.79
Rising Ranipokhari	39.92	25.57	65.49	44.56	24.14	68.7
Kotdurbar	38.36	21.49	59.85	40.89	15.55	56.43
Jamune	38.02	27.29	65.31	41.93	22.6	64.53
Majhkot	37.52	22.11	59.63	39.24	18.64	57.88
Pokhari Bhanjyang	34.43	23.59	58.01	36.68	23.05	59.73
Kahun Shivapur	27.44	24.28	51.72	22.37	19.26	41.63
Average	37.1	24.08	61.18	38.93	20.82	59.76

Source: DEO, Tanahu, 2006

As Table 4.38 indicates about 84 percent of the population has access to primary schools within 1 km distance. In the case of Kahun Shivapur VDC, only half of the population can have access to primary schools within 1 km distance.

Table 4.38 : Distance to Nearby Primary School

Affected VDCs/	Within 1km (%)	More than 1 Km less than 2km (%)
Bhimad	70.59	29.41
Chhang	96.3	3.7
Majhkot	78.38	21.62
Rising Ranipokhari	89.47	10.53
Kotdurbar	97.14	2.86
Jamune	93.75	6.25
Kahun Shivapur	50	30
Pokhari Bhanjyang	94.74	5.26
Average Project VDCs	83.46	15.36

Source: DEO, Tanahu, 2006

Eighty eight percent of the children at school age are enrolled at the primary level 5-9 years in the affected VDCs and Municipality. This is still lower compared to the district average NER (96%). In some of the VDCs such as Bhimad, the NER at primary level is found to be the poorest (48%) while that of Vyas Municipality is 113% (Table 4.39)

Table 4.39: Net Enrollment Ratio (NER) of Primary Level in the Affected VDCs/ Municipality

Affected VDCs/Municipality	NER at Primary Level (5-9years) in 2005		
	Male (%)	Female (%)	Total (%)
Bhimad	46	51	48
Chhang	94	82	88
Majhkot	88	80	84
Rising Ranipokhari	88	97	93
Kotdurbar	99	107	103
Jamune	82	91	87
Kahun Shivapur	101	88	94
Pokhari Bhanjyang	96	105	100
Vyas Municipality	113	114	113
Average Project VDCs/ Municipality	95	81	88
District Average	95	96	96

Source: DEO, Tanahu 2006.

4.4.1.3 Health

The project site has a 15 bed hospital located at Damauli of Vyas Municipality, one Primary Health Centre with 3 beds facility at Bhimad, one health post located at Tharpu, Chhang VDC and 6 Sub-health posts located in 6 VDCs. Table 4.40 shows the health related institutions and facilities available in the project affected VDCs and Municipality.

Table 4.40: Health Related Institutions and Facilities in the Project VDCs/ Municipality

Institution Type	Location in Affected VDCs/Municipality	Physical Facilities
Hospital	Damauli, Vyas M. -10	Land Area 10-6-2 ropani, 14 rooms, Electricity, Telephone, Toilet. Water Supply available
Primary Health Center	Bhimad-1	Land Area 10-15-3 ropani, 24 rooms, Electricity, Telephone, Toilet. Water Supply available
Health Post	Chhang-1, Tharpu	Land Area 5-0-0 ropani, 7 rooms, Electricity, Water Supply available
Sub-Health Post	Jamune-4	Land Area 5-0-0 ropani, 1 room, Water Supply available
	Kahun Shivapur (Suke-4)	4 rooms, Water Supply available
	Kotdurbar-4	1 room, Water Supply available
	Pokhari Bhanjyang-7	3 rooms
	Rani Pokhari	2 rooms,
	Majhkot	5 rooms,

Source: District Health Office, Tanahu, 2006.

Most of the health related indicators of the affected VDCs and Municipality are not available. However, the assessment of the malnutrition level by Poverty Mapping Project DDC (2001) reveals that almost one quarter of the affected VDC population has a low malnutrition level. The malnutrition level varies significantly among the affected VDCs and 85 percent population of Ranipokhari VDC has low malnutrition level while 99 percent population of Chhang VDCs does not have malnutrition problems (Table 4.41).

Table 4.41: Malnutrition Level at Affected VDC

Affected VDCs	Malnutrition Level (%)			
	Severe	Moderate	Low	None
Bhimad	4.98	55.25	20.97	18.8
Chhang	0	0.63	0	99.37
Majhkot	8.97	40.34	33.1	17.6
Rising Ranipokhari	1.24	12.32	84.97	1.46
Kotdurbar	1.28	6.41	10.51	81.8
Jamune	0	4.38	0.73	94.9
Kahun Shivapur	8.15	62.46	26.77	2.62
Pokhari Bhanjyang	2.1	17.76	7.16	72.99
Average Project Site	3.34	24.94	23.02	48.70
District Average	3.92	35.88	20.08	40.12

Source: Poverty Mapping Report, Tanahu, DDC 2001

4.4.1.4 Water Supply and Sanitation

Only about 52 percent of the population in the affected VDCs is reported to use piped water, whereas over 70 percent use piped water in the district level. Although almost 80 percent of the population is fetching drinking water within one hour distance, a significant number of the population (15%) spend more than 5 hours a day to fetch drinking water. A large number of such a population is reported in Majhkot VDC (29%) and Kahun Shivapur VDC (27%). Accessibility of water supply in the affected VDCs and Municipality is shown in Table 4.42.

Table 4.42 : Accessibility of Water Supply in the Affected VDCs

Affected VDCs	Access to safe drinking water (% of HHs)	% of HHs reporting drinking water accessibility in different hours			
		< 1Hrs	1-<3 Hrs	3-5Hrs	>5Hrs
Bhimad	67.95	65.33	1.51	14.13	19.04
Chhang	38.24	85.37	0.95	0	13.69
Majhkot	28.16	55.69	14.57	0.52	29.22
Rising Ranipokhari	88.65	96.81	1.62	0	1.57
Kotdurbar	31.63	86.41	1.15	0	12.43
Jamune	37.5	98.75	1.04	0	0.12
Kahun Shivapur	46.67	69.85	3.54	0	26.62
Pokhari Bhanjyang	78.61	77.46	4.78	0.9	16.87
Average	52.18	79.46	3.64	1.94	14.96

Source: Poverty Mapping Report, Tanahu, DDC, 2001.

Springs are the major sources of water supply in the affected VDCs since the accessibility is not so easy. Table 4.43 presents some of the major sources being utilized for drinking water located in the affected VDCs and Municipality. Besides these sources, it is reported that 11 medium level drinking water schemes have been proposed by the district assembly to serve the affected VDCs and Municipality except for Bhimad, Chhang, Pokhari Bhanjyang VDCs some of which are under construction and the other are about to be completed.

Table 4.43: Sources of Drinking Water being used and Impacted by the Project

Affected VDCs/Municipality, Ward	Source Type	Source Name	Location	Beneficiary Household (HH)
Chhang VDC Ward 4, Chokre	Pond/Pokhari	Chokre Pokhari	Just below Chokre village	39
Chhang VDC Ward 5, Fulbari Ghaderi	Pond/Pokhari	Chokre	Chokre	20
	Pipe water	Pipale	Pipale	15
Chhang VDC Ward 7, Jhakash Fulbari	Pipe water	Chitung Khola	Jhakash-Fulbari	23
Rising Rani Pokhari VDC Ward 9, Rising Patan	Spring /Mulpani	Kumalpani	Rising Patan	50
	Spring /Mulpani	Amalapani	Rising Patan	50
	Spring /Mulpani	Dulegaunda	Rising Patan	40
	Spring /Mulpani	Dhunge Pandhero	Rising Patan	200
	Spring /Mulpani	Tarebhir	Rising Patan	70
Rising Rani Pokhari VDC Ward 9, Rising Patan – Kharkhare	Stream	Bokse Chhahra	Sanutari	16
Kotdurbar V D C Ward 1, Maidan Swanra	Spring /Mulpani	Risini Khola	Ward-3	35
Kahun Shivapur VDC Ward 3, Bakle	Kuwa	Bakle Kuwa	Bansbot	4
	Kuwa	Sarki Kuwa	Kahun	50
	Pipe Water	Kheradi	Kahun Basti	20
	Kuwa	Gidha	Ranibari Gidha	5
Vyas Municipality Ward 7, Beni Patan	Spring /Mulpani	Linde Dhara	Near School	25
	Water Tank	Dharakholsi and Asagurikholsi	Asaguri	45
	Pipe Water	Dharakholsi	Asaguri Puchhar	1

Source: Supplemental EIA Survey, JICA, 2006.

Unavailability of safe drinking water to 48 percent of the population and lack of toilet facilities to 77 percent of the population indicates the poor sanitation condition of the project affected VDCs. In 5 VDCs (62%), the access of toilets is limited to less than 15 percent households. Further, almost 36 percent households have no access of hospital within 3 km distance (Table 4.44).

Table 4.44: Sanitation Condition of the Project VDCs

Affected VDCs	%of HH not access to Safe Drinking Water	Access to Sanitation Service	
		%HH Not access to latrine	%HH not having Hospital within 3km
Bhimad	32.05	58.96	35.29
Chhang	61.76	85.25	37.04
Majhkot	71.84	91.45	62.16
Rising Ranipokhari	11.35	88.05	47.37
Kotdurbar	68.37	92.05	22.86
Jamune	62.5	37.25	9.38
Kahu Shivapur	53.33	73.96	25
Pokhari Bhanjyang	21.39	90.0	47.37
Average Project VDCs	47.82	77.12	35.81
District total/Average	43.47	73.04	29.25

Source: Poverty Mapping Report, 2001, DDC, Tanahu.

4.4.1.5 Electricity and Transportation

Only about 13.3 percent of the population in the project VDCs has access to electricity services. The remaining households use kerosene for lighting. Among the 8 VDCs, larger population of Bhimad and Jamune are using electricity facility (42 and 38%), while none of the households in the Kahun Shivapur have access to electricity services (Table 4.45). Fuel wood is the main source for cooking for the large majority of the households in the project VDCs except in a few urban and semi-urban areas such as Vyas Municipality, Bhimad where the well-off households and businessmen use LP gas and kerosene.

Table 4.45: Percentage of Population Served with Electricity

Affected VDCs	Pokhari Bhanjyang	Rani Pokhari	Jamune	Majhkot	Kahun Shivapur	Kotdurbar	Bhimad	Chhang	Total
% of Pop.	6.0	0.5	37.5	7.2	0	0.4	41.7	13.4	13.3

Source: Periodic District Plan (2058/59-2063/064); DDC Tanahu

The assessment of accessibility of other services in the project area reveals that 53 percent of the affected households have access to a motorable road within 2 km, 39 percent population within 4 km and 8 percent within 6 km. Similarly, 39 percent of the population has access to the major trail within 0.5 km distance (Table 4.46).



Table 4.46: Motorable Road Accessibility

Affected VDCs	Motorable road accessibility (%)			Major trail accessibility within 0.5 km (%)
	Within 2km	More than 2 km and less than 4km	More than 4 km and less than 6km	
Bhimad	47.06	47.06	5.88	82.35
Chhang	66.67	33.33	0	33.33
Majhkot	51.35	40.54	8.11	2.7
Rising Ranipokhari	57.89	42.11	0	63.16
Kotdurbar	25.71	71.43	2.86	54.29
Jamune	95.31	4.69	0	48.44
Kahun Shivapur	10	40	45	30
Pokhari Bhanjyang	68.42	31.58	0	0
Average	52.8	38.8	7.73	39.28

Source: Poverty Mapping Report, 2001, DDC Tanahu.

4.4.1.6 Economic Condition

Sixty-eight percent of the population within 10 years of age and over is economically active, out of which 64 percent are female (Table 4.47).

Table 4.47: Economically Active Population 10 Years of Age and Over by Village Development Committee /Municipality

Affected VDCs/ Municipality	Economically Active						Economically Inactive					
	Male		Female		Total		Male		Female		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Bhimad	1282	59	1494	60	2776	59	898	41	1000	40	1898	41
Chhang	1220	62	1892	69	3112	66	747	38	840	31	1586	34
Majhkot	2073	82	2767	82	4840	82	452	18	595	18	1047	18
Rising Ranipokhari	1383	100	1842	100	3226	99	0	0%	7	0	7	0
Kotdurbar	1663	79	1975	78	3638	63	434	21	543	22	977	21
Jamune	2270	67	2483	62	4753	64	1136	33	1548	38	2684	36
Kahun Shivapur	1724	62	1798	61	3522	61	1070	38	1173	39	2243	39
Pokhari Bhanjyang	1101	87	1617	95	2718	91	170	13	94	5	263	9
Vyas Municipality	6417	63	6252	55	12669	59	3702	37	5157	45	8858	41
Total	19133	69	22120	67	41254	68	8609	31	10957	33	19563	32
%	31.4		36.4		67.8		14.2		18.0		32.2	

Source: CBS, 2001

Agriculture combined by livestock remains to be the main occupation for the majority of the population in the affected VDCs. The assessment of income of households by DDC (2001), however reveal that the households derive major portion of their income (86%) from non-agricultural income. The average income of NRs 24,620 is significantly lower than the average national income of western hills estimated by NLSS 2004, i.e. NRs 64,447 (Table 4.48).

Table 4.48 Share of Agricultural and Non-Agricultural Income in the Project VDCs

Affected VDCs	Income from Agriculture & Live.		Income from Non-Agricultural Activities.		Total Rs
	Rs	%	Rs	%	
Bhimad	5,315	14.3	31,811	85.7	37,126
Chhang	873	1.60	53,761	98.4	54,634
Majhkot	1,838	8.6	19,641	91.4	21,479
Rising Ranipokhari	996	6.7	13,852	93.3	14,848
Kotdurbar	2,353	8.4	25,628	91.6	27,981
Jamune	149	16.4	760	83.6	909
Kahun Shivapur	5,793	31.3	12,709	68.7	18,502
Pokhari Bhanjyang	10,789	50.2	10,697	49.8	21,486
Average	3,513	14.3	21,107	85.7	24,620

Source: District Profile of Tanahu District, DDC, Tanahu, 2001

The poverty mapping of the affected VDCs further reveal that 80-90 percent of the households of the project VDCs are below the poverty line. (Table 4.49).

Table 4.49: Poverty by Income in the Project VDCs

Affected VDCs	Poverty by income (NPC Cut off Point)				Poverty by income (NPC Cut off Point)			
	Rs. 30000/household/year to meet 2256kcal intake				Rs. 50000/hh/year of \$150/Capita/year			
	Above Poverty Line (>Rs 30000)		Below Poverty Line (<30000)		Above Poverty Line (>Rs 30000)		Below Poverty Line (<30000)	
	HH	%	HH	%	HH	%	HH	%
Bhimad	324	37.53	539	62.43	220	25.48	643	74.48
Chhang	443	46.63	507	53.37	330	34.74	620	65.26
Majhkot	142	12.24	1018	87.76	106	9.14	1054	90.86
Rising Ranipokhari	117	18.97	500	81.08	60	9.73	557	90.33
Kotdurbar	291	37.31	489	62.69	168	21.54	612	78.46
Jamune	7	0.73	953	99.27	7	0.73	953	99.27
Kahun Shivapur	59	9.08	591	90.92	33	5.08	617	94.92
Pokhari Bhanjyang	83	12.39	587	87.61	40	5.97	630	94.03
Total Project Site	1466	22.05	5184	77.95	964	14.5	5686	85.5
District Total	9646	20.72	33174	79.28	4809	10.21	38011	89.79

Source: Poverty Mapping Report, Tanahu, DDC 2001

The food sufficiency status of the project VDCs shown in Table 4.50 which reveals that only 37 percent of the households in the project area have food sufficiency throughout the year.

Table 4.50: Food Sufficiency Status of Affected VDC

Affected VDCs	Total HHs	Food Sufficiency			
		≥12m Sufficiency.		<12m Sufficiency	
		HH	%	HH	%
Bhimad	863	195	22.59	668	77.37
Chhang	950	209	22.00	741	78.00
Majhkot	1160	590	50.86	570	49.14
Rising Ranipokhari	617	303	49.14	314	50.92
Kotdurbar	780	204	26.15	576	73.85
Jamune	960	624	65.00	336	35.00
Kahu Shivapur	650	240	36.92	410	63.08
Pokhari Bhanjyang	670	123	18.36	547	81.64
Total Project VDCs	6650	2488	37.4	4162	62.6
District Total	42821	13758	32.12	29062	68.57

Source: Poverty Mapping Report, 2001, DDC, Tanahu.

The project affected VDCs have several resource potentials with respect to enhancement of livelihood if the resources are properly utilized. All the VDCs have been identified as potential pockets for livestock development. The collaborative forest management practices adopted in Vyas Municipality, Bhimad and Pokhari Bhanjyang VDCs have been a major source of income of the local community. Similarly, the VDCs have great potentials for the commercialization of agricultural crops.

4.4.1.7 Cultural and Historical Places

Vyas cave and Shidha Baba cave in Bhimad VDC are some of the famous and historical and cultural places located in the affected VDCs. No other culturally important places were recorded in project affected VDCs and Municipality.

4.4.2 Project Affected Persons/Households

A household survey was conducted by randomly selecting 399 households having land or assets below FSL of 425 m to collect the socio-economic and cultural situation of affected persons and households. These households were from the affected VDC and Municipality. (Appendix B-Household Survey Questionnaire). The households in Jamune VDC were not covered by this survey since those who have land or assets below 425 m of reservoir FSL were not present during the household survey. The sample represents about 50 percent households of the area (below 425m reservoir FSL) that are expected to have some types of impacts due to the project activities. The findings of the survey are analyzed and presented in the respected headings in the following paragraphs.

4.4.2.1 Demographic Characteristics

Eighty percent of the surveyed households are headed by male members while 19 percent are headed by female members. The total population of 399 surveyed households is 2839. The average family size is 7.1, which is significantly higher than the average family size of the project affected VDCs (5.0) and district average family size (5.01). 47 percent of the total population is females (Table 4.51).

Table 4.51 Population and Family Size of the Sample Households

Description	Households		Population			Average Family Size
	Number	%	Male	Female	Total	
Male Headed	322	80.7	1237	1107	2344	7.3
Female Headed	77	19.3	248	237	485	6.3
Total	399	100	1485	1344	2839	7.1

Source: Supplemental EIA Survey, JICA Study Team, 2006

The sampled households are divided into 4 major ethnic/caste groups. They are presented in Table 4.52 which reveals that Magars are the most dominant population (51%), followed by Brahmins (15.79%), Gurungs (8.52%) and Dalits (8%).

Table 4.52: Ethnic/Caste Division

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

Source: Supplemental EIA Survey, JICA Study Team, 2006

More than half of the surveyed households adopt the joint family system under which 2-3 generations of families live together while 46 percent households are under the nuclear family system. It is reported that the nuclear system of family structure has increased over the past years.

The ratio of families adopting the joint family system to nuclear family is almost 1:1 among Dalits, higher between Brahmins/Chhetris and Adibasis/Janjatis. However, the majority of the Sanyasi (62%) group follows nuclear system of family structure. Similarly, majority and almost an equal percentage of male and female-headed households are also adopting the joint family structure (Table 4.53).

Table 4.53: Family Structure of Survey Households

Categories	Nuclear		Joint		Total	
	Nos.	%	Nos.	%	Nos.	%
Brahmin/ Chhetri/ Thakuri	34	44.7	42	55.3	76	100.0
Adibasi/ Janajati	125	45.0	153	55.0	278	100.0
Dalit	16	50.0	16	50.0	32	100.0
Other (Sanyasi)	8	61.5	5	38.5	13	100.0
Total/ Overall	183	45.9	216	54.1	399	100.0
Male	147	45.7	175	54.3	322	100.0
Female	36	46.8	41	53.2	77	100.0
Total/ Overall	183	45.9	216	54.1	399	100.0

Source: Supplemental EIA Survey, JICA Study Team, 2006.

1 About 60 indigenous tribes of Nepal are defined as Adibasi/Janjati by GoN.

It was found that almost half of the surveyed households have been residing in the area for more than two generation before, 24 percent one generation before and 30 percent within the last 30 years. Among those living within the last three decades, a large majority (98 %) migrated from the same district (Table 4.54).

Table 4.54: Migration Pattern

Categories	Two Generation Before		One Generation Before		Recent (within 30 Years)		Total		Place of Recent Migrants (for within 30 years migrants)					
									Migrated from the Same District		Migrated from other District		Total Migrating	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Brahmin/ Chhetri/ Thakuri	29	38.2	24	31.6	23	30.3	76	100	23	100			23	100
Adibasi/ Janajati	143	51.4	54	19.4	81	29.1	278	100	80	98.8	1	1.2	81	100
Dalit	15	46.9	9	28.1	8	25.0	32	100	8	100			8	100
Other (Sanyasi)			7	53.8	6	46.2	13	100	4	66.7	2	33.3	6	100
Total/ Overall	187	46.9	94	23.6	118	29.6	399	100	115	97.5	3	2.5	118	100
Male	157	48.8	77	23.9	88	27.3	322	100	86	97.7	2	2.3	88	100
Female	30	39.0	17	22.1	30	39.0	77	100	29	96.7	1	3.3	30	100
Total/ Overall	187	46.9	94	23.6	118	29.6	399	100	115	97.5	3	2.5	118	100

Source: Supplemental EIA Survey, JICA, 2006

The structure of the age groups of the sample population shown in Table 4.55 reveals that 58 percent of the population under the age group of 16-60 years and can be considered as economically active. Almost a quarter of the population is under the age group of 6-15 years and can be considered as school going population. The population below 5 years of age (11%) and above 60 years (7%) can be considered as an economically inactive group.

Table 4.55: Age Group of Surveyed Population (in Percent)

	Up to 5 Years			6 to 15 Years			16 to 60 Years			Over 60 Years			Total		
	Σ	♂	♀	Σ	♂	♀	Σ	♂	♀	Σ	♂	♀	Σ	♂	♀
%	5.5	5.4	10.9	12.4	11.7	24.1	31.2	26.9	58.1	3.4	3.5	6.9	52.5	47.5	100

Source: Supplemental EIA Survey, JICA Study Team, 2006

The families surveyed follow three religions. The majority of the families (86%) have adopted the Hindu religion followed by Buddhists (14%) and Christians (0.3%). The followers of the Buddhist and Christian religion are found only among Adibasi/Janjatis within the sample frame (Table 4.56).

Table 4.56: Religion of the Surveyed Families

Categories	Hindu		Buddhist		Christian		Total	
	No.	%	No.	%	No.	%	No.	%
Brahmin/ Chhetri/ Thakuri	76	100.0					76	19.0
Adibasi/ Janajati	223	80.2	54	19.4	1	0.4	278	69.7
Dalit	32	100.0					32	8.0
Other (Sanyasi)	13	100.0					13	3.3
Total/ Overall	344	86.2	54	13.5	1	0.3	399	100.0

Source: Supplemental EIA Survey, JICA Study Team, 2006

4.4.2.2 Education

A large number of the sample population (79%) is reported to be literate. The literacy percentage of the population is relatively better when compared to the average literacy rate of the project VDCs (61%) and the district (71%). The literacy rate among male and female members varies to a great extent. Among different caste/ethnic groups, the literacy rate is higher among the Brahmin/Chhetri caste (84%) compared to others (Table 4.57).

Table 4.57: Literacy Status of Population

Categories	Illiterate			Literate			Total		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Brahmin/ Chhetri/ Thakuri	10.0	23.4	16.0	90.0	76.6	84.0	55.2	44.8	100.0
Adibasi/ Janajati	14.3	30.2	21.9	85.7	69.8	78.1	51.9	48.1	100.0
Dalit	14.0	35.2	23.7	86.0	64.8	76.3	54.0	46.0	100.0
Other (Sanyasi)	13.3	21.4	17.2	86.7	78.6	82.8	51.7	48.3	100.0
Total/ Overall	13.4	29.1	20.8	86.6	70.9	79.2	52.7	47.3	100.0

Source: Supplemental EIA Survey, JICA Study Team, 2006

Among the literate population 14 percent had not attended any school while 86 percent had attended schools. The level of education completed by the population is also presented in Table 4.58. The table reveals that 39 percent of the population has completed primary level education, 27 percent have completed lower secondary and secondary level education and 7 percent has completed above School Leave Certificate (SLC) level education. The percentage of population that have completed education at the secondary level education and above SLC is found higher among the Brahmin/Chhetri community compared to the others.

Table 4.58 Distribution of Literate Population by Level of Schooling (% of Population)

Categories	Completed Level (Class)				
	1-5	6-8	9-10& SLC	>SLC	Total
Brahmin/ Chhetri/ Thakuri	20.1	18.1	41.4	20.4	100.0
Adibasi/ Janajati	42.4	29.5	23.7	4.5	100.0
Dalit	57.1	24.8	16.5	1.5	100.0
Other (Sanyasi)	35.0	32.5	32.5	0.0	100.0
Total/ Overall	38.8	26.9	26.9	7.4	100.0

Source: Supplemental EIA Survey, JICA Study Team, 2006

Note: School Leave Certificate, SLC



4.4.2.3 Water Supply and Sanitation

The majority of the households in the survey area (85%) have piped water supply while 14 percent households rely on wells /ponds and one percent on springs (Table 4.59).

Table 4.59: Sources of Drinking Water

Categories	Source of Drinking Water									
	Piped Tap		MUL		Stream/ River		Well/ Pond		Total	
Brahmin/ Chhetri/ Thakuri	69	90.8	1	1.3	2	2.6	4	5.3	76	100.0
Adibasi/ Janajati	231	83.1	2	0.7			45	16.2	278	100.0
Dalit	24	75.0	1	3.1			7	21.9	32	100.0
Other (Sanyasi)	13	100.0							13	100.0
Total/ Overall	337	84.5	4	1.0	2	0.5	56	14.0	399	100.0

Source: Supplemental EIA Survey, JICA Study Team, 2006

Regarding the sanitation condition, 63 percent of the households of the project area have toilets. It is reported that 82 percent of the toilets are improved types. Among the different categories of households, the lowest number of households having toilet are reported between Dalit (44%) and Janjati (57%) while 100 percent of Sanyasi and 86 percent of Brahmin/Chhetri have toilet facilities. It is also found that female-headed households are found to be more aware regarding the construction of toilets than the male-headed households, 75 percent female-headed households have toilets compared to 60 percent of male-headed households (Table 4.60). In general, access to drinking water service and sanitation of the survey households is found to be in better condition compared to the average district and VDC situation.

Table 4.60: Households Having Toilet Facility

Categories	HH Having Toilet		Type of Toilet Owned			
	Number	Percent	Pit		Improved	
			Number	Percent	Number	Percent
Brahmin/ Chhetri/ Thakuri	65	85.5	7	10.8	58	89.2
Adibasi/ Janajati	159	57.2	33	20.8	126	79.2
Dalit	14	43.8	3	21.4	11	78.6
Other (Sanyasi)	13	100.0	2	15.4	11	84.6
Total/ Overall	251	62.9	45	17.9	206	82.1
Male Headed HHs	193	59.9	35	18.1	158	81.9
Female Headed HHs	58	75.3	10	17.2	48	82.8
Total/ Overall	251	62.9	45	17.9	206	82.1

Source: Supplemental EIA Survey, JICA Study Team, 2006

An enquiry with the sampled households regarding other devices of sanitary condition reveal that 98 percent of the households have provisions of a separate livestock sheds, 12 households were observed using improved cooking stoves.(Table 4.61).

Table 4.61: Households Having other Sanitation Devices

Categories	Has Separate Shed		Have Smokeless Stove	
	No	%	No	%
Brahmin/ Chhetri/ Thakuri	75	98.7	15	19.7
Adibasi/ Janajati	273	98.2	28	10.1
Dalit	32	100.0	5	15.6
Other (Sanyasi)	13	100.0	1	7.7
Total/ Overall	393	98.5	49	12.3

Source: Supplemental EIA Survey, JICA Study Team, 2006.

4.4.2.4 Energy for Lighting and Cooking

60 percent of the sampled households have electricity services while 43 percent use kerosene for lighting. Access to electricity is highest among the Sanyasi (100%) and Brahmin/Chhetri (87%) communities while 57 percent of Janjati and 59 percent of Dalit are benefiting from electricity for lighting purposes. The households use more than one source for lighting (Table 4.62).

Table 4.62: Households Using Various Type of Energy for Lightning (Multiple Responses)

Categories	Kerosene		Firewood		Electricity		Other	
	No.	%	No.	%	No.	%	No.	%
Brahmin/ Chhetri/ Thakuri	21	27.6			66	86.8	1	1.3
Adibasi/ Janajati	134	48.2	1	0.4	159	57.2	5	1.8
Dalit	15	46.9			19	59.4		
Other (Sanyasi)					13	100.0		
Total/ Overall	170	42.6	1	0.3	257	64.4	6	1.5

Source: Supplemental EIA Survey, JICA Study Team, 2006.

The households use multiple sources of energy for cooking. Five major sources of cooking energy are used by the Project Affected Families. The large majority (94%) are dependent on firewood, followed by bio-gas (27%), LP gas (10%), kerosene (2%) and electricity (1%) respectively. Brahmin/ Chhetri and Sanyasi are found to be largest user of biogas and LP gas while only a few Dalits are capable of using biogas and LP gas (Table 4.63).

Table 4.63: Households Using Various Type of Energy for Cooking (Multiple Responses)

Categories	Kerosene		Firewood		Bio-Gas		LP Gas		Electricity	
	No.	%	No.	%	No.	%	No.	%	No.	%
Brahmin/ Chhetri/ Thakuri			72	94.7	43	56.6	11	14.5		
Adibasi/ Janajati	5	1.8	261	93.9	55	19.8	22	7.9	3	1.1
Dalit	3	9.4	30	93.8	2	6.3	2	6.3	1	3.1
Other (Sanyasi)			13	100.0	7	53.8	3	23.1		
Total/ Overall	8	2.0	376	94.2	107	26.8	38	9.5	4	1.0

Source: Supplemental EIA Survey, JICA Study Team, 2006

The average quantity of firewood consumed by a household in a year is estimated to be 2819 Kg. which is equivalent to NRs 6,128 at local price. Among different categories of households,

Adibasi/Janjatis are found to be the uppermost user of firewood i.e. 3055 kg (Table 4.64).

Table 4.64: Average Quantity of Firewood Used & its Value (NRs)

Categories	Quantity Used/Yr (Kg)	Value Equivalent
Brahmin/ Chhetri/ Thakuri	2046	4369
Adibasi/ Janajati	3055	6678
Dalit	2608	5720
Other (Sanyasi)	2825	5649
Total/ Overall	2819	6128

Source: Supplemental EIA Survey, JICA Study Team, 2006

4.4.2.5 Membership of Community Group and Training

Participation in various institutions was also recorded when assessing the quality of life values of the project affected households. It was found that only about 29 percent of the households were representing local level organizations such as Community Forest Users' Groups, Water Users' Groups, Saving and Credit Groups etc. About 42% of the project affected households reported that at least one member of the family has obtained income generating trainings. Majority of the members have obtaining training in masonry (27%), sewing/cutting (21%), knitting basket/rope (Doko/Namlo) (14%), driving (12%), carpentry (11%), construction (10%), etc. The majority of the households obtaining these trainings are from Adibasi/Janjati (75%) and male headed households (86%). The details of the various trainings received by the project affected households are shown in the Table 4.65.

Table 4.65: Various Trainings Received by Household Members

Categories	Mason		Carpentry		Sewing/Cutting		Driving		Other construction related trainings		Knitting doko / namlo		Iron Work, Shoe Making and Other		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Brahmin./Chhetri/ Thakuri			1	7.1	6	42.9	5	35.7	1	7.1			1	7.1	14	100
Adibasi/ Janajati	34	26.8	14	11.0	26	20.5	12	9.4	13	10.2	23	18.1	5	3.9	127	100
Dalit	9	47.4	4	21.1	1	5.3	2	10.5	1	5.3			2	10.5	19	100
Other (Sanyasi)	3	33.3			3	33.3	1	11.1	1	11.1	1	11.1			9	100
Total/ Overall	46	27.2	19	11.2	36	21.3	20	11.8	16	9.5	24	14.2	8	4.7	169	100
Male Headed HHs	40	27.6	17	11.7	24	16.6	18	12.4	15	10.3	24	16.6	7	4.8	145	100
Female Headed HHs	6	25.0	2	8.3	12	50.0	2	8.3	1	4.2			1	4.2	24	100
Total/ Overall	46	27.2	19	11.2	36	21.3	20	11.8	16	9.5	24	14.2	8	4.7	169	100

Source: Supplemental EIA Survey, JICA Study Team, 2006.

4.4.2.6 Economic Condition

The main occupation of the majority of the sampled people is agriculture (56%) followed by service (15%) and business (13%). A significant number of population (16%) are students and are less engaged in earning activities. Dalits (30%) are engaged in business and wage earning related activities whereas only 8 percent of Brahmin/Chhetri is engaged in such activities (Table 4.66). Business and wage earning activities are more practiced by the Dalits (30%) than Brahmin/Chhetri (8%).

Table 4.66: Major Occupation of the Households

Categories	Agriculture			Service			Student			Business/Wage/ Others			Total		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
Brahmin/ Chhetri/ Thakuri	40.7	68.3	53.2	25.8	6.2	16.9	22.2	10.5	21.4	11.3	5.0	8.5	54.6	45.4	100
Adibasi/ Janajati	41.8	78.8	59.1	25.0	2.3	14.4	15.3	12.3	13.9	17.8	6.6	12.6	53.4	46.6	100
Dalit	30.8	60.4	44.1	7.7	1.9	5.1	23.1	18.9	21.2	38.5	18.9	29.7	55.1	44.9	100
Other (Sanyasi)	17.6	63.2	41.7	58.8	5.3	30.6	5.9	15.8	11.1	17.6	15.8	16.7	47.2	52.8	100
Total/ Overall	40.3	74.9	56.4	24.6	3.1	14.7	17.2	14.6	16.0	17.9	7.3	13.0	53.7	46.3	100

Source: Supplemental EIA Survey, JICA Study Team, 2006

Land and livestock holdings are the basic indicators of well being in the area as elsewhere in rural Nepal. The entire households own certain portions of land within the project area. However, only 55% households own the most productive irrigated land (Khet) while 92.2% households own un-irrigated land (Pakho or Bari land). Similarly, 8% own kharbari, 2.5 percent private forest and 2 percent orchards. The majority of the khet owners recorded are Brahmins/Chhetris while only 22 percent of Dalits own khet land. The percentage of female-headed households owning khet is lower than that of male-headed households (Table 4.67).

Table 4.67: Households Owning Different Type of Land

Categories	Total HH Owning Land		HH Owning Khet Land		HH Owning Bari Land		HH Owning Kharbari		HH Owning Private Forest		HH Owning Orchard	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Brahmin/ Chhetri/ Thakuri	76	100.0	61	80.3	64	84.2	13	17.1	4	5.3	2	2.6
Adibasi/ Janajati	278	100.0	150	54.0	259	93.2	16	5.8	5	1.8	6	2.2
Dalit	32	100.0	7	21.9	32	100.0	3	9.4				

Other (Sanyasi)	13	100.0	2	15.4	13	100.0	2	15.4	1	7.7		
Total/ Overall	399	100.0	220	55.1	368	92.2	34	8.5	10	2.5	8	2.0
Male	322	100.0	187	58.1	295	91.6	28	8.7	9	2.8	7	2.2
Female	77	100.0	33	42.9	73	94.8	6	7.8	1	1.3	1	1.3
Total/ Overall	399	100.0	220	55.1	368	92.2	34	8.5	10	2.5	8	2.0

Source: Supplemental EIA Survey, JICA Study Team, 2006

The average landholding of the households surveyed is estimated to be 0.685ha. Almost 70 percent comprise of bari land followed by khet (27%), kharbari (3%) etc. The average land holding size is the highest among Brahmins/Chhetris (0.83ha/HH) and lowest among Sanyasi (0.281ha/HH) and Dalit (0.361ha/HH). The average land holding size of affected HHs is shown in Table 4.68.

Table 4.68: Average Land Owned (Own Land Self Cultivated + Rented Out Land)

Categories	Khet (Ha/HH)	Bari (Ha/HH)	Kharbari (Ha/HH)	Private Forest (Ha/HH)	Orchard (Ha/HH)	Total Land Owned (Ha/HH)
Brahmin/ Chhetri/ Thakuri	0.380	0.397	0.052	0.001	0.004	0.834
Adibasi/ Janajati	0.160	0.519	0.017	0.001	0.002	0.700
Dalit	0.031	0.318	0.013			0.361
Other (Sanyasi)	0.053	0.228				0.280
Total/ Overall	0.188	0.470	0.023	0.001	0.002	0.685
Male Headed HHs	0.203	0.500	0.028	0.000	0.002	0.733
Female Headed HHs	0.125	0.346	0.004	0.005	0.001	0.481
Total/ Overall	0.188	0.470	0.023	0.001	0.002	0.685

Source: Supplemental EIA Survey, JICA Study Team, 2006

Besides their own land, the households were also found occupying certain portions of Government owned land, generally known as ailani land. The average ailani land occupied by a household is estimated to be 0.111 ha. Thus, the total land operated by a household including ailani land accounts to 0.796 ha. The households of the project area are growing different types of crops such as cereals (paddy, maize, millet, wheat etc), oil seeds, fruits and vegetables. Although 94 percent of the households are producing cereals, pulses and oil seeds, the percentage of farmers farming fruits is below 50 percent. Sixty five percent of the households are cultivating vegetables. The percentage of farmers with vegetable farming is recorded to be the highest among Brahmins/Chhetris (85%) and lowest among the Dalit community (44%) Table 4.69 shows the number of households cultivating different types of crops.

Table 4.69: Households Cultivating Different Crops

Categories	Cereal, Pulses and Oil Crops		Fruits		Vegetables		Growing at Least One Type	
	No.	%	No.	%	No.	%	No.	%
Brahmin/ Chhetri/ Thakuri	74	97.4	46	60.5	65	85.5	74	97.4
Adibasi/ Janajati	260	93.5	130	46.8	169	60.8	263	94.6
Dalit	28	87.5	9	28.1	14	43.8	28	87.5
Other (Sanyasi)	12	92.3	12	92.3	10	76.9	12	92.3
Total/ Overall	374	93.7	197	49.4	258	64.7	377	94.5
Male	308	95.7	164	50.9	220	68.3	311	96.6
Female	66	85.7	33	42.9	38	49.4	66	85.7
Total/ Overall	374	93.7	197	49.4	258	64.7	377	94.5

Source: Supplemental EIA Survey, JICA Study Team, 2006

The production and yield of different crops grown in the area are shown in Table 4.70. The yield calculated for different crops indicate that the crop harvest of the households is generally good.

Table 4.70 Area, Production and Yield of Major Crops Grown by Project Area Households

Description	Paddy	Maize	Wheat	Millet	Potato	Oil Crops	Pulses	Vegetables	Sugarcane	Total
Av. Area under Crops (ha/HH)	0.242	0.516	0.118	0.154	0.008	0.035	0.117	0.019	0.001	1.209
Av. Quantity of Crops Produced (Kg/HH)	638	1162	174	189	57	38	104	206	5	2573
Yield (Mt/ha)	2.6	2.3	1.5	1.2	7.3	1.1	0.88	10.8	11.0	38.68

Source: Supplemental EIA Survey, JICA Study Team, 2006

The average crop intensity of the area is calculated to be 152 percent and varies between 109 percent and 176 percent. The crop intensity is found to be the highest among the Dalit community (Table 4.71).

Table 4.71: Cropping Intensity of the Area

Categories	Cultivated Area (Ha)	Cropped Area (Ha)	Cropping Intensity (%)
Brahmin/ Chhetri/ Thakuri	0.900	1.450	161
Adibasi/ Janajati	0.815	1.213	149
Dalit	0.516	0.905	176
Other (Sanyasi)	0.424	0.464	109
Total/ Overall	0.794	1.209	152
Male	0.856	1.291	151
Female	0.536	0.867	162
Total/ Overall	0.794	1.209	152

Source: Supplemental EIA Survey, JICA Study Team, 2006

Despite good yield and crop intensity of crops, the majority of the households (78%) surveyed have reported food deficiency from their own production. The number of households facing food deficiency is reported highest among Dalit (97%) and female headed households (83%). Food

sufficiency status of the sampled PAFs is shown in the Table 4.72.

Table 4.72: Food Sufficiency Status in Households Level

Categories	Food Sufficiency					
	Sufficient		Not Sufficient		Total Reporting	
	No.	%	No.	%	No.	%
Brahmin/ Chhetri/ Thakuri	36	47.4	40	52.6	76	100.0
Adibasi/ Janajati	50	18.0	228	82.0	278	100.0
Dalit	1	3.1	31	96.9	32	100.0
Other(Sanyasi)	1	7.7	12	92.3	13	100.0
Total/ Overall	88	22.1	311	77.9	399	100.0
Male	75	23.3	247	76.7	322	100.0
Female	13	16.9	64	83.1	77	100.0
Total/ Overall	88	22.1	311	77.9	399	100.0

Source: Supplemental EIA Survey, JICA Study Team, 2006

The population and food deficiency period is given below:

Table 4.73: Duration of Food Sufficiency in Households Level

Categories	Food Sufficient Months							
	Sufficient up to 3 Months		Sufficient for 4-6 Months		Sufficient for 7 to 9 Months		Total Reporting	
	No.	%	No.	%	No.	%	No.	%
Brahmin/ Chhetri/ Thakuri	11	27.5	17	42.5	12	30.0	40	100.0
Adibasi/ Janajati	67	29.4	108	47.4	53	23.2	228	100.0
Dalit	16	51.6	12	38.7	3	9.7	31	100.0
Other (Sanyasi)	4	33.3	5	41.7	3	25.0	12	100.0
Total/ Overall	98	31.5	142	45.7	71	22.8	311	100.0
Male Headed HHs	70	28.3	119	48.2	58	23.5	247	100.0
Female Headed HHs	28	43.8	23	35.9	13	20.3	64	100.0
Total/ Overall	98	31.5	142	45.7	71	22.8	311	100.0

Source: Supplemental EIA Survey, JICA Study Team, 2006

The households are adopting more than one strategy to meet the food deficiency, Wage labor income (41%) and borrowing money (40%) and income from service/pension (36%) are the main strategies adopted by the majority of the households (Table 4.74).

Table 4.74: Copping Strategies Against Food Deficit (Multiple Response)

	Borrow Money to Buy Food	Use Income from Wage Labor	Sale of HH Assets	Use Income from Porter	Sale of Livestock	Use Income from Service/ Pension	Other	Av. Amount Spend to Purchase Food (Rs)
No.	160	127	9	7	52	111	30	11,156
%	40.1	41.0	2.9	2.3	16.8	35.8	9.4	

Source: Supplemental EIA Survey, JICA Study Team, 2006

A significant number of household members (43%) are migrating from the area for seasonal earnings to meet their food deficit. The migration of households occurs irrespective of caste and ethnicity. At least one member of the household is migrated for the seasonal earning. The average

income of the people migrated for job is estimated to be NRs 14,433 per season (Table 4.75).

Table 4.75: Migration of Household Members for Seasonal Earning

Categories	HH having Members Migrated for Job		Average No. of Persons per Migrating HH	Income per Migrating HH (Rs)/ Season
	No.	%		
Brahmin/ Chhetri/ Thakuri	33	43.4	1.48	14258
Adibasi/ Janajati	124	44.6	1.48	14856
Dalit	11	34.4	1.36	12382
Other Sanyasi	4	30.8	1.50	8400
Total	172	43.1	1.48	14,433

Source: Supplemental EIA Survey, JICA Study Team, 2006

The households that are borrowing loans to meet the food deficit and other household necessities use three sources; namely friends/relatives (39%), the Agricultural Development Bank (24%) and local money lenders (19%). The total amount borrowed by a household is NRs 31,123/annum. The borrowers pay up to 36 percent rate of interest which is charged by the local moneylenders. The rate of interest charged by the banks and cooperatives ranges between 17-20 percent (Table 4.76).

Table 4.76: Borrowing of Loan (Source, Amount and Rate of Interest)

Description	Average Amount Borrowed (Rs)							
	Agricultural Development Bank	Nepal Bank Limited	Co-operatives	Small & Cottage Institutions	Local Money Lender/ Merchant	Friends/ Relatives	Other Sources	Total /Average
% of Borrower	24.4	0.6	6.9	3.8	19.4	39.4	15.6	40.1
Av. Amount Borrowed (Rs/HH)	5820	125	627	2018	7574	13798	1162	31123
Av. Rate of Interest	17.3	18.0	20.2	22.8	30.3	32.0	16.4	25.4

Source: Supplemental EIA Survey, JICA Study Team, 2006

Eighty four percent of the households are rearing at least one type of livestock. Among the different types of livestock reared by the majority of the households are goats/sheep (73%) followed by buffaloes (72%), cattle (66%) and pigs (37%). Similarly, 64 percent of the households are also rearing poultry (Table 4.77).

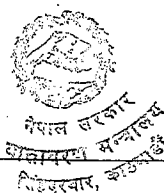


Table 4.77: Households Rearing Different Kinds of Livestock

Categories	Livestock Type											
	Cattle		Buffalos		Sheep/ Goat		Poultry		Pig		At Least One Type	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Brahmin/ Chhetri/ Thakuri	41	60.3	60	88.2	46	67.6	13	19.1	2	2.9	68	89.5
Adibasi/ Janajati	164	70.4	153	65.7	181	77.7	188	80.7	115	49.4	233	83.8
Dalit	11	52.4	16	76.2	11	52.4	12	57.1	7	33.3	21	65.6
Other (Sanyasi)	6	50.0	11	91.7	7	58.3	1	8.3			12	92.3
Total/ Overall	222	66.5	240	71.9	245	73.4	214	64.1	124	37.1	334	83.7

Source: Supplemental EIA Survey, JICA Study Team, 2006.

The average livestock size is 4.6 for cattle, 1.6 for buffalo and 4.6 for goat/sheep and 1 for pig. The total animal holding size is estimated to be the largest among the Adibasi/Janjati (11), followed by Brahmin/Chhetri (6.8) and Sanyasi (6.1). The Dalit community has the lowest animal holding size among the four categories of the households surveyed. The average holding size of poultry is 12.7. The average holding size of poultry is the highest among Janjati (16) (Table 4.78). According to the household survey, about 12 percent of households are selling at least one type of livestock product and the majority of the households (69%) sell milk and milk products.

Table 4.78: Average Number of Livestock Holding

Categories	Number of Animals					Poultry
	Cattle	Buffalos	Sheep/ Goat	Pig	Total Animals	
Brahmin/ Chhetri/ Thakuri	1.4	2.1	3.2	0.1	6.8	5.2
Adibasi/ Janajati	2.8	1.6	5.5	1.2	11.1	16.0
Dalit	1.2	1.1	1.6	0.6	4.5	4.8
Other (Sanyasi)	1.5	2.0	2.6	0	6.1	3.8
Total/ Overall	2.3	1.6	4.6	0.9	9.4	12.7

Source: Supplemental EIA Survey, JICA Study Team, 2006

The households surveyed are generating income from more than one source (Table 4.79). However, majority of the households are deriving income from agriculture (94%), livestock (56%), loan (38%), salary/pension (33%), remittance and wage earning (32% each) and business (9%).

Table 4.79: Households Reporting Various Sources of Income

Categories	Agri.	Live stock	Wage Earning	Salary /Pension	Remittance	Loan	Business	Interest/ Sell	Total
Brahmin/ Chhetri/ Thakuri	97.4	52.6	10.5	39.5	28.9	52.6	9.2		100.0
Adibasi/ Janajati	94.6	60.1	35.6	31.3	35.3	33.1	7.9	1.1	100.0
Dalit	87.5	43.8	50.0	25.0	18.8	37.5	12.5	3.1	100.0
Other (Sanyasi)	92.3	30.8	38.5	46.2	15.4	61.5	15.4		100.0
Total/ Overall	94.5	56.4	32.1	32.8	32.1	38.1	8.8	1.0	100.0
Male Headed HHs	96.6	60.2	33.5	31.4	32.0	39.8	8.1	0.9	100.0
Female Headed HHs	85.7	40.3	26.0	39.0	32.5	31.2	11.7	1.3	100.0
Total/ Overall	94.5	56.4	32.1	32.8	32.1	38.1	8.8	1.0	100.0

Source: Supplemental EIA Survey, JICA Study Team, 2006

The average annual income of the surveyed household is estimated to be NRs 185,364 which is significantly higher than the district average income of the western hill estimated by NLSS 2003/04. The highest annual income is derived by Brahmin/Chhetri (Rs238, 419/HH/Yr) while Sanyasins and Dalits are deriving the lowest income lower than the average income. Although 94 percent of the surveyed households are deriving income from the agriculture sector, the contribution of this sector in the average household income is only 24 percent. Now, almost one-third of the total average income is derived from foreign remittance. Similarly, the contribution of wage earning and livestock is 8 percent and 4 percent, respectively (Table 4.80).

Table 4.80: Average Annual Household Income

Categories	Agriculture	Livestock	Wage Earning	Salary/ Pension	Foreign Remittance	Loan	Industry/ Business/ Rentals	Interest & Asset Sell	Total
Brahmin/ Chhetri/ Thakuri	54,362	3,556	3,684	33,324	59,526	80,618	3,349	-	238,419
Adibasi/ Janajati	43,112	8,460	16,443	21,665	65,222	18,874	3,766	376	177,916
Dalit	37,245	5,785	26,150	18,013	31,875	18,906	5,094	56	143,124
Other (Sanyasi)	30,190	5,673	14,923	36,592	14,769	32,462	3,846	-	138,455
Total/ Overall	44,363	7,220	14,742	24,079	59,819	31,080	3,795	266	185,364
Male	46,867	7,438	15,732	19,644	62,850	33,978	3,024	266	189,801
Female	33,894	6,311	10,597	42,623	47,143	18,961	7,019	265	166,813
Total/ Overall	44,363	7,220	14,742	24,079	59,819	31,080	3,795	266	185,364
%	23.9	3.9	7.9	13.0	32.3	16.8	2.0	0.20	100.0

Source: Supplemental EIA Survey, JICA Study Team, 2006

The average annual expenditure is estimated to be Rs 119,511², of which a major portion is spent in purchasing food items (57.91%) followed by health and education (13.19%), transportation religious activities (9.22%), clothing (7.34%), and fuel (6.82%). The average expenditure is also recorded to be the highest among the Brahmin/Chhetri communities (Table 4.81).

Table 4.81: Average Annual Household Expenditure

Categories	Food Items	Alcohol & Tobacco	Clothing	Jewelry/Asset Purchase	Fuel	Inputs (Agri/Livestock)	Health & Education	Transportation/Religion and Other	Total
Brahmin/Chhetri/Thakuri	74,173	701	9,239	1,191	6,421	5,054	27,047	18,473	142,299
Adibasi/Janajati	68,608	3,426	8,693	1,145	8,753	2,172	12,772	9,344	114,913
Dalit	68,941	3,820	8,250	452	7,213	1,302	10,748	7,656	108,382
Other (Sanyasi)	53,793	369	9,038	-	7,529	3,290	26,262	11,707	111,988
Total/ Overall	69,213	2,839	8,773	1,061	8,145	2,688	15,769	11,024	119,511
Male Headed HHs	71,000	3,016	8,829	984	8,206	2,900	15,529	11,885	122,349
Female Headed HHs	61,736	2,100	8,540	1,385	7,892	1,800	16,772	7,423	107,648
Total/ Overall	69,212	2,839	8,773	1,061	8,145	2,688	15,769	11,024	119,511
%	57.91	2.38	7.34	0.89	6.82	2.25	13.19	9.22	100

Source: Supplemental EIA Survey, JICA Study Team, 2006.

4.4.3 Community Resources and Properties

Focus Group Discussions were held in 13 different communities within the affected VDCs and Municipality. These discussions revealed that forest resources and water resources were indispensable for the daily life of the people. The local people manage these common resources and properties.

4.4.3.1 Forest Resource Use

I. Fodder Use Pattern of the Study Area

Fodder is one of the several important resources being used by the beneficiary farming system households to raise cattle, buffaloes and other small ruminants. Fodder use pattern differs from one community to another. Fodder resources for cattle and buffalo are collected for 2-6 months from their own cultivation while for the remaining months it is collected from Government Forests, from Community Forests and Private Forests in some cases. As a whole the sources of fodder resources are mainly Government Forests, secondly Community Forests and very few Private Forests and cultivated land.

² It may exclude loan payments. Since anything that comes to the household is income, the loan can be regarded as income. However, information on loan payments is neither given by the household surveyed, not included in Table 2.3-31. Net saving of the household is very difficult to grasp from the given income and expenditure tables.

II. Supply of Fuel Wood Demand

In the study area the beneficiary households who were ranked relatively better economic status were found using biogas for cooking and for other purposes like preparation of livestock feed Kundo/concentrate whereas for occasional heating they use fuel wood. The beneficiary households who have food shortage of more than 6 months from their own products do not use biogas and fully depend upon fuel wood. Very few households who are residing relatively in remote villages have planted or kept a few number of trees within their premises. Otherwise most of the households have been reported to be dependent on forest products for energy.

III. Availability of Grazing Resources

Open spaces for livestock grazing are not enough for the number of livestock held in the area. Therefore, forests have been reported to be more in use for grazing of cattle and small ruminants. For about two or three months the practice of fallow grazing after crop harvesting was reported. Pressure on forests has been noted to be excess; forests are being used for timber, fuel wood, and fodder and grazing as well.

IV. Roofing Material

Most households use either slate or zinc sheets as roofing material. Earlier, the people were using roofing material such as stone, timber and thatch which were locally available. It was noticed that some houses and even some cattle sheds are constructed with cement concrete.

4.4.3.2 Water Resource Use

The sources of drinking water differ from community to community. They include pond, piped water, water tank, springs and streams. In most places except for Vyas Municipality, it was reported that irrigation water from streams is available (See Table 4.82 and Table 4.83).

Table 4.82: Sources of Drinking Water

Group No.	Source Type	Source Name	Location	Beneficiary Household
1. V D C- Chhan-4, Chokre				
	Pond/Pokhari	Chokre Pokhari	Just below Chokre village	39
2. V D C- Chhan- 5, Fulbari Ghaderi				
	Pond/Pokhari	Chokre	Chokre	20
	Pipe water	Pipale	Pipale	15
3. V D C- Chhan-7, Jhakash Fulbari				
	Pipe water	Chitung Khola	Jhakash-Fulbari	23
4. V D C- Bhimad - 1, Khanaltar				
	-	-	-	-
5. V D C- Rani Pokhari - 9, Rising Patan				
	Spring /Mulpani	Kumalpani	Rising Patan	50
	Spring /Mulpani	Amalapani	Rising Patan	50
	Spring /Mulpani	Dulegaunda	Rising Patan	40
	Spring /Mulpani	Dhunge Pandhero	Rising Patan	200
	Spring /Mulpani	Tarebhir	Rising Patan	70



6. V D C- Rani Pokhari - 9, Rising Patan – Kharkhare				
	Stream	Bokse Chhahra	Sanutari	16
7. V D C- Kotdarbar - 1, Maidan Swanra				
	Spring /Mulpani	Risini Khola	Ward-3	35
8. V D C- Kahun Shivapur - 3, Bakle				
	Kuwa	Bakle Kuwa	Bansbot	4
	Kuwa	Sarki Kuwa	Kahun	50
	Pipe Water	Kheradi	Kahun Basti	20
	Kuwa	Gidha	Ranibari Gidha	5
9. V D C- Kahun Shivapur - 1, Beltar				
	-	-	-	-
10. Vyas Municipality - 7, Tallo Patan				
	-	-	-	-
11. Vyas Municipality - 7, Beni Patan				
	Spring /Mulpani	Linde Dhara	Near School	25
	Water Tank	Dharakholsi and Asagurikholsi	Asaguri	45
	Pipe Water	Dharakholsi	Asaguri Puchhar	1
12. Vyas Municipality - 7, Beteni				
	-	-	-	-
13. Vyas Municipality - 5, Baireni-Botegaun				
	-	-	-	-

Source: Supplemental EIA Survey, JICA Study Team, 2006

Table 4.83: Irrigation Scheme and Source

Group No.	Source Type	Sscheme Name	Location	Beneficiary Household
1. V D C- Chhan-4, Chokre				
	Stream/Khola	Dumre Khola Kulo	Duwan	7
2. V D C- Chhan- 5, Fulbari Ghaderi				
	Stream/Khola	Chokre Canal	Chokre	35
3. V D C- Chhan-7, Jhakash Fulbari				
	Stream/Khola	Huti Khola Kulo	Chokretar	18
4. V D C- Bhimad - 1, Khanaltar				
	Stream/Khola	Birta Nahar		40
	Stream/Khola	Mathillo Kulo		40
5. V D C- Rani Pokhari - 9, Rising Patan				
	-	-	-	-
6. V D C- Rani Pokhari - 9, Rising Patan – Kharkhare				
	Stream/Khola	Bandarkuna Kulo	Bandarkuna	45
	Stream/Khola	Jhakash Kulo	Sankhar, Jhakash	8
	Stream/Khola	Sankhar Kulo	Sankhar	6
	Stream/Khola	Tarebhir Kulo	Tarebhir khet	6
7. V D C- Kotdarbar - 1, Maidan Swanra				
	Stream/Khola	Odare Kulo	Shivapur	3
	Stream/Khola	Chhabise Kulo	Kotdarbar	6
	Stream/Khola	Wasebagar-1	Kotdarbar	3
	Stream/Khola	Wasebagar-2	Kotdarbar	2
	Stream/Khola	Dhap Kulo	Kotdarbar	3
	Stream/Khola	Manpure Khola Kulo	Kotdarbar	1
	Stream/Khola	Khahare Khola Kulo	Kahun Shivapur	2
8. V D C- Kahun Shivapur - 3, Bakle				
	Stream/Khola	Mathillo Kulo	Ranguwa	20
	Stream/Khola	Barala Tharamuni	Tharamuni	3
	Stream/Khola	Phordi Khola Muhan	Lima Khola	2
	Stream/Khola	Khare Khola kulo	Khahare	3

9. V D C- Kahun Shivapur - 1, Beltar	-	-	-	-
10. Vyas Municipality - 7, Tallo Patan	-	-	-	-
11. Vyas Municipality - 7, Beni Patan	Stream/Khola	Asaguri Kulo	Asaguri Danda	3
12. Vyas Municipality - 7, Beteni	-	-	-	-
13. Vyas Municipality - 5, Baireni-Botegaun	-	-	-	-

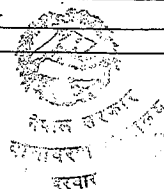
Source: Supplemental EIA Survey, JICA Study Team, 2006

4.4.3.3 Cemetery and Cremation Ground

Most communities use the cremation grounds near the river, which do not have permanent structures. It was found in several cases that different ethnic groups use the same place (Refer Table 4.84).

Table 4.84: Cemetery and Cremation Ground

Group No.	Name of cemetery & cremation ground	Locality name	Users' households	Users ethnic group
1. V D C- Chhan-4, Chokre	Seti Ghat	4,5 wards of Chhan VDC	600	Newar, Magar, Damai, Kami, Chhetry, Brahmin
2. V D C- Chhan- 5, Fulbari Ghaderi	-	-	-	-
3. V D C- Chhan-7, Jhakash Fulbari	Kundale Ghat	Chhap, Manapang	1000	Magar, Sarki, Damain, Chhetri, Kami,
	Chokretar	Chokre, Chhan, Hatiya	400	Newar, Magar, Kami, Chhetri
	Sankhra-lower	Chhan, Ghaderi	25	Newar
	Sankhra-upper	Chhan, Ghaderi	100	Gurung
	Khayarlo Ghat	Chhan, Ghaderi	100	Gurung
	Mankhola Ghat	Chhan, Nayabasti	300	Magar, Kami, Damai,
4. V D C- Bhimad - 1, Khanaltar	Talloghumaune, Seti Ghat	Bhimad, Chhang Majhkot, Arunodaya	5000	Brhamin, Chhetry, Kumal Magar, Gurung, Damain...
5. V D C- Rani Pokhari - 9, Rising Patan	Seraghat-Seti Beni	Ranipokhari, Chhan	100	Newar, Magar, Kami, Brahmin, Chhetri, Damain
	Dablyanghat-Ghumaune	Ranipokhari, Chhan	90	Newar, Magar, Kami, Brahmin, Chhetri, Damain
	Dablyanghat- Turture	Ranipokhari, Chhan	70	Newar, Magar, Kami, Brahmin, Chhetri, Damain
6. V D C- Rani Pokhari - 9, Rising Patan – Kharkhare	Badarkunaghat	Rising Patan	50	Magar, Sarki, Kami
	Geruwaghat	Rising Patan	70	Magar, Kami
	Kundaleghat	Paltyang	80	Magar, Kami
7. V D C- Kotdarbar - 1, Maidan Swanra	Limadovan	Banjhogara, Chhapbesi	150	Magar, Sarki, Kami, Newar
8. V D C- Kahun Shivapur - 3, Bakle	-	-	-	-
9. V D C- Kahun Shivapur - 1, Beltar	-	-	-	-



10. Vyas Municipality - 7, Tallo Patan				
	Seti-Madi Beni **	Syamgha, Jamune, Manapang VDCs, 6,7,8 wards of Municipality	4000	All caste except the people of other religion rather than Hindu
11. Vyas Municipality - 7, Beni Patan				
	"	"	"	"
12. Vyas Municipality - 7, Beteni				
	"	"	"	"
13. Vyas Municipality - 5, Baireni-Botegaun				
	"	"	"	"

Source: Supplemental EIA Survey, JICA Study Team, 2006

Note: ** No other impact except the flow of Seti River may not possible.

4.4.3.4 Religiously and Culturally Significant Spots

Some communities have a temple or other religious places for gathering in the project area. Some of them can be used for only specific ethnic groups while others can be used for any ethnic and caste groups (Table 4.85).

Table 4.85 Temple, Religiously and Culturally Significant Spots

Group No.	Type of Temple	Location	Specific ethnic group observing	User Household
1. V D C- Chhan-4, Chokre				
	X	X	X	X
2. V D C- Chhan- 5, Fulbari Ghaderi				
	X	X	X	X
3. V D C- Chhan-7, Jhakash Fulbari				
	Shimbhu Sivalaya	Shangumukh	Newar, Gurung, Magar	100
	Nagasthan	Shangumukh	Newar, Gurung, Magar	100
	Maisthan	Pulkhomukh	Newar, Gurung, Magar	100
	Nagasthan	Khayarlo	Newar, Gurung, Magar	100
4. V D C- Bhimad - 1, Khanaltar				
	Pauwa-Community Gathering Place ¹	Masanghat Setidovan	All caste	4-5,000
	Chaupari ²	Masanghat Setidovan	All caste	4-5,000
5. V D C- Rani Pokhari - 9, Rising Patan				
	Ekle deuta	Dovan	Bramhin (gaire)	150
	Religious spot (Rudri garne Thaun)	Turture	Bramhin (gaire)	150
6. V D C- Rani Pokhari - 9, Rising Patan – Kharkhare				
	Kundala Thanti ³	Geruwater	All passer-by	
7. V D C- Ko tadarbar - 1, Maidan Swanra				
	Thanti	Lima khola	Magar	19
8. V D C- Kahun Shivapur - 3, Bakle				
	X	X	X	X
9. V D C- Kahun Shivapur - 1, Beltar				
	X	X	X	X
10. Vyas Municipality - 7, Tallo Patan				
	Ganesh mandir	Tallo Patan (Owner-Madhu Maya Malla)	All Hindus	65

11. Vyas Municipality - 7, Beni Patan				
	X	X	X	X
12. Vyas Municipality - 7, Beteni				
	Dhursyangdi Barahi	Beteni	Magar and other Hindus	60
13. Vyas Municipality - 5, Baireni-Botegaun				
	X	X	X	X

Source: Supplemental EIA Survey, JICA Study Team, 2006

Note:

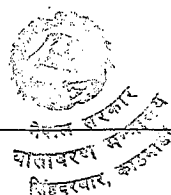
¹ Constructed by Matrisishu Kalyan Ama Samuha, Bhimaad-1.

² Constructed by Magar Ama Samuha, Bhimaad-1.

³ Constructed by a widow of Jamdar Satabir Ale on the memory of her husband.

4.4.3.5 User's Group

There are various types of users' group in the communities of the project area. There are about 8 Community Forest Users' Groups, 13 Water Users' Groups, 2 irrigation Water Users' Groups, 3 livestock raising groups, 7 cereal farms groups, 13 women groups and 7 saving credit groups that have been identified by the community people and participated in the focus group discussions .



CHAPTER FIVE

IMPACT ASSESSMENT

5.0 General

This section highlights potentially significant and adverse impacts of the construction and operation of the Upper Seti Storage Hydroelectric Project, which will result in changes to the existing baseline conditions. The contents of this chapter discusses the potential impacts on the physical, biological and social environment that are associated with the implementation of the project. The adverse impact on physical, biological, socio-economic, and cultural environment have been described in Sub-chapters 5.1, 5.2 and 5.3. Similarly, beneficial impacts have been described in Sub-chapter 5.4.

5.1 Physical Environment

Since the project is a storage type, the main physical impacts on the environment are the impacts associated with land take for the reservoir, resettlement, potential disturbance or change in the slope stability, runoff and drainage patterns in the project facility areas, access road and temporary construction areas. Shoreline erosion around the reservoir, downstream impacts and change in water quality are a few important impacts associated with the formation reservoir discussed in detail. However, as the dam is concrete gravity dam type with underground powerhouse with a headrace tunnel the impacts are expected to be less.

There will also be an increase in shoreline erosion around the rim of the reservoir due to the fluctuations in the water level with the formation of the reservoir. Apart from the issues related to land take, resettlement and changes in water quality of the reservoir, the majority of the physical impacts can be mitigated and reduced to an acceptable level. Air quality impacts are localized and can be mitigated.

Another, main adverse impact will be on the river flow as the project is a seasonal storage project. The flow regime and associated river morphology processes will be significantly affected along the newly formed reservoir with an area of 7.26 km² and an approximate length of 18 km.

5.1.1 Watershed Conditions

The watershed area of the Upper Seti Storage Hydroelectric Project lies in a fragile physiographic region of the middle mountains, which is susceptible to landslides.

5.1.1.1 Construction Phase

Adverse impacts anticipated during project construction include a range of site specific or localized construction induced effects. These would include the potential for rock and landslides

from disturbance due to construction blasting, drilling, vibration and slope cutting operations; alteration of localized drainage and storm runoff, and haphazard release of construction spoils into the river. The impact on the watershed is expected to be moderate in magnitude, long term in duration and local in extent.

5.1.1.2. Operation Phase

The formation and operation of the reservoir with an approximate area of 7.26 km² will lead to landslides especially along the shoreline. The shoreline erosion is expected to be more pronounced in weak areas susceptible to slides such as in areas like Bhimad Bazaar, Chore Patan and along the Wanton Khola. Some sections of the reservoir from Bhimad Bazaar to Geruwatar exhibit typical vertical bank erosion of loosely consolidated terraces.

In the upper reservoir area, the soil slides associated with terrace materials are prevalent, while in the lower reservoir area, soil slides associated with colluvial material are dominant. However, the landslides in the lower reservoir area are of small scale and are observed above the Full Supply Level. Thus, the risk of slope instability due to the reservoir operation should be considered in the upper reservoir area. The failure at the terrace breaks are mostly associated with the toe cutting by the stream, caving and overhanging. Toe cutting of the terrace breaks is remarkable at Bhimad Bazaar, Sanutar, Jhakas, Wantan Khola and Phedi Khola. In the colluvial materials below Tittuwa it is reported that slow creeping phenomenon is observed in the colluvial material on the valley slopes below Tittuwa, which needs to be investigated.

After impounding, further slides and slope failures can be expected in the reservoir area consisting of weathered and fractured dolomite, slate, phyllitic slate, colluvial soil and conglomerate. The weathered/ fractured rock, colluvial soil and conglomerate after inundation will become saturated. Furthermore, the saturation enhances the decrease in shearing resistance and will increase the pore pressure thus resulting in the sliding of the rock mass causing shoreline erosion. Similarly, the collapse of such sediments in the reservoir will eventually decrease the live storage of the reservoir.

However, approximately the initial 11 km of the reservoir stretch flows in a narrow gorge with vegetation on both banks of the river. This stretch can be rated as having a moderate risk of instability. The last 6-7 km stretch of the reservoir can be rated as having a high risk of instability.

The probability of small-scale slides will increase because of inundation of the lower slopes and the initiation of small flood waves will have little effect on the stability of the dam and the side slope itself. However, after impoundment of the reservoir the slides along the side slopes may continue until the slope will turn to its natural state of equilibrium.

Furthermore, the fluctuation of the water level up to almost 27.8 m will create a zone devoid of vegetation leading to additional slope failures. The water level raised during the operation of the

reservoir will increase the existing risk of instability especially along the immediate foreshore. The critical areas have been identified during the survey, which are along the Seti river bank near Bhimad Bazaar up to Badarkuna. This stretch has a high risk of failure in the long run even if it does occur immediately after the reservoir formation. This area is more critical, as there are settlements along the banks. The impact is expected to be long termed but quantification of the extent of this induced additional risk is almost impracticable.

5.1.2 Topography, Land Take and Landuse

5.1.2.1 Construction Phase

The total land take for various project components like the dam site, reservoir and powerhouse, as well as construction borrow pits and quarries, temporary and permanent work camps and construction of an access road is estimated at 1034 ha. The major portion of the land take will be for the reservoir. The reservoir area mainly consists of forest and agricultural land. The estimate of different types of land involved in the land take is given Table 5.1. About 52% of the land take for the project will be forest, grazing and shrubland area, 15 percent rain-fed cultivated lands and the rest will be barren land, river and escarpments etc.

The impact can be classified as high in magnitude, local in extent and duration is long term..

Table 5.1: Estimated Land Take of the Project

Project Facility	Land Take ⁽¹⁾ (ha)	Type	Characteristics
Reservoir (el. 415+10)	901	P	Mainly forest and agricultural land
Damsite and Powerhouse	18	P	Mainly forest land;
Borrow Pits and Quarry Areas	25	T	Agriculture and forest land;
Construction Access Road	30	P	Agriculture and forest land
Temporary Construction Camps/Construction Yards	35	T	Up to 3 camps; mainly agriculture land;
Permanent Work Camp	25	P	One camp which will be converted from a temporary to permanent camp; mainly agriculture land;
Total	1034	P+T	
Notes: (1) Land Take is estimated (2) P-Permanent Land Take; T-Temporary Land Take			

Another major adverse impact of the reservoir type project is inundation of fertile agricultural land. However, avoiding land use changes completely is not possible given the project requirements. The impact will be high, local and long termed.

5.1.2.2 Operation phase

No significant impacts on topography and land use is expected during the operation phase. The temporary land use for temporary camps, construction yards and labour camps will be restored and converted to the original state and returned to its owners.

In the upstream reservoir area, soil slides associated with terrace materials are prevalent, while in the lower reservoir area, soil slides associated with colluvial material are dominant. However, the landslides in the lower reservoir area are small in scale and were encountered above the Full Supply Level. Thus, the risk of slope instability due to the reservoir operation should be considered in the upstream reservoir area.

The failure at the terrace breaks are mostly associated with toe cutting by the river, caving and overhanging. Toe cutting of the terrace breaks is remarkable at Bhimad Bazaar, Sanutar, Jhakas, Wantan Khola and Pedhi Khola. In the colluvial materials below Tittuwa, it is reported that a slow creeping phenomenon is observed with the colluvial material on the valley slope below Tittuwa. The impact is expected to be moderate in magnitude, long term in duration and local in extent.

5.1.3 Air Quality

5.1.3.1 Construction Phase

The impact on air quality during the construction of the project will be limited and much localized due to the narrow topography of the construction area. Both the damsite and the powerhouse sites are located in the narrow gorge, which will limit the local dispersion of pollution. However, some impacts on the settlements in and around the project area like Bisghare, Beteri and Simalchaur at the downstream of the powerhouse is expected. Furthermore, as the damsite and powerhouse site is or only two kilometers away from Damauli bazaar on the national highway, a leading trading center of the area, air pollution due to vehicular movement will be felt, noise pollution due to blasting, and other construction activities will be also felt.

Construction activities such as blasting, quarrying, excavation, site clearing and emissions from trucks and construction equipment will generate fugitive dust, particulate matter, No_x , and So_x . Another potential source of localized air pollution around the houses near the damsite will be from the access road construction and the traffic. The impact is expected to be moderate in magnitude, for short duration and site specific.

Besides this the presence of 1000-2500 labourers during the construction period will generate smoke from cooking which will be also one of the sources of air pollution.

5.1.3.2 Operation phase

However, during the operational phase air pollution effects associated with the project are expected to be from the vehicles of the power plant on unpaved road sections and other disturbed surfaces. The impact is expected to be low in magnitude, long termed in duration and site specific in extent.

5.1.4 Microclimate

5.1.4.1 Construction Phase

No impacts are expected during the construction phase

5.1.4.2 Operation Phase

As the reservoir area is 7.26 km² ha over an approximately 18 km. stretch along the Seti river some changes in the local micro-climate is expected. There will be an increase in the humidity due to evaporation from the reservoir, and a decrease in the average maximum temperature in the summer season as well as a rise in the average minimum temperatures in the vicinity of the reservoir. When the temperature cools down especially during the night, fog may be formed around the reservoir area and slopes. The impact will be low in magnitude and for long term and site specific.

In the dewatered section, there might be an increase in temperature by a degree or more. The impact will be felt more during the non-peak hours and for approximately 2.4 km. The impact is expected to be low after 2.4 km as the Madi River will augment the reduced flow. The impact is expected to be low in magnitude, local in nature and will be for a long duration.

5.1.5 Noise and Vibration

5.1.5.1 Construction Phase

Construction activities and operation of diesel plants, vehicles, and ventilators, cement batching and aggregate crushing plants at various project sites will generate noise and vibrations. The increase in ambient noise levels will have pronounced impacts on settlements nearby to the headworks, powerhouse site and some sections of the access road. Blasting will generate the loudest noise levels of short duration in the range of 100-140 dBA near the source. No impact will be felt in the core project area as there are no settlements nearby. However, the impacts will be felt in Huksetar, Beteni and Bisghare which are downstream of the powerhouse. The impacts are expected to be moderate in magnitude and for short duration and local.

Strong vibrations and overpressure can damage nearby houses and other structures. The main sites of vibration generation will be at the blasting sites, tunnel portals and entrances, adits and intake etc. The impact is expected to be moderate in magnitude, site specific and for short duration.

5.1.5.2 Operation Phase

Noise generated during the operational phase will generally result from vehicular traffic and vibration levels are expected to be negligible.

5.1.6 Surface Hydrology

5.1.6.1 Construction Phase

No impacts is expected during the construction phase

5.1.6.2 Operation Phase

5.1.6.2.1 General Flow Change and Downstream flow change

The main impact during the operation phase will be the impact on the 2.0 km stretch of the river upto the Madi confluence. However, the impact is expected to be moderate as the Madi River with a mean average flow of $14 \text{ m}^3/\text{s}$ joins the Seti River at about 2.0 km downstream of the dam. The mitigating effects of joining the Madi River downstream have a flow regime equivalent to 75% of the Seti River flows.

There is no religious and consumptive use in the community from the Seti River flows. Another impact can be envisaged during the annual complete flushing of the reservoir over a one month period which will result in extensive sedimentation in that the section of the Seti River between the dam and the confluence with the Madi River

The impact can be expected to be moderate in magnitude, local in extent and for long duration.

5.1.6.2 .2 Reduced Dry Season Flow and peaking releases

(a) Dry Season Flow

The powerhouse will run only for 6 hours during the dry season that is from November to May and the remaining 18 hours will be utilized for maintaining FSL of 415 m in the reservoir. Therefore, apart from this 6 hours of peak, the flow in the Seti River will be much lesser. The flow $127.4 \text{ m}^3/\text{sec}$ will be available for approximately 15-20 km stretch of the river downstream of the dam up to the Trishuli confluence during the dry season. Thus, dry season flows in the Seti River downstream of the dam will change from the natural mean monthly flow of $107 \text{ m}^3/\text{sec}$ to $127.4 \text{ m}^3/\text{sec}$.

However, during the non-peak hours in the dry season only compensation flow equivalent to 10% of the minimum average flow of $2.4 \text{ m}^3/\text{s}$ will be available to maintain the aquatic ecology downstream upto a distance of 2.0 km from the dams site. At 2.0 km from the dams site the Madi River joins the Seti which has a mean monthly discharge of $14 \text{ m}^3/\text{sec}$

The settlements along the banks of the Seti River downstream of the dam are mainly on the upper slopes except immediately upto approximately 4 km downstream of the dam, where settlements exist near the bank of the river. However, there is perennial river Madi with a mean monthly discharge of $14 \text{ m}^3/\text{sec}$ just 2.0 km downstream of the dam. Therefore, the impact on the local people residing along the banks is expected to be limited as the villagers will be able to use the Madi flow. It was found that people also use piped and spring water for drinking and other household works. The Project is planned to deliver the water diverted at the dam to the underground powerhouse through the 927 m long of headrace tunnel for generation and release the water used for the generation from a tailrace outlet to the Seti River.

The impact on the hydrology of the Seti River is expected to be moderate in magnitude, long term in duration and local in extent.

(b) Monsoon flow

However, during the wet season from the month of June to October a flow of $127.4 \text{ m}^3/\text{sec}$ will be available during 24 hours together with the spillway discharge. This will lead to significant impact on the river ecosystem along this section. During the monsoon, as soon as the reservoir is full the excess flow will pass over the spillway and the river will assume its full monsoon state. However, the change in river morphology is not expected to be significant since more than 15-20 km stretch of the river at the downstream of the dam flows through a narrow gorge. The river at this stretch consists of steep banks with vegetation.

(c) Fluctuation Characteristics

The flow in the downstream of the powerhouse will fluctuate in a manner dictated by the daily reservoir impoundment and peaking operations. The turbines will be operated at full capacity for 6 hours with all 2 units running which will release $127.4 \text{ m}^3/\text{s}$ in the dry season and a flow of $557 \text{ m}^3/\text{sec}$ in the wet season. The rapid variation of flow in this river section from peaking hours (6 hours) to off-peaking hours during the dry season will have limited but mitigable physical impacts. However, there is potential for more significant impacts on the aquatic system.

Due to the narrow gorge, the fluctuation in the flow will not have major impacts, although scouring of the river banks is expected immediately after the powerhouse. The effect of scouring will gradually diminish as the river flows downstream. The impact is expected to be low in magnitude, long term and site specific.



Table 5.2 Variation in peak and non peak flow downstream upto the Trishuli confluence.

Months	Mean flow m ³ /sec	Spill from the dam during the wet season m ³ /sec	Compensation flow during (from dam)	Mean flow of madi river m ³ /s	6 hrs Peaking releases downstream of the powerhouse m ³ /sec	Total flow in the downstream of Trishuli confluence in dry season in m ³ /s (peak hours)	Total Flow in the river in the wet season in m ³ /sec up to Trishuli confluence (non peak hours)
January*	27.00	0.00	2.40	18.02	127.4	147.82	20.42
February*	23.70	0.00	2.40	15.62	127.4	145.42	18.02
March*	24.00	0.00	2.40	16.19	127.4	145.99	18.59
April*	27.40	0.00	2.40	18.40	127.4	148.2	20.80
May	41.10	0.00	2.40	29.18	127.4	158.98	31.58
June	113.80	1.56	2.40	77.88	127.4	207.68	80.28
July	287.20	141.40	0.00	201.60	127.4	329	201.60
August	322.60	199.80	0.00	216.30	127.4	343.7	216.30
September	225.80	100.40	0.00	153.40	127.4	280.8	153.40
October	107.40	6.72	0.00	69.20	127.4	196.6	69.20
November	52.00	0.00	2.40	34.45	127.4	161.85	36.85
December*	34.40	0.00	2.40	22.93	127.4	150.33	25.33

5.1.7 Sedimentation and River Morphology

5.1.7.1 Construction phase

The Seti River which originates from the Annapurna range contains a high sediment yield. During the Feasibility Study, the annual sediment load in the Seti river system has been calculated as 6240 t/km²/year whereas during construction there will be a temporary increase in the sediment due to site clearing activities, excavation of aggregate materials from the stream bed etc. However, this will be limited only to the construction phase and will be insignificant compared to the total annual suspended sediment yield in the river. The total area of disturbances will be 20-30 ha during the construction phase which will also contribute to the sediment increase in the river. Generally, the sediment problem will be significant during the monsoon.

5.1.7.2 Operation phase

Fluctuation of the reservoir may induce slides in areas like Bhimad Bazaar, Chore Patan and Wanten Khola, Badarkuna with steep slopes and contain loose cemented materials. Sediment will be fed abruptly to the reservoir when landslides will occur in these areas due to bank erosion. Besides this, changes in land use practices in the upper catchment area may also contribute to increased sediment yields over the longer term since the project has also cultivated and fragile areas.

The construction of the dam will stop the sediment flow from the damsite to the downstream river reaches. The change in the hydraulic regime will affect normal erosion and sediment transport patterns along the banks and river beds. Degradation of the Seti river bed and the scouring of the banks will occur due to release of sediment free water. The deposition of nutrient laden silt onto its banks will cease which in the long term may affect the productivity of the

fertile agricultural land downstream.

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

5.1.8 Water Quality

5.1.8.1 Construction phase

During the construction activities there will be a temporary increase in the turbidity and sediment content of the river. 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. The potential for adverse impacts is nevertheless short term in nature.

5.1.8.2 Operation Phase

Since the project consists of a seasonal reservoir with a depth of 140 m at the damsite the change in water quality during the operational phase is expected to be significant. The operation of the reservoir will have a short retention time of less than a month (11 days). The total annual run-off into the reservoir is 3335 million m³/year and the live storage volume of the reservoir is 167 million m³. Therefore, the flow in the reservoir will cycle often. Due to the considerable short retention time of water in the reservoir, effects such as temperature and nutrient stratification is not expected to be severe. However, changes in water quality include sediment entrapment, increase in carbonaceous compounds and an increase of H₂S and CO₂ at the lower parts of the reservoir due to anaerobic decomposition of flooded vegetation and organic matters which will be more pronounced during the initial 1-3 years.

The construction of an impoundment in a flowing river or stream may affect the oxygenation capacity of the stream to some extent. The increase in depth and decrease of the slope in the impoundment results in a flow in lower speed behind the dam and reduces or eliminates surface aeration due to the turbulent flow and the peaking power operation of the hydroelectric power plant in the dam reduces the aeration of the oxygen-deficient water released from the impoundment. (*The influence of impoundments on waste assimilative capacity; Peter A. Krenel, Edward L Thackston and Frank L Parker*)

The temperature stratification will also occur in the reservoir. The top layer (*epilimnion*) becomes warmer than the bottom layer (*hypolimnium*). Due to this reason, water circulates in the top layer and it does not mix with colder layer. Figure 5.1 (a) illustrates the typical temperature profile in stratified reservoirs. A steep gradient will be formed between the two layers and a

transitional zone called thermocline zone will be formed. If the thermocline is below the depth of light penetration, there is very little oxygen production from photosynthesis which will result in an anaerobic condition in the bottom layer. This situation will be more severe in the months following the monsoon because during the monsoon the impact will be mitigated to some extent with the mixing, resulting from the large monsoon flows. Stratification in a deep reservoir leads to an anaerobic condition which favors the dissolution of iron, manganese and sulphur production.

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

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

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

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

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

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

Furthermore, before the heat receiving period, for which thermal stratification is developed, the reservoir water is completely evacuated and the natural river flow condition recreate by the

sediment flushing operation. Consequently, cold water cannot be retained in the reservoir and it is expected that a severe thermocline will not be formed in the reservoir.

The oxygen content of the reservoir will be low (less than 4 mg/l) in the first year of impoundment due to the oxygen demand for the decomposition of organic matters in the bottom of the reservoir. This will also depend upon the treatment given to the bottom before refilling, the fraction of water in effective contact with the bottom, and the age of the reservoir. If the power intake of the system is situated near the bottom of the reservoir, releasing of *hypolimnium* water which has a low temperature and little or no dissolved oxygen could adversely affect the ecosystem of the downstream areas.

The relationship between oxygen content and depth of the reservoir is expected to be as shown in Figure 5.1(b).

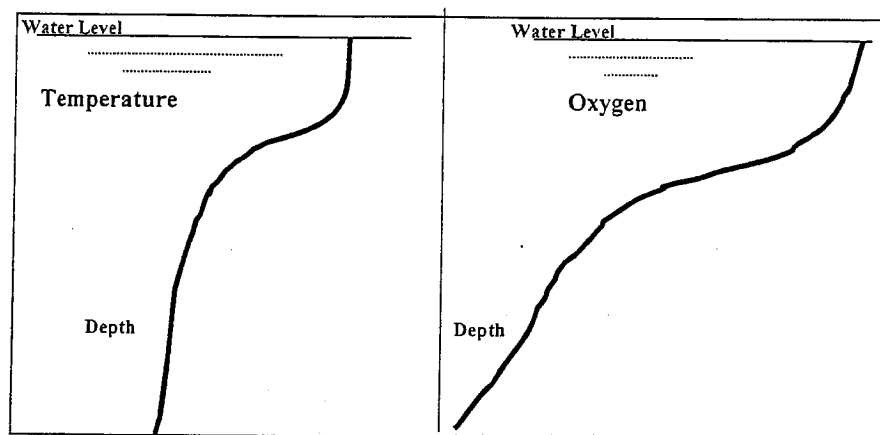


Figure 5.1 (a) and 5.1(b) Temperature Stratification and Oxygen Content in the Reservoir

The temperature stratification and oxygen profile of the reservoir will not necessarily affect human consumption or use of water; however it will be a factor in planning the reservoir fisheries program with respect to the species and nature of the fish stocking which will affect commercial operation of the reservoir fisheries industry.

The turbidity of the river water downstream will be less than that of the Seti River upstream as most of the sediment will be trapped in the reservoir. The impact on the river water quality is expected to be high at the construction phase and will be for short term. However, the impact on the reservoir water quality is expected to be moderate and the duration will be for the long term during the operation phase.

Eutrophication is defined as the process by which the water body contains phosphates and other nutrients which help the growth of algae and kill other organisms. Increasing the inflow of nutrients, in particular phosphorus or nitrogen, by human activities (human waste and agriculture)

is considered as one of the causes of algae bloom. This can be a major problem in stagnant water bodies situated in sub-tropical and tropical regions. Eutrophication will depend mainly on the retention time, temperature and nutrient contents.

Eutrophication is related to various factors, not only the nutrient concentration flowing into the reservoir but also hydraulic conditions such as retention period of the reservoir water, meteorological conditions etc. Even though the concentration of nutrients in the water increases, the problem of eutrophication does not occur in areas where the retention time is short since the nutrient flows down before phytoplankton increases (e.g. a river).

Vollenweider Model (1976) has been applied for the analysis, which is commonly used for the initial estimation of eutrophication in the world to confirm for the possibility of the eutrophication. The JICA Study Team conducted *Vollenweider Model (1976)* in Japan, the result of which is discussed below:

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

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

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

V_p : Setting velocity of phosphorus (10m/year)

H : Average water depth (40.65m)

α : Run - over rate (12 times/year)

The average concentration of total phosphorus is 0.186 mg/l. The total phosphorous level is much greater than 0.03 mg/l. Figure 5.2 presents the results of the analysis for average total phosphorus on the sampled date. Although the data used in this study is limited to water quality analysis for June and October, the average phosphorous concentration values reveal that the reservoir will be eutrophic even in the present day loadings of phosphorous from the Seti watershed.

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

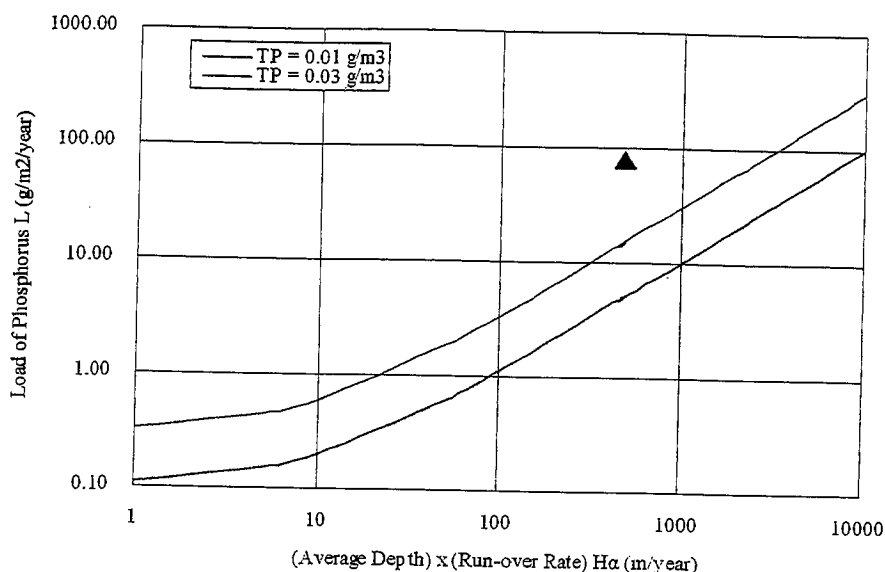


Figure 5.2 Results of Vollenweider Model Analysis

5.1.9 Seismicity Risk

5.1.9.1 Construction Phase

No impacts are anticipated during the construction phase.

5.1.9.2 Operation phase

Several instances of reservoir induced seismicity have been recorded and the mode of earthquake induced by the filling of a large reservoir is not yet understood. According to international research and records it has been found that the formation of deep reservoirs may trigger a seismic phenomenon, irrespective of the past history or cycles of seismic events in the region. Nonetheless, further extensive studies have yet to be done to confirm this thesis in international practice. Seismicity is due to the weight of the impounded water which may change the stress field under the reservoir or due to increased ground water pore pressure.

Several instances of reservoir induced seismicity have been recorded and the mode of earthquake induced by the filling of large reservoirs is not yet understood. However, it is believed that seismicity increases with the reservoir impoundment under certain conditions and it does not exceed the natural seismicity level. The hydraulic head of more than 100 m in the reservoir and the presence of tectonic elements such as faults etc. are conditions leading to create reservoir-induced seismicity. Therefore, reservoir induced seismicity is expected in the Upper Seti Storage HEP since both conditions are present in the project area.

Seismic Risk Analysis has been done to determine the horizontal seismic coefficient for the seismic design of dams. Various methods have been used to determine the horizontal seismic coefficient.

The horizontal seismic coefficient for the design of high dam of Upper Seti project has been taken as 0.15 considering different evaluation methods.

Considering that Far Western Nepal is seismically more active than Eastern and central Nepal, the seismicity risk of the project is considered to be low in magnitude, regional and long termed.

5.1.10 Changes in Water Table

5.1.10.1 Construction Phase

No major impacts are expected during the construction phase

5.1.10.2 Operation Phase

A storage type of hydropower project affects the ground water situation. However, the severity of the impact totally depends on site-specific conditions such as ground water level, gradients, soil and rock permeability and the topography of the area. After the construction of the reservoir, changes in the water table are expected at the upstream and around the reservoir rim. The water table is expected to rise especially in areas like Bhimad Bazaar where the topography of the area is rather flat and the geology consists of permeable rocks. However, due to the steep slopes of the reservoir valley with vegetation on both banks of the river it is anticipated that the impact will be low in magnitude, site specific and will be for long duration.

5.1.11 Spoil Handling and Disposal

5.1.11.1 Construction Phase

During the construction of the underground powerhouse, dam foundation, power intake portal considerable amount of excavated material will be generated. Reuse of spoils for aggregates and backfill, and careful disposal of the balance is necessary. Limited space is available for disposal in the dams site area as the dam site is located in a narrow valley.

The main potential impacts associated with spoil disposal are the increase in the turbidity and sediment of river water and potential loss of protective land. As the dumping site identified is at the downstream of the dam at the lower slopes of Beteni village and along the banks of the Seti river downstream the landscape of the area will be affected. The impact due to spoil handling and disposal is expected to be low in magnitude, site specific and for short duration.

5.1.11.2 Operation Phase

No impact is expected during the construction phase.



5.2 Biological Environment

The implementation of the project will affect the baseline terrestrial and aquatic ecosystems in the project impact area in a number of ways, which are both adverse and positive. Since, the project is designed as a storage type; the main biological impact will be due to the clearance of vegetation from the reservoir submergence zone.

The potential impacts during project construction and operation phases of the proposed project on biological resources of the project area are as follows:

5.2.1 Vegetation / Forest Resources:

5.2.1.1 Construction Phase

Loss of natural vegetation due to site clearance from the 422 ha forest land (construction sites and reservoir submergence zone) is the major impact due to the implementation of project. Impacts on natural vegetation and forests include:

- Loss of vegetation due to site clearance
- Increased demand for fuel wood and timber
- Encroachment on national and Community Forests
- Loss of protected species

(a) Loss of Vegetation Due to Site Clearance:

(1) Construction Phase

A large number of construction workforces and their families will flow into the project area and settle at various construction sites. Tea stalls and restaurants to cater the needs of construction workforces will be constructed in the adjoining areas of construction sites. Insufficient supply of kerosene and LPG will lead to pressure on the existing local forest resources. The majority of the workers will prefer kerosene for their daily use while LPG will be common in the contractor and proponent camps. Besides the direct work force, temporary migrants will increase the demand for fuel wood and timber. If there is inadequate supply of alternative fuel for the construction labourers, the pressure for fuel wood will increase. This impact will be moderate in magnitude, local in extent and for a short duration.

(2) Operation Phase

As shown in Tables 5.3 and 5.4, the project impacts most severely on the Hardwood Mixed Open Forest with total of 29.46 ha affected with FSL of 415 m, followed by 271.81 ha of Mixed Open Forest and 52.62 ha of Khair/ Sisso Forest at the same FSL.

Table 5.3 Loss of Forest/Shrub/Grasslands under Reservoir FSL 415m

S N	Forest Land	Area (ha)
1.	Grazing Land	84.59
2.	Shrubs Land	17.94
Total grazing/shrub		102.53
3.	Hardwood Sal Forest Land	29.46
4.	Mixed Open Forest Land	271.81
5.	Khair/Sisso Forest Land	52.62
Total Forest		353.89

Source: Supplemental EIA Survey, JICA Study Team, 2006

Table 5.4 Loss of Forest/Shrub/Grasslands in the Project Facility Sites

S N	Forest Land	Area (ha)
1.	Grazing land	7.35
2.	Shrub land	4.67
Total Grazing and Shrub		12.02
3.	Hardwood Sal Forest Land	44.46
4.	Hardwood Mixed Forest land	24.24
5.	Khair/Sisso Forest Land	0.00
Total Forest land		68.7

Source: Supplemental EIA Survey, JICA Study Team, 2006

Tables 5.5 and 5.6 present the tree species and its number found in the three types of forests in the reservoir area and project facility sites which will be affected by the Project.

Table 5.5 Estimated Number of Timber Tree Species in the Reservoir Area at FSL 415m

SN	Name of Species	Types of forest		
		National Forest	Community Forest	Private Forest
1.	<i>Acacia catechu</i>	14,291	4,882	919
2.	<i>Adina cordifolia</i>	2,598	888	0
3.	<i>Aegle marmelos</i>	1,559	533	0
4.	<i>Albizia lebbek</i>	2,598	888	0
5.	<i>Albizia lucidior</i>	3,378	1,154	0
6.	<i>Bombax ceiba</i>	3,378	1,154	54
7.	<i>Castanopsis indica</i>	1,039	355	21
8.	<i>Dalbergia sisoo Roxb.</i>	0	0	1,342
9.	<i>Garuga pinnata</i>	260	89	0
10.	<i>Lagerstroemia parviflora</i>	2,858	976	0
11.	<i>Mallotus philippensis</i>	4,157	1,420	0
12.	<i>Melia azederach L.</i>	0	0	98
13.	<i>Pterospermum lanceaefolium</i>	3,638	1,243	0
14.	<i>Sapium insigne</i>	4,677	1,598	0
15.	<i>Schima wallichii</i>	4,677	1,598	9
16.	<i>Shorea robusta</i>	31,960	10,910	0
17.	<i>Syzygium cumini</i>	260	89	0
18.	<i>Terminalia alata</i>	8,315	2,841	0
Total		89,643	30,618	2,443

Source: Supplemental EIA Survey, JICA Study Team, 2006

Table 5.6 Estimated Number of Timber Tree Species in the Project Facility Sites¹

S N	Tree Species	Number of trees
National Forest		
1.	<i>Shorea robusta</i>	25,743
2.	<i>Schima wallichii</i>	3,174
3.	<i>Acacia catechu</i>	1,858
4.	<i>Lagerstroemia parviflora</i>	150
5.	<i>Ligustrum confusum</i>	1,806
6.	<i>Mallotus philippensis</i>	602
7.	<i>Pterospermum lanceaefolium</i>	1,806
8.	<i>Sapium insigne</i>	1,505
Total National Forest		36,644
Community		
1.	<i>Dalbergia sisoo Roxb.</i>	2,407
Total Community Forest		2,407
Private Forest		
1.	<i>Dalbergia sisoo Roxb.</i>	212
Total Private Forest		212
Grand Total		39,263

Source: Supplemental EIA Survey, JICA Study Team, 2006

The local people are highly dependent on forest resources for fodder and fuel wood in their daily lives. The inundation of forests in the project area will bring negative impacts on the communities. The annual production losses incurred by the loss of the forest area and vegetation are presented in Table 5.7 and the losses in monetary terms are presented in Table 5.8. The magnitude of impact is considered to be high in magnitude, local and for long termed.

Table 5.7 Annual Forest Resource Production Losses in the Project Area²

Forest Resource	Reservoir Area FSL 415m	Project Facility Site	Total
National Forest			
Annual Timber Production Loss (m ³)	1,868	512	2,380
Annual Fuel Wood production Loss (m ³)	1,233	338	1,571
Annual Feed Resource Production Loss (LU)	6,756	489	7,245
Community forest			
Annual Timber Production Loss (m ³)	666	46	712
Annual Fuel Wood production Loss (m ³)	439	30	469
Annual Feed Resource Production Loss (LU)	2,308	133	2,441
Private Forest			
Annual Timber Production Loss (m ³)	27	4	31
Annual Fuel Wood production Loss (m ³)	18	3	21
Annual Feed Resource Production Loss (LU)	138	12	150

¹ Since the project facility sites were redesigned after the completion of the Field Survey, these estimates shall be revised.

² Since the project facility sites were redesigned after the completion of the Field Survey, these estimates need to be revised.

Forest Resource	Reservoir Area FSL 415m	Project Facility Site	Total
Grassland			
Annual Feed Resource Production Loss (LU)	60	5	65
Shrub land			
Annual Feed Resource Production Loss (LU)	466	121	587

Note:

Annual Timber harvest is calculated estimating 5% of standing crops

Annual Fuel Wood harvest is calculated estimating 3.3% of standing crops

Annual feed resource harvest from grass land is calculated 0.7 LU/ha

Annual feed resource harvest from shrub land is calculated 26 LU/ha

Annual feed resource harvest from forest land is calculated 26 LU/ha

Table 5.8 Annual Forest Resource Production Losses in Monetary terms in the Project Area

(Unit: million NRs.)			
Forest Resource	Reservoir Area FSL 415m	Project Facility Site	Total
National Forest			
Annual Timber Production Loss	10.27	2.82	13.09
Annual Fuel Wood Production Loss	3.27	0.90	4.17
Annual Feed Resource Production Loss	3.38	0.24	3.62
Community forest			
Annual Timber Production Loss	3.66	0.25	3.91
Annual Fuel Wood Production Loss	1.16	0.08	1.24
Annual Feed Resource Production Loss	1.15	0.07	1.22
Private Forest			
Annual Timber Production Loss	0.15	0.02	0.17
Annual Fuel Wood Production Loss	0.05	0.01	0.06
Annual Feed Resource Production Loss	0.07	0.01	0.08
Grassland			
Annual Feed Resource Production Loss	0.03	0.0025	0.033
Shrub land			
Annual Feed Resource Production Loss	0.23	0.06	0.29

Note:

Timber round wood = NRs. 5500/m³ Averaged from the costs of forest timber Forest Regulation 1995

Fuel wood = NRs. 2650/m³ Averaged from the costs small sized forest products, Forest Regulation 1995

Feed Resource loss = NRs. 500/LU

The impact is expected to be high in magnitude, local in extent and for long duration.

(b) Increased Demand for Fuel wood and Timber

The inflow of people for construction works and other related works will increase in the project area. The construction workers, their dependents and people who provide goods and services to these new migrants will undoubtedly have an impact on the forest of the surrounding area. So this impact is considered to be moderate in magnitude, site specific and for short duration.

(c) Possible Encroachment on the National Forest

During the site clearance period the petty contractor, the local people from surrounding area may involve in the encroachment of the National Forest outside of the submergence zone. The possibility of encroachment on Community Forests is low due to the continuous movement of the

"Heralo" in the forest area. Such impacts are considered to be moderate in magnitude, site specific and for short duration.

(d) Exploitation of Non-timber Forest Products

During the construction period, human resources affiliated directly or indirectly in the construction of the project may be involved in the collection and selling of Non-Timber Forest Products (NTFP) like medicinal plants. These species are not only common in the project site but are equally found in similar climatic regions in other parts of the country. Therefore, the impact is considered as low, site specific and for short duration.

(e) Impact on Rare, Endangered and Threatened Plant Species

Gittha (*Dioscorea deltoidea*) of the Appendix II of the CITES categories is found in the project alignment. Similarly, Sal (*Shorea robusta*), Khair (*Acacia catechu*) and Simal (*Bombax ceiba*) found along the alignment has been banned for the transportation, export and felling for the commercial purposes under the Forest Act 1993, GoN. Vulnerable species Tatelo (*Oroxylum indicum*) and rare species of Chatiwon (*Alstonia scholaris*) reported elsewhere in similar climatic regions of the country is also found in the project areas which are likely to be affected by the implementation of project. The impact is considered to be low in magnitude, local and for long duration.

5.2.1.2 Operation Phase

(a) Encroachment of Forest

During the operation phase, the buffer zone that lies between the forest land and reservoir level may provide easy access to the local people for the encroachment of forests and its products. It will provide opportunities for earning by selling of timber and non-timber products. This impact will be moderate in magnitude, local and for a long duration.

(b) Conservation Status of Plants

Although 11 species included in the conservation lists of IUCN, CITES and Government of Nepal were found in the study area, it is actually not very rich in terms of biodiversity. The flora in the project area is already disturbed and impacted by human activities such as farming, cutting of trees, hunting and trapping, collection of various forest products, etc. Only residual populations of plants colonize near the human habitation zone and reservoir area. No permanent core colony of endangered and rare plant species is found in this area. Furthermore, the habitat for those species are not limited in the project area but similar conditions for the habitats of those species widely extend in the vicinity of the study area such as the Madi river and Trishuli river watersheds and other regions in the country. Therefore, loss of these species in the local, regional and national scale is minimal and the project will have moderate impacts which will be local and for long duration.



5.2.2 Wildlife

The potential impacts on the local fauna during construction and operation phases of the Upper Seti Storage Project are as follows:

5.2.2.1 Construction Phase

(a) Loss of Habitat

Loss of habitat is considered a direct long-term impact to wildlife of the project area. The construction of the dam, intake, powerhouse and reservoir and other associated facilities requires site clearance which will disturb the wildlife habitat. The loss of 422.5 ha forest land and 114.5 ha shrub land and greybeard area due to reservoir formation and placement of different facilities and other associated works will produce a long term localized impact on the fauna. A total of 27 species of mammals reported from the Project area by direct and indirect survey methods will lose their natural habitats. Some of the wild animals reported in the project area such as *Panthera pardus*, *Presbytes entelus* and *Nemorhaedus goral* have been enlisted under CITES Appendix I while *Macaca mulata*, *Felis chaus* in CITES Appendix II and *Vulpes bengalensis*, *Martin flavigula*, and *Canis aerus* in CITES Appendix III. All these species are listed as susceptible (S) categories of NRDB status.

However, the fauna reported from the area are widely distributed in the forest of the upper hills and the area occupied by the project in comparison to the total available forest habitat is less and likely to be considered as low impacts.

Exploitation of the natural forest in reservoir clearance will inevitably lead to the loss of biodiversity. More stratified and diverse habitats provide shelter and food for more diverse fauna and flora (Shrestha, 1989). The behavior of animals will change due to the loss of their natural habitats and other disturbance associated with constructive activities. These impacts are low in magnitude, site specific and for long duration.

(b) Construction Disturbances

Construction disturbances resulting from blasting, drilling, vehicle movement and other related activities would interrupt normal movement, feeding and other activities of mammals. Night blasting, electric lights in an around the work site and the presence of humans will also affect wild animals grazing around the area. The clearing, excavation, grading and filling activities will affect less mobile, frequently smaller species such as frogs, lizards and small mammals (rats). Water pollution from project activities (muck disposal, washing of concrete batching plant, solid waste and accidental spill of oil and lubricants) may also affect the local wild fauna and water birds. This is short-term, localized and of low impacts and will be reduced as construction work at each site is completed. This impact is low, local and for short duration.

(c) Hunting and Poaching by the Labor Force

Possible hunting and poaching by the labor force may also consider a short-term localized impact. The local hunters and the workforce might be attracted to hunt birds and other wild animals. The possibilities of hunting and trapping by workers during the construction period will have some adverse impacts on the local wild fauna. However such pressure on wildlife will be site specific and decrease as the work tends to be completed. This impact is considered as low, site specific and for short duration.

5.2.2.2 Operation Phase

The wildlife of the project area will completely lose their natural habitats due to the submergence of 726 ha land including agricultural land, forest land, greybeard areas and shrub lands by the reservoir formation. The normal movement of fauna from one river bank to another will be completely blocked by the reservoir formation. Some wild animals may change their natural behaviour, although most of the fauna reported from the area are predator visitors and confined to the uphill-forested areas. So the magnitude of the impact due to project operation is considered as high, site specific and for long duration.

5.2.3 Fish and Aquatic Life

The construction and operation of the Upper Seti Storage Hydroelectric Project is likely to have some impacts on the local fish resources. Submergence of 7.26 km² riverine habitats, loss of habitat, blockage of fish migration and dewatering of approximately 2.0 km river section are the impacts likely to appear due to implementation of the project. The other possible impacts are reduced flow from the Madi-Seti confluence to further downstream, changes in water quality, and possible increase in river sedimentation etc.

5.2.3.1 Construction Phase

a) Habitat Destruction and loss of Spawning Ground

The construction disturbances such as removal of river boulder, temporary diversion of the river for dam construction, water pollution and possible increase in fishing activities are considered as adverse impacts of the project during the construction phase. The Seti river contains large number of boulders, pebbles and gravels especially in the downstream of the dam.

The boulders occupy large pool areas acting as fish shelters whereas pebbles and gravels deposited in the river provide potential spawning habitats. The excess removal of boulders from a particular place will affect the fish habitat, upstream migration (migration with the help of adhesive disc as in *Schizothorax sp*) and provide easy place for exploitation of fishes. The impact is considered to be moderate in magnitude, local and short termed.

5.2.3.2 Operation Phase

a) Impact on Fish

The transition from riverine to lacustrine conditions would probably have profound effects on the aquatic conditions and fauna of the area. Due to the formation of the reservoir the river flow velocity along the reservoir stretch will be substantially reduced. All rapids and stretches of broken water (run and riffle) and spawning and rearing areas will be submerged accordingly. Rapid colonization of fish species preferring standing water environments often takes place soon after a reservoir has been created.

Fish species such as Copper mahseer, mahseer, minor carps (*Labeo sp.*) and *Puntius sp.* will grow well in the reservoir area. There will be abundant growth of aquatic vegetation which, contribute direct food to most of fish species such as *Labeo sp.* and *Chagunius chagunio*. Carnivorous fish species will breed fast and dominate the ecosystem due to the prolific growth of aquatic and terrestrial insects stranded on the slow moving water surface of the reservoir. The other species likely to be adapted in reservoir type habitat are *Channa sp.* and *Barilius sp.* The snow trout species which occupy a very low distributional range and composition in the project area will further be decreased or eliminated by the formation of the reservoir. This species will be adapted to live in cool precipitous upper section of the Seti reservoir. The population of migratory catfish such as (*Bagarius bagarius*) and Jalkapoor (*Clupisoma garua*) will also probably be eliminated from the reservoir area.

The impact is expected to be moderate in magnitude, local and for long duration.

b) Fish Migration

A barrier effect is expected on long distance and mid-range migrant species due to the construction of the dam about 140 m high above the riverbed. The presence of long distance migrant species such as Sahar, Gouch, Jalkapoor and Eel are reported from the Seti river especially in the high water phase. The banks of the Seti river near Bandarkuna and Sisneri are the likely spawning sites in the upstream area. The construction of the dam will eliminate access to some upstream spawning areas for migratory fishes. The migratory species which occupy a long migration range for spawning, rearing and feeding in the upstream of the Seti river will be significantly affected by the construction of the dam. The construction of the dam will pose significant impacts with regard to the migration of migratory species of the Seti river. Mahseer, Eel, Gouch and Jalkapoor are of prime concern.

The overall magnitude of the impact is considered high, long term and localized because as mentioned fish diversity and density is high in the Bhimad area. The construction of the dam will pose significant impacts to river migration of fishes. The impacts on different types of fish are discussed below:

c) Resident Species

It is expected that the resident fish species in the affected parts of the river will be influenced during all the stages of life cycle. All fish populations will decrease according to the reduction of water discharge and change of water quality. The species and population of fish living in the dewatered section will be affected most. This includes the following species *Garra gotyla*, *Noemacheilus beveni*, *N. rupicola*, *Glyptothorax sp.*, *Barilius bendelisis*, and *B. barana*. The pool area will provide a suitable rearing ground for the resident and midrange migrant species. Some small size fish like *Barilius* may survive in pool areas.

d) Mid-range Migrant Species

The adult Mid-range migratory fish, residing in the central or lower parts of the Seti and spawning in upper parts, will be affected mainly by the reduced area for spawning and growth of fry. The impact will be considered particularly high during March -April when the popular snow trout breed. However, the adult stages will also be affected in 1.5 km stretch according to discharge reduction. Any change in water quality will also affect the spawning and nursery ground more severely than the adult residence area. This includes the snow trout species *Schizothorax plagiostomus*, *S. progastus*, *Neolissocheilus hexagononepis* and *Labeo dero*. The adult fish requires more water as a result of low flows and they could move out of the area (1.5 Km) into deeper water. In the worse case scenario there could be a species change to catfish, rock carp and loaches which are adaptable to low flow conditions.

e) Long Distance Migrant Species

Long distance migratory fish can be defined as fish residing in the downstream part of the Seti and or Narayani river and move into the upper reaches for spawning. The upstream spawning migrations mostly take place between May to July. The likely reduction in flow during spawning and migration will have significant impacts on long distance migratory fishes. The young fry residing in spawning areas or nearby downstream will experience lower discharge and different water quality compared to pre-diversion years. Production of fish fry of these fish species will be reduced due to the reduction of discharge in addition to impacts affects caused by the modified water quality. This will concern fish species like *Tor putitora*, *T. tor*, *Anguilla bengalensis*, *Bagarius bagarius* and *Clupisoma garua*.

f) Loss of Micro-organism

Dewatering below the powerhouse for approximately 18 hours a day for a stretch of 1.5 km will have a serious impact on the micro-flora and aquatic invertebrates. A total of 5 species of fish, 14 species of phytoplanktons, 4 species of zooplanktons and 10 species of aquatic insects may be lost in this section. Fish food in the Seti river is plentiful. The reduced flow would result in lower flow velocities, increase in water temperature and shifts in zooplankton, aquatic and riparian vegetations. There could be a shortage of fish food for 7.5 months in the dewatered bed. The

overall aquatic production in a moderate or fast flowing river takes place on the river bottom. In addition, input from the terrestrial surrounding along the river like leaves, insects, grass, and other organic particles often play an important part to increase the productivity of the river. Generally speaking, a permanent reduction of water flow in a river will reduce the area of river bottom for aquatic production.

5.3 Socio-economic and Cultural Environment

This section provides an assessment of potential socio-economic impacts and a description of the proposed mitigation measures. The implementation of the project will have impacts like landtake, population displacement, social problems due to influx of labourers and economic spin-offs etc. The eight VDCs including Vyas Municipality (Damauli) of Tanahu District which will be affected by the project, has a total area of 1546 km² and a population of 304496.

The main social impacts arising from the construction and operation of the storage type of hydropower project in an area where subsistence agriculture is the main economic activity and culture traditional can be broadly classified as:

- Relocation of the people;
- Increased pressure on community resources like water, forest, and agriculture land;
- Potential health, sanitation concerns and increase in disease vectors associated with the pollution from construction operations, work camps and from the deterioration of air, water quality;
- Potential for an increase in illegal activities such as illegal fishing, hunting, felling of trees resulting from the increased population and access;
- External pressure on social/religious traditional ways of living in the communities; and
- Overburdening of the existing social infrastructure (e.g. health services and schools) due to the influx of the construction and operation work force.

The households affected directly and indirectly from the project are given in Table 5.9. The households in the project impact area would be indirectly affected to varying degrees both adverse and positive resulting from changes in the physical, biological and social baseline conditions in the area. Positive impacts arising from the opening of the area for direct and indirect employment, job creation, increasing rural electrification and other social services will be highly significant.

Table 5.9: Affected Area, Villages and Population

Directly Affected People (i.e., families whose houses or land have to be acquired temporarily or permanently for the project)	<ol style="list-style-type: none"> 86 families to be relocated from the reservoir area Families whose houses or land are affected by the access roads, borrow areas, construction camps) Families whose houses or land are affected by the fluctuation of the reservoir level
Indirectly Affected (i.e., families or villages that will be disrupted or benefited from construction activities, road access and project operation)	<ol style="list-style-type: none"> Villages to be affected by construction of the dam: Beteni, Huksetar, Patan, Bisghare, Thati, Patighar, Dharapani and Gyajha Villages to be affected by construction of the powerhouse: Samidanda, Malinge, Banchare, Simalswara, Belbase and Simalchaure. Villages in the reservoir area: Lokma, Syanlun, Bajhogara, Hukadi, Chap, Chilekama, Machadanda, Kortan, Tutwa, Badarkuna, Jalbire, Jaruwapani, Risinpatan, Geruwatar, Chorepatan, Saune, Dumsadi, Khanaltar, Baghtar, Malebagar, Bhimad bazaar, and Geruwapani, Thandiphant, Chanpatan, Tallotar, Jhakkas, Chimkhan and Pipale Village to be affected by the access road - Beteni All the women population residing in and around the project area
Regional Economic Impacts (i.e., districts and VDCs that will benefit from direct, indirect and induced project impacts)	<ol style="list-style-type: none"> The Tanahu District will be affected by the project in terms of project expenditures, employment, economic spin-offs, and power generation revenues. Damauli municipality, which lies along the highway, will be affected by the project.

Table 5.10: Affected VDCs

Name of the Affected VDCs	Villages in the affected VDCs
Vyas Municipality	Beteni, Huksetar, Patan, Bisghare.
Kahun Shivpur	Thati, Patighar, Dharapani, Samidanda, Malinge, Banchare, Lokma, Syanlun and Gyajha
Pokhari Bhanjyang	Simalswara, Belbase and Simalchaure.
Rising Rani Pokhari	Tutwa, Badarkuna, Jalbire, Jaruwapani, Risinpatan and Geruwatar.
Kot Durbar	Bajhogara, Hukadi, Chap, Chilekama, Machadanda, Kortan.
Majhkote	Chorepatan, Saune and Dumsadi
Bhimad	Khanaltar, Baghtar, Malebagar, Bhimad bazaar, and Geruwapani.
Chhan	Thandiphant, Chanpatan, Tallotar, Jhakkas, Chimkhan and Pipale

Only the lower reaches of the villages and patches of agricultural land on the lower slopes of the villages are affected by the reservoir formation. VDCs like Jamune, Kot Durbar, Kahu Shivpur and Pokhari Bhanjyang are not considered to be seriously affected as the settlements situated on the upper and lower slopes consist of only forests. The affected settlements are shown in Figure 5.3

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

5.3.1 Loss of Land and Property

5.3.1.1 Effect on Land for Cultivation

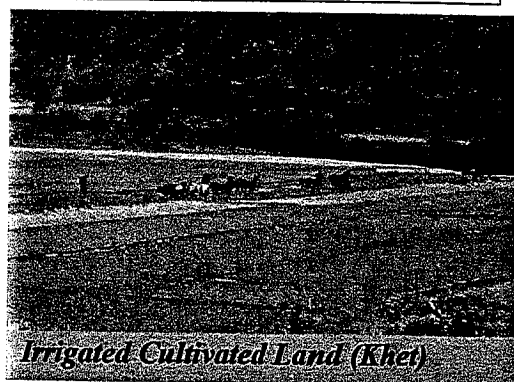
The cultivated land areas are under the ownership of the local people. As indicated in Table 5.11, the project will affect 151.22 ha of cultivated area, accounting for approximately 15% of the total affected land.

Table 5.11: Cultivated Area along the Reservoir Site as per GIS Maps and Cadastral Maps

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

Source: GIS Map, JICA Study Team, 2006.

Most of the agricultural land is located in Rising Patan in Rising Ranipokhari VDC, Saune and Chhore Patan in Majhkot and Bhimad Bazaar and its vicinity in Bhimad VDC. A comparative analysis of the cultivated land areas using GIS and the cadastral map reveals that the GIS land use under cultivation is higher than the cadastral map. This can imply that in the reservoir area, there are many land plots which are under cultivation, but are not legally registered in the Land Revenue Office or in the District Survey Office. As the construction of the project acquires 151.22 ha of agricultural land, this impact is high in magnitude, local and long term in duration.



TANAHU DISTRICT



- RIVER
- CONTOUR
- SAND DEPOSIT
- MUNICIPALITY
- MAJOR SETTLEMENTS
- RISK OF SLOPE FAILURE
- P/H POWERHOUSE

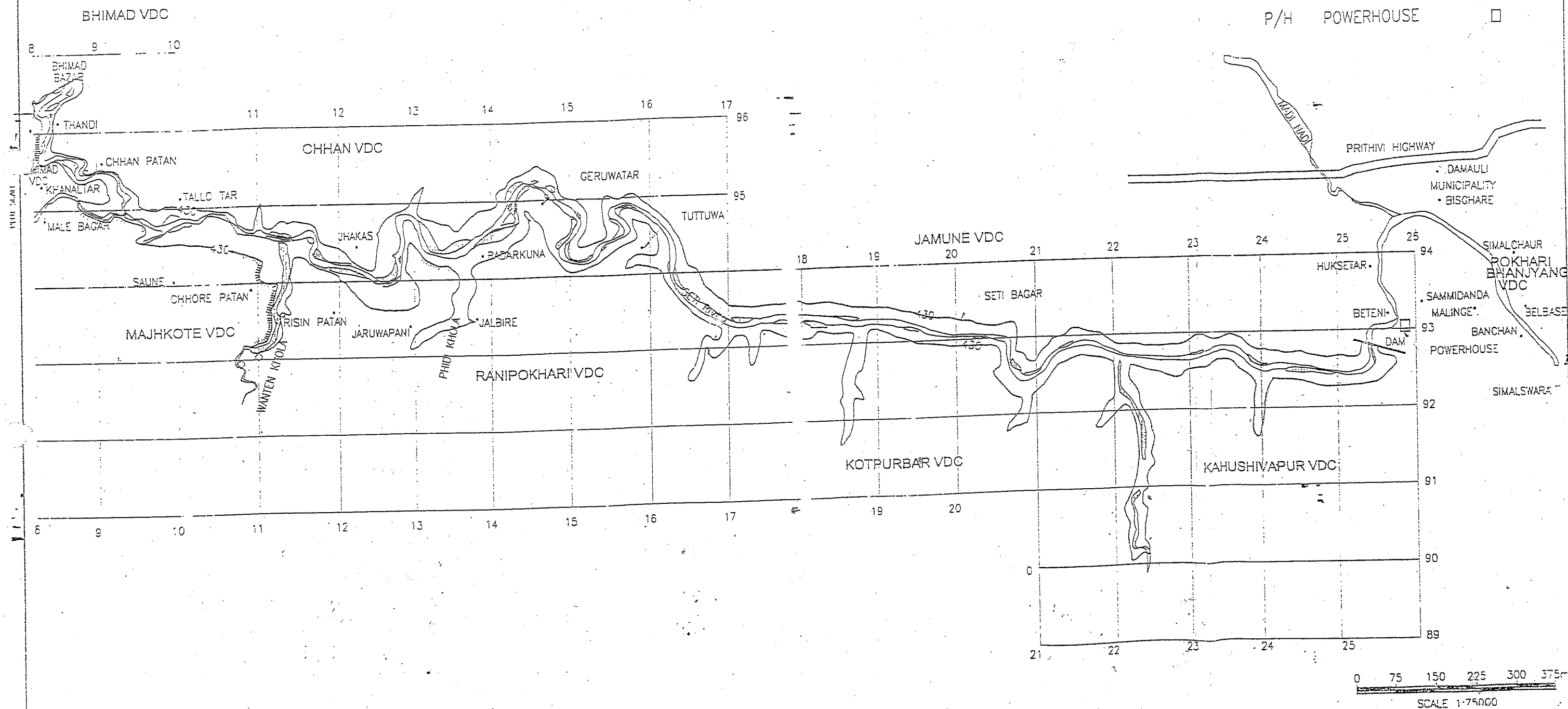


Fig 5.3

Upper Seti Storage Hydroelectric Project
Major Settlements in the Project Area



Table 5.12: Cultivated Areas in the Reservoir Site as per GIS and Cadastral Maps

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

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

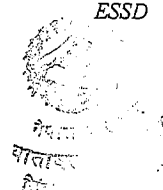
Note: The Geruwatar area is currently under grassland, but is registered as agricultural land. The GIS map has recorded this area as grassland. It is because of this, the actual cultivated land in Rising Ranipokhari VDC is less than the cultivated land indicated in cadastral maps.

5.3.1.2 Effect on Agricultural Products

The annual production loss from the agricultural areas occupied by the project is presented in Table 5.13. It is estimated that 660 metric tons of annual production will be lost due to the implementation of the project. If we assume that average crop yields for paddy are 3.15 metric tons per ha, the annual loss of paddy production resulting from the project is approximately 285 metric tons, accounting for 43 percent of the total annual production loss. Since the great majority of the local people in the affected areas are engaged in agriculture, the project will bring about adverse impacts on their livelihood. As the annual production loss is very high, this impact is high in magnitude, local in extent and long term in duration.

Table 5.13: Annual Production Loss of the Agricultural Land

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



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

Source: Supplemental EIA Survey, JICA Study Team, 2006.

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

5.3.2 Direct Impacts to the Households

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

5.3.2.1 Affected Land Parcels of the Project

The cadastral maps were the basic input for the identification of the land parcel in the project affected area. The Household Survey of the affected people could not verify all the land parcels due to a high number of absentees during the survey. Besides, there are number of land areas under cultivation, but are not defined as land parcels legally and the limited field survey was unable to define these lands in land parcel category. The cadastral maps of the area limits mapping only to agricultural areas of the survey period, i.e. about 35 years back with a few modifications only. The forest, barren area, river corridor, shrub land and grassland are not shown in the cadastral map. Table 5.14 presents the accounted land parcels in the project affected area as per the cadastral map.

Table 5.14: Number of Land Plots Affected by the Project

Affected VDCs/Municipality (FSL 415+10 m)	Number of land plots
Bhimad	21
Chhang Bazaar	116
Majkot	134
Rising Ranipokhari	252
Kotdurbar	68
Kahun Shivapur	52
<i>Total land plots affected (Reservoir)</i>	<i>643</i>

Kahun Shivapur	52
<i>Total land plots affected (Reservoir)</i>	643
Kahun Shivapur VDC	
Access road	24
Spoil disposal (Beltar)	317
Base camp (Huksetar)	55
Vyas Municipality	
Access road (Benipatan and Betini)	130
<i>Total land plots affected (project facility sites)</i>	526
Grand Total Land plots affected Project	1169

Source: Cadastral maps of the affected area

5.3.2.2 Affected Land Owner of the Project

Table 5.15 presents the numbers of land owners actually verified and those estimated from the database of the field book of the District Survey Office. The number of total private land owners is estimated to be 838 households.

Table 5.15: Number of Affected Land Owners of the Project Area

Particulars	Reservoir area FSL 415+10 m	Project Facility Sites
Owners identified plots	471	662
Owner unidentified plots	113	55
Government plots	59	9
Estimated private owners of unidentified plots	70	34
Private owners of identified plots	275	405
Total arable land not registered (ha)	16.6	
Estimated private owners of the not registered plots	54	
Total owners	839	
Total Private Owners	838	
Government Owner	1	

Source: Supplemental EIA Survey, JICA Study Team, 2006

Note: Estimation of owners of unidentified plots and areas is based on the total identified owners Vs identified plots areas for 425 m levels.

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

5.3.2.3 Affects on Private Built Structures

The project is envisaged to affect two types of built structures, namely privately owned structures and community owned structures. The privately owned structures include houses, cowsheds, toilets and other facilities. As indicated in Table 5.16, 313 private structures in total will be affected by the project. About 55 % of the total affected private structures are located in the



project facility sites, in which congested communities have been developed due to good access to Damauli.

Table 5.16: Affected Private Structures

	Affected VDCs/Municipality	Number of Affected Private Structures
Reservoir Area (FSL 415+ 10 m)	Bhimad,	0
	Chhang	31
	Majkot,	4
	Rising Ranipokhari	82
	Kotdurbar	5
	Jamune	18
	Kahun Shivapur	0
	Vyas Municipality	0
	Total	140
Project Facility Sites	Kahun Shivapur-Beltar (for Spoil disposal)	64
	Kahun Shivapur-Huksetar (for base camp)	41
	Vyas Municipality- Lower terrace (for access road Benipatan-Dam right bank of Seti)	68
	Total	173
Grand Total		313

Source: Supplemental EIA Survey, JICA Study Team, 2006

5.3.3 Affected Structure Owners of the Project

Generally, one owner has several structures. The number of owners having affected structures is presented in Table 5.17. The name of each owner having these affected structures was identified in the reservoir area and project facility sites during the household survey. It was estimated based on the GIS Map that structures of 20 people will be affected. Construction of the project needs the permanent acquisition of 313 private structures owned by 110 families. Thus this impact is expected to be high in magnitude, local in extent and of long term in duration.

Table 5.17: Structure Affected Owners of the Project area.

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

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

For the Risk Zones, it was assumed that all structures belong to different 20 people due to no inventory structure survey.

5.3.4 Residential Structure Affected Owners

The entire owners of the affected structures are not residing in these structures. Table 5.18 presents the number of affected owners of residential structures, who need to be relocated from the present residential premises to a new location. In other words, these people will be immediately and severely affected by the implementation of the project.

As 86 families are displaced due to the construction of the proposed project, the impact is high in magnitude, local in extent and of long term duration. The list of the affected families are given in Appendix L.

Table 5.18: Affected Residential Structure Owners of the Project Area

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

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

Note: For the Risk Zones, it was assumed that all structures might be residential structures due to no inventory structure survey.



5.3.5 Residential Structure Affected Owners without Legal Holdings

Some of the residential structure owners to be affected by the project have no legal holdings of the land plots. Such residential structure owners are found at Wantang Khola, of Rising Ranipokhari, Beltar of Kahun Shivapur VDC, Bhimad, Chhang, Rising Ranipokhari, and Jamune VDCs. These residential structures are located on government land.

Apart from this, there are people having residential structures in other people's land but without any legal documents. Table 5.19 presents the number of such residential structures in the reservoir area and project facility sites. From Table 5.19, it is evident that 30 households will be losing their residential buildings but these households have no entitlements on these properties. This implies that the households are landless. So, the impact is very high in magnitude, local in extent and of long term in duration.

Table 5.19: Residential Structure Affected Owners without Legal Holdings

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

Source: Supplemental EIA Survey, JICA Study Team, 2006

5.3.6 Seriously Project Affected Families and Project Affected Families

As previously mentioned, the effect of the project due to the acquisition of land and other assets is not equal for all the affected people. Some people may lose a significant amount of land or residential house while others may marginally be affected due to loss of small portions of land or income. Those who will lose their houses and be relocated may not be seriously affected in terms of an economic point of view if they have sufficient amount of land or other assets in non-affected areas. It is very difficult to identify a definitive conclusion on the severity of the impacts objectively to each of the project affected people since there are not reliable databases on the social and economic conditions of the households in the VDC and district. There have been no standard criteria of Seriously Project Affected Families (SPAF) and Project Affected Families (PAF) in Nepal. Every project has developed and used different criteria for SPAF and PAF³.

³ Kaligandaki A project has employed categorization of the project affected households on the basis of the loss of land. Any household losing more than 50% of the total land irrespective of the landholding size and other off-farm income was identified as SPAF and the rest as PAF. This evaluation was based on the answers of the respondents in the household survey.

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

Thus, a distinction has been made between SPAF and PAF taking consideration of 2 poverty related criteria and putting the sample households. The criteria for SPAF are given below;

- Marginal households having < 5 ropani (0.25ha) of land or
- Households having the below poverty line per capita/annum income of NRs 8902 (defined by Nepal Living Standard Survey 2003/04 for Rural Western Hill)

Based on the land holding criteria, altogether 263 households (66%) are identified as SPAF, while under the per capita poverty line income criteria, only 30 households (7.5%) are identified as SPAF (Table 5.20).

Table 5.20: SPAF and PAF by VDC

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

Source: Supplemental EIA Survey, JICA Study Team, 2006

The SPAF are found mostly among the Dalits (78%) compared to other four categories of caste/ethnic households under the land holding criteria, while under the per capita income criteria, the highest number of Adibashis/Janjatis (9%) are categorized as SPAF (Table 5.21). The impact is high, local and for long duration.

Table 5.21: SPAF and PAF by Caste/Ethnicity

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

Source: Supplemental ELA Survey, JICA Study Team, 2006

5.3.7 Socio-Economic and Cultural Impact during the Construction Phase

5.3.7.1 Affect on Infrastructures

The reservoir inundation affects a variety of infrastructure facilities of the communities. They include motorable roads, suspension bridges, foot trails, irrigation canals, and electricity distribution.

I. Motorable Road

The motorable roads are an important transportation means of moving goods and people from the bazaar areas such as Damauli and Bhimad Bazaar to the rural villages. Motorable roads to be submerged by the reservoir of FSL 415 m are presented below in Table 5.22. This impact is moderate in magnitude, local in extent and medium in duration.

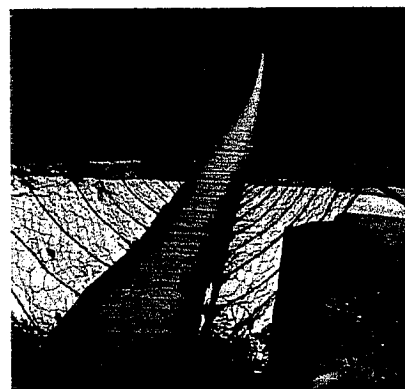
Table 5.22: Affected Motorable Road – Graveled

SN	Name of Structure	Location VDC/Municipality	FSL 415 m	Remarks
			Affected Stretch (m)	
1	From Majkot to Wantang Khola	Majkot	200	Replace by rerouting
2	From Wantang Khola to Rising Patan	Rising Ranipokhari	100	Replace by rerouting
	Total		300	

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

II. Bridge and Suspension Bridge

The inundation of suspension bridges will seriously affect the daily life of the local people living on either banks of the Seti river since these suspension bridges are the lifeline of transportation and communication for them. Table 5.23 indicates the name, the location and the affected stretch of these affected suspension bridges and a bridge.



Lima Suspension bridge (Khaun to Damauli)

Table 5.23: Affected Suspension Bridge

SN	Name of Structure	Location VDC/ Municipality	FSL 415 m	Remarks
			Affected stretch (m)	
1	Suspension Bridge across Seti from Rising Patan to Jhakas (Jhakas Pool)	Rising Ranipokhari / Chhang	125	Replace by longer SB
2	Suspension Bridge across Seti from Geruwatar to Kundale (Kundale Pool)	Rising Ranipokhari / Chhang	110	Replace by longer SB
3	Suspension Bridge across Seti from Tutuwa to Belbot (Tutuwa Pool)	Rising Ranipokhari / Jamune	110	Replace by longer SB
4	Suspension Bridge across Seti from Belbot to Machang Bhagar (Tuni Pool)	Kotdurbar / Jamune	135	Replace by longer SB
5	Suspension Bridge across Seti from Bajogara to (Chule Pool)	Kotdurbar / Jamune	125	Replace by longer SB
6	Suspension Bridge across Seti from Bajogara to Bhagar (Lima Pool)	Kahun Shivapur / Jamune	135	Replace by longer SB
Total			740	

Source: Supplemental EIA Survey, JICA Study Team, 2006

III. Foot Trails

Foot trails are also very important transportation mode for the local people living on either banks of the Seti river since these foot trails can serve to connect one community to another, and the scattered communities and the district headquarter Damauli as well as Bhimad Bazaar. The affected foot trails are described below in Table 5.24. This impact is high in magnitude, local in extent and for long duration.

Table 5.24: Affected Foot Trails

SN	Name of Structure	Location VDC/ Municipality	FSL 415 m	Remarks
			Affected stretch (m)	
1	From Tallo Tar to Jhakas along left bank of Seti	Chhang	2000	Replace by rerouting
2	From Jalbire –Bandarkuna to Geruwatar along right bank of Seti	Rising Ranipokhari	2600	Replace by rerouting
3	From Jhakas to Kundaletar along left bank of Seti	Chhang	3000	Replace by rerouting
4	From Jaruwapani to Jhakas suspension bridge	Rising Ranipokhari	750	Alternative to be decided

SN	Name of Structure	Location VDC/ Municipality	FSL 415 m	Remark
			Affected stretch (m)	
5	From Rising Patan to Jhakas suspension bridge	Rising Ranipokhari	500	Alternative to be decided
6	From Geruwatar to Amdanda	Rising Ranipokhari	520	Alternative to be decided
7	From Kundaletar to Lankuswara	Chhang	410	Alternative to be decided
8	From Tittuwa to Tittuwa suspension bridge	Rising Ranipokhari	260	Alternative to be decided
9	From Tittuwa suspension bridge to Betini along left flank of Seti	Jamune / Vyas Municipality	13500	Replace by rerouting
10	From Tittuwa suspension bridge to Tuni suspension bridge along right flank of Seti	Rising Ranipokhari / Kotdurbar	2500	Replace by rerouting
11	From Chap to Tuni suspension bridge	Kotdurbar	225	Alternative to be decided
12	From Dumdanda to Tuni suspension bridge	Jamune	260	Alternative to be decided
13	From Bahapur to Tuni suspension bridge	Jamune	730	Alternative to be decided
14	From Machang Bhagar to Chelekarna	Kotdurbar	500	Alternative to be decided
15	From Banjgara to Chule Suspension bridge	Kotdurbar	500	Alternative to be decided
16	From Banjgara to Lima suspension bridge	Kahun Shivapur/ Kotdurbar	250	Alternative to be decided
17	From Lima suspension bridge to Rainidanda	Kahun Shivapur	300	Alternative to be decided
18	From Satan to Lima suspension bridge along Lima Khola	Kahun Shivapur	2500	Alternative to be decided
19	From Chule suspension bridge to Barchyan	Jamune	320	Alternative to be decided
20	From Lima suspension bridge to Parithan	Jamune	320	Alternative to be decided
	Total		31945	

Source: Supplemental EIA Survey, JICA Study Team, 2006

IV. Irrigation Canals

The formation of the reservoir with the FSL of 415 m will submerge one irrigation canal located in Rising Ranipokhari. Since all the land irrigated by this canal lie below the reservoir levels, there is no alternative at all. Details of the affected irrigation canals are shown in the Table 5.25 below. This impact is high in magnitude, local in extent and long term in duration.

Table 5.25: Affected Irrigation Canals

SN	Name of Structure	Location VDC/Municipality	FSL 415 M	Remarks
			Affected stretch (m)	
1	Irrigation System of Bandarkuna	Rising Ranipokhari	3000	No alternative
	Total		3000	

Source: Supplemental EIA Survey, JICA Study Team, 2006

V. Electricity Distribution Line

Table 5.26 shows the name, location and affected stretch of electricity distribution line. This impact is high in magnitude, local and for long term.

Table 5.26: Affected Electricity Distribution Line

S.N	Name of Structure	Location VDC/ Municipality	FSL 415 M	Remarks
			Affected stretch (m)	
1	From Majkot to Rising Patan	Majkot/ Rising Ranipokhari	600	Replace by rerouting
2	From Rising Patan to Jhakas	Rising Ranipokhari	1500	Replace by rerouting
	Total		2100	

Source: Supplemental EIA Survey, JICA Study Team, 2006

VI. Water Resources

Other infrastructures to be affected by the project are 3 pipe water systems, 2 ponds, and 11 natural springs (refer Table 5.27). This impact is high in magnitude, local and long term in duration.

Table 5.27: Affected Water Resources

SN	Name of Structure	Source Name	Location, Ward, VDC/Municipality	Beneficiary Households
1	Pipe Water	Pipale	Pipale, Ward 5 Chhan VDC	15
2	Pipe Water	Chitung Khola	Jhakash-Fulbari, Ward 7 Chhan VDC	23
3	Pipe Water	Kheradi	Kahunn Basti, Ward 8, Kahun Shivapur VDC	20
4	Pond/Pokhari	Chokre Pokhari	Just below Chokre Village, Chokre, Ward 4, Chhang VDC	39
5	Pond/Pokhari	Chokre	Chokre Ward 5 Chhang VDC	20
6	Natural Spring	Kumalpani	Rising Patan, Ward 9, Rani Pokhari VDC	50
7	Natural Spring	Amalapani	Rising Patan, Ward 9, Rani Pokhari VDC	50
8	Natural Spring	Dulegaunda	Rising Patan, Ward 9, Rani Pokhari VDC	40



9	Natural Spring	Dhunge Pandhero	Rising Patan, Ward 9, Rani Pokhari VDC	200
10	Natural Spring	Tarebhir	Rising Patan, Ward 9, Rani Pokhari VDC	70
11	Natural Spring	Bokse Chhahra	Sanutari, Ward 9, Rani Pokhari VDC	16
12	Natural Spring	Risini Khola	Ward-3, Maidan Swanra, Ward 1, Kotdurbar VDC	35
13	Natural Spring	Bakle Kuwa	Bansbot, Ward 3, Kahun Shivapur VDC	4
14	Natural Spring	Sarki Kuwa	Kahun, Ward 3, Kahun Shivapur VDC	50
15	Natural Spring	Gidha	Ranibari Gidha, Ward 3, Kahun Shivapur VDC	5
16	Natural Spring	Linde Dhara	Near School, Beni Patan, Ward 7, Vyas Municipality	25

Source: Supplemental EIA Survey, JICA Study Team, 2006

VII. Summary of Affected Infrastructures

Table 5.28 presents the summary of main infrastructures to be affected by the project.

Table 5.28: Project Affected Main Infrastructures

Type of Infrastructure	Reservoir FSL 415 (m)	Affected Length (m)
Motorable road gravel	2	300
Bridge and Suspension Bridges	6 suspension bridges	925
Foot Trails	20	34530
Irrigation Canals	1	3000
Electricity Distribution	2	2100

Source: Supplemental EIA Survey, JICA Study Team, 2006

VIII. Effects on Community Structures

The implementation of the project will adversely affect several community structures. These structures include 1 cremation structure (ghat) used by the Gurung community in Bhimad, 1 Mahadev Temple located in Chhang VDC, and 5 resting places. The loss of these community structures might lead to adverse effects on the existing community support network and socio-cultural and religious practices such as neighborhood



Resting Place

gatherings, worships and festivals. Particularly such temples and cremation structures are essential for religious and cultural practices of the local people, which require appropriate compensation for the loss of these structures. The list of the affected community structures are shown in the Table 5.29. This impact is moderate in magnitude, local in extent and for long duration.

Table 5.29: Affected Community Structures

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

Source: Supplemental EIA Survey, JICA Study Team, 2006

5.3.7.2 Water supply, Sanitation and Health

The construction activities and the likely increase in population of the area during the construction phase may give increased pressure to the existing water supply system and bring about the shortages of drinking water. This may also generate conflicts and dissatisfaction between the local and new users. Furthermore, the influx of a large number of workers during the construction will potentially deteriorate the existing sanitation conditions. The lack of proper sanitary measures and increase in water pollution and solid waste can bring about epidemics such as typhoid, cholera, and diarrhea. Other communicable diseases like STD and HIV cannot be ruled out when a large number of people flock and live in a limited area at the construction sites. This impact is high in magnitude, local in extent and of long term.

5.3.7.3 Accidents and Occupational Health

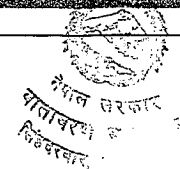
Work related injuries and accidents are likely to occur during the construction phase, not only to those who are engaged in construction work but also to the local people since they live close to the construction sites.

5.3.7.4 Vulnerable Groups

The past experiences in other project have shown that women and children are vulnerable group. Girl trafficking, and sexual and labor exploitation can happen during the construction phase. Although child labor is prohibited as per Nepal's law, children are engaged in stone quarries and other menial jobs. Besides women, children and elderly people can be considered as one of



Woman and child working in stone quarrying in Danauli



the vulnerable groups, who may be in more danger of accidental risks and health hazards. In some cases, it will be more difficult for the elderly people to be relocated away from the current places to new places since they have had a strong and long relationship with the community and an attachment for their own structures and community itself. This impact is high in magnitude, local in extent and of long term.

5.3.7.5 Inflow of a Large Number of Workers

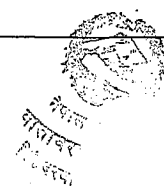
The influx of a number of workers including construction laborers into the project area will bring about a number of impacts to the local communities and the environment. As previously mentioned, there will be significant stress to the local water supply system and existing public facilities. Deterioration of sanitary conditions and environment will also occur. There will also be a potential risk of the spreading of the communicable diseases such as typhoid, cholera, and diarrhea if the appropriate measures for sanitation will not be taken. Furthermore, the inflow of a number of male workers might increase sexual activities, and consequently lead to the possibilities of transmitted diseases such as STD and HIV Aids. In addition, the possibilities of trafficking and sexual exploitation of women or children cannot be ruled out. Since it is assumed that the construction workers will come from different places and different ethnic and caste groups to work in the limited area for a long time, there will also be possibilities of social conflicts and disruptions between these workers and the local communities and the workers and project management. This impact is high in magnitude, local in extent and for long term.

5.3.7.6 Effects on the Livelihood of Fishermen

It will be less likely that the project will adversely affect any specific fishermen communities like Kaligandaki 'A' HEP. Furthermore, there are no full time fishermen in the Seti and Madi rivers. The Bote community (ferry rider community) used to be engaged in ferry operations across the Seti and Madi Rivers and practice fishing as their main livelihood in the past years. However, after the replacement of boats with the construction of suspension bridges, the traditional ferry operations came to a halt. They are now engaged in agro-economic activities and fishing practiced occasionally. Other ethnic groups such as Magars, Gurungs and Kumals are also engaged in part-time fishing. Accordingly, it cannot be said that the project will directly and seriously affect specific fishermen groups or fishermen communities. However, it can be assumed that the water diversion of the Seti river will bring about some effects on the fishery resources in the project area, and may influence their fishing activities to some extent. This impact is high in magnitude, local in extent and of long term.

5.3.8 Beneficial Impacts

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



5.3.8.1 Beneficial Impacts during the Construction Phase

The implementation of this project will lead to economic development opportunities in the region. The main areas of benefit during the construction period will be:

- Opening the area to market forces and trading of goods to some extent.
- Job opportunities to the local people

As most of the outside construction related population will depend on cash to meet their day to day requirements and housing expenses, there will be some opportunity for the locals as well as outsiders to exploit the market for essential commodities and hotels.

Overall the region is expected to relish economic benefits from the implementation of the project:

- Rural Electrification;
- Employment Opportunities; and
- Flow of Goods and Services.

These impacts are generally expected to be positive, moderate in magnitude, regional and both short and long term in nature.

5.3.8.2 Socio-Economic and Cultural Impact during the Operation Phase

5.3.8.2.1 Downstream Effect

There may be accidental risks to the lives of people and cattle, particularly in the downstream areas due to surge of water in the Seti River twice a day during the peak power demand periods. The sudden release of water and the fluctuation in the flow downstream of the powerhouse will also affect white water rafting tour operators who have recently been opened and carried out in the Seti River up to Deughat which is close to Narayanghat. On the other hand, it will be less likely to occur are serious downstream effects on the agricultural activities in the areas since the local people in downstream areas do not use water from the Seti river even for irrigation but from small streams. This impact is moderate in magnitude, local in extent and long term in duration.

I. Safety Issue

Regarding the downstream safety issue, it has not been examined in detail from an environmental aspect at this stage of the project since topographic surveys and hydraulics of the downstream river course have not been conducted. Operation of irrigation schemes in the immediate area of the tailrace has not been seen from preliminary examination by using the topographic map at 1:25,000 scale and field reconnaissance survey. This may be because the immediate downstream area consists of a deep gorge. This impact is moderate in magnitude, local in extent and long term in duration.

II. Impact on White Water Rafting

Regarding the potential impact to white water rafting, two types of impacts are considered; (1) During the non-power generation period, rafting activity would be disturbed in the downstream river course since the fall on the water level and flow speed at certain sections of the river course

may occur due to regulation of water discharge from the dam. On the other hand, there is no impact at the downstream area of the dam since there is no rafting activity at present., and (2) During the power generation period, danger on rafting activity in the river and camp site for rafting tour at river reservation (or river side area) would be considered due to immediate increase of downstream water level due to the discharge from the tailrace outlet. The same situation can be considered in the sediment flushing operation period. However, since downstream conditions and present rafting activities are not known in detail as well as its safety issue, type and degree of the impact for rafting activity could not clearly be identified in the study. In addition, the possibility to implement the rafting activity in the non-power generation period should be examined and discussed between NEA and rafting operators in the later stage of the project. This impact is moderate in magnitude, local in extent and long term in duration.

In non-power generation period

In the project operation, impact to the rafting activity would occur between February and May and between September and December in the river section between the confluence of the Madi and Trishuli rivers, where the daily average flow volume will be almost half of the present flow volume. However, in addition to where the hydraulic condition such as decrease of water level and speed in some river sections cannot be predicted due to lack of information on the downstream river course and the present rafting activity is not known in detail. Therefore, the exact impact and possible measures cannot be identified and proposed in the present stage of the study. This impact is moderate in magnitude, local in extent and long term in duration.

In power generation period

As the peaking period for power generation is planned between 5 am and 8 am and between 6 pm and 9 pm, rafting activity during this period should be banned. The possibility to implement the rafting activity in the generation period should be discussed between NEA and rafting operators in the later stage of the project.

III. Withdrawal of Economic Activities

The first and foremost impact during the operational phase is the withdrawal of economic activities which flourished during the construction phase since most of the construction related workforce will leave the project areas. However, it is likely that some economic activities will continue or be further promoted in these areas because of the relatively good accessibility to urban areas such as Damauli and Bhimad Bazaar. Considering this, the impact of the withdrawal of economic activities during the operational phase can be assumed to be moderate in magnitude, regional in extent and for short duration.

CHAPTER SIX

ALTERNATIVE ANALYSIS

6.0 General

During the feasibility design process, several alternatives were examined for all project components. These alternatives were assessed on operational, economic, engineering and environmental aspects and are discussed in this section.

An analysis of potential storage projects in Nepal was done prior to the feasibility level study in Phase I. Three best projects were selected from the inventory prepared, for the feasibility study through Coarse and Fine Screening and Ranking procedures. During the selection process, technical, financial and environmental criteria were considered. The Upper Seti Storage Hydroelectric Project is one of these projects which have been selected through the Screening and Ranking process for the feasibility level study

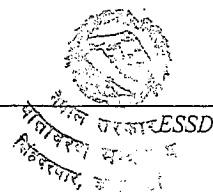
6.1 Alternatives Study

During the feasibility and EIA study process a comparison of alternative project strategies, sites for facilities, technologies and designs were carried out. These alternatives were based on site conditions and practical options developed by the technical and environmental team. The following were the topics where alternatives were considered:

- ◆ Location and Design of Major Project Structures (Different dam height);
- ◆ Powerhouse Locations;
- ◆ Location of Construction Camps; and
- ◆ No Project Options

Alternative studies were also conducted by the JICA Study Team during the Upgrading Feasibility Level Study. In this Study, two kinds of alternative studies were undertaken: (1) Layout study to determine the optimum location of the project facilities such as the powerhouse and diversion tunnel, and (2) Comparative Full Supply Level (FSL) study to determine the optimum FSL of the reservoir. The alternative studies were looked at from various aspects such as economical, financial, technical, and environmental and social aspects.

The following sub-sections present the concerns, comparisons and conclusions for each major issue.



6.1.1 Siting and Design of Major Project Structures

6.1.1.1 Different reservoir level

This section summarizes the results of the comparison of resettlement impacts under different reservoir FSL scenarios between 375 and 435 m. As shown in Table 6.1 the overall resettlement effects will dramatically increase if the FSL changes from 415 to 425 m. The FSL above 425 m including the 10 m vertical height as risk zones will result in increased land acquisition such as 265 ha for cultivated land and 1160 metric ton loss of agricultural production, and an increment in the relocation of 160 people.

Table 6.1 Resettlement Effects with Different Reservoir FSL

Réservoir FSL + riser zone 10m	435 +10m*	425 + 10m	415 + 10m	405 + 10m	395 + 10m	385 + 10m	375 + 10m
Cultivated Land (ha)	499.92	265.55	151.22	111.69	94.05	79.78	71.1
Built up Area (ha)	3.93	2.545	1.7	1.205	0.74	0.355	0.36
Forest Land (ha)	615.71	543.06	480.09	424.5	375.31	325.79	282.81
Loss of Agricultural Production (MT)	2184.4	1160.3	660.7	488.0	410.9	348.6	310.6
	5	5	7	4	6	1	8
Number of Affected Private Structure	920	515	313	250	217	215	210
Number of Affected Community Structure	32	15	7	5	4	4	4
Number of Affected Private Land Owners	1943	1276	838	734	647	589	584
Number of Affected Structure Owners	335	199	110	88	79	77	73
Number of Residential Structure Owners =Relocatee	274	160	86	65	63	59	59

Note: *Since Field Survey including inventory structure survey covered the areas below FSL 435, each particular for 435+10m was estimated based on the incremental value from FSL 425 to FSL 435.

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

The more the resettlement impacts increase, the more social and environmental costs for mitigation will result. The comparison of resettlement and relocation costs is presented in Table 6.2. It is apparent that the compensation costs for private lands, structures and loss of agriculture production will increase to a large extent with the FSL above 425 m.

Table 6.2 Resettlement Cost with Different Reservoir FSL

Particular	Million Mrs.						
	435 +10m*	425 + 10m	415 + 10m	405 + 10m	395 + 10m	385 + 10m	375 + 10m
Reservoir FSL + risk zone 10m							
Cost Estimation for the Private Land (cultivated and built up)	2755.7	1602.1 6	999.5 1	801.8 3	712.8 2	640.8 2	598.1 5
Cost Estimation for the Structure	210.38	77.05	33.97	23.88	22.81	20.78	20.44
Cost Estimation for Agriculture Production Equivalent to one year production	2.16	1.17	0.65	0.49	0.42	0.35	0.31
Other Rehabilitation Compensation to Relocatee	105.66	67.43	44.95	37.91	37.24	35.89	35.89
Transportation Allowance to affected Structure owners other than the affected residential structure owners	1.67	0.97	0.56	0.50	0.36	0.40	0.32
Monitoring for 10 years	1.80	1.80	1.80	1.80	1.80	1.80	1.80
Grand Total	3077.4	1750.6	1081. 4	866.4	775.5	700.0	656.9

Note: The details of the basis for each mitigation cost is described in Chapter 4, Section 4.11 in Part D of the ESC Report.

6.1.1.2 Design Capacity Optimization

Changing the project size from the present capacity will lead to significant increase in the Environmental Management Cost. Increment of the FSL even only by 10 m would mean a considerable increase in resettlement and risk to major settlements like Bhimad Bazar, Risin Patan and Jaruwapani. However, by lowering the FSL by 10 m, the storage volume would decrease significantly but there would be significant reduction in land acquisition and displaced families.

The size of the project was determined by comparing the various options with economic benefits of power. Therefore, the location and size of the project as established in the feasibility level optimization is acceptable to the EIA team from the environmental and social tradeoffs.

6.1.1.3 Dam type

Due to the narrow gorge two alternatives of dam types –RCC, concrete gravity and arch dam were considered during the project feasibility level study. Although the Arch dam was found to be possible, it would be rather risky in the Himalayan geology and would require a separate spillway arrangement that would entail additional costs.

Dolomite is the predominant rock type in the both the abutments of the dam. Although the dolomite is sound rock, at present it reacts with water forming small caves or karstic topographical conditions in the future. The karstic condition makes the rock mass weak in strength and a high seepage zone as well. Therefore, the abutments consisting of dolomite rock will not have the required strength to hold the arch dam foundation. Several small caves are still visible on both river banks at the surface. Due to the adverse geological condition for the

construction of the arch dam, a concrete gravity dam has been preferred.

Beside this due to the narrow valley, a spillway on the top of the arch dam is not possible. A separate spillway on the left bank has to be proposed to safely discharge the PMF. The topographical condition of the spillway, approach channel and chute consists of steep slopes and need significant rock excavation and possess high risks during construction. The space is very limited in the damsite area and the disposal of excavated material will be a problem. In addition, there is a risk of slope stability. Hence, based on these factors, the concrete gravity dam is preferred and has been adopted for the Upper Seti Storage Hydroelectric Project.

6.1.2 Power House Options

Four alternatives for the powerhouse were studied during the feasibility study::

- Underground powerhouse with 927 m long headrace tunnel;
- Shaft option;
- Toe option; and
- Surface option.

For the toe option, the intake and waterway are embodied in the dam and the powerhouse is located at the left downstream side of the dam. This option was discarded due to poor geology and to increase the head and capacity of the project.

The underground powerhouse with 927 m long headrace tunnel option was selected as the best option due to good geological conditions and less impacts on the environment. Compared to other options less forests and less agricultural land will be affected by this option.

Likewise, the shaft alternative was not preferred due to the relatively high cost of the waterways and only a modest increase in energy generation.

The surface alternative was not selected due steep topography, unavailability of space creating a problem in disposing excavated materials.

6.1.3 Construction Camp Sites

The size of the construction work force for the Upper Seti Storage Hydroelectric Project is estimated to range up to 2500 workers in peak years. The estimate of the area needed to support the population is 10 ha. The actual size of the work force will vary depending upon the contractors and type of construction methods used.

Different layouts of the project facilities, specially the construction facilities, based on the GIS Map have been examined at site. The layout of the construction facilities were determined

considering the following aspects to minimize the impacts on the communities of Beni Patan and Shivapur, which included:

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

Space is available in villages like Huksetar near Patan for permanent staff quarters. Nevertheless, the site should be selected to reduce the temporary and permanent loss of cultivated land.

6.1.4 Timing and Phasing of Project Construction

The factors that come into play in the construction phase are numerous. They include optimization of the work schedules to provide the best utilization of labour and construction equipment; the necessary sequencing of civil construction activities; completion of diversion works during the dry season, and recognition of the limitations imposed on construction activities by heavy monsoons and river flows. In total 3 seasons are required to build the structures in the river. Other factors include consideration of the optimal timing for building of road access, river crossings, scheduling diversion activities in the river, clearing of lands for construction sites and camps, and head pond clearance.

In general, and for the purpose of this EIA level study there appear to be no major environmental impact mitigation or enhancement advantages related to minor alterations in the phasing of the civil construction works, as identified in the feasibility study.

There are some possibilities to schedule works that take place in more environmentally sensitive areas in periods where impacts will be lessened, and to maximize use of the local labour force. For example, there are some considerations for scheduling activities to avoid the most adverse impacts at sensitive ecological periods such as fish migration periods, wildlife breeding seasons; and in the social context, minimizing disturbance at critical times for farm activities (planting and harvesting) where local labour would want to return to their farmlands. Construction material or spill releases into the river would have to be controlled in dry seasons where the flow is reduced and the dispersion is low.

Scheduling issues should be reviewed further during the detailed design stage to identify possible mitigation measures.

6.1.5 No project Options

Nepal has been facing an acute shortage of peak load during the past few years. The present generation of the Integrated Nepal Power System (INPS) in winter is only about 615 MW as of July 2006/07 and the peak demand is 648 MW. The construction of the run-of-river type of projects will generate surplus power in the wet season while there is a deficit during the dry season. Therefore, the need for storage type of projects has been felt to fulfill the country's peak load demands.

At present, the Kulekhani hydroelectric project is the only storage scheme available for meeting the peak demand of electricity in the country. The rest of the schemes is all run- of- river type. Therefore, the Upper Seti Storage Hydroelectric Project will be able to fulfill the country's peak demand and reliable power supply to the country.

Without the project, there will be deficit power, which will lead to frequent load shedding especially in the dry season. In such a case, thermal power generation would lead to higher cost of generation apart from emission of noxious gases.

CHAPTER SEVEN

ENVIRONMENT MITIGATION AND ENHANCEMENT MEASURES

7.0 General

The following mitigation measures have been proposed to ameliorate the possible negative impacts identified during the study. The measures outlined at this time are intended to mitigate the potential adverse impacts of the project and enhance the positive impacts, which involve changes to the baseline conditions. It is important to note that the detailed version of the Environmental Mitigation Plan will be finalized at the Detailed Design Stage of project development. Moreover, the proponent will primarily be responsible for implementation of all the proposed mitigation and enhancement measures. The mitigation measures to be carried out during the two phases have been presented in tabular form in Table 7.11. Any losses caused by the project activities will be borne by the project proponent as per the prevailing laws of the Government of Nepal. Cash compensation will be made to that landowner whose land is affected by landslides due reservoir operation especially at the upstream area. The proposed mitigation measures to avoid/ reduce or mitigate adverse impacts have been described in Sub-chapter 7.1, 7.2 and 7.3. Similarly, enhancement measures to enhance beneficial impacts have been described in Sub-chapter 7.4.

7.1 Physical Environment

The main impacts associated with the reservoir type of project will be firstly those related to land take. The major land take will be for the reservoir. The breakdown of the total land takes of 1034 ha for the different project facilities were summarized in Table 5-1 in Chapter 5 of the report. The minimization of land take where feasible, will be the primary mitigation measure.

The second category of physical impacts includes a range of potential, site specific or localized adverse effects, such as the potential for construction induced rockfall and landslides due to the fluctuation in the water level upto 27.8 m in the dry season and due to construction blasting, drilling, vibration and slope cutting operations; alteration of localized drainage and storm run off patterns, unplanned release of construction spoils in the river, and localized noise and air pollution. Stabilization of slopes using bioengineering works etc., controlled drainage system, construction and waste management are some of the measures required. Other concerns include the use and disposal of construction wastes and proper location and management of borrow pits.

7.1.1 Watershed Conditions

The watershed management will include afforestation programs to limit slope erosion and sediment transportation in the reservoir and construction of check dams in tributaries, which will control sediment transportation into the reservoir.

7.1.1.1 Construction Phase

- Ground disturbances will be minimized
- Protection works such as retaining walls (revetment walls and gabion walls) will be constructed in critical areas near habitations specially in areas like Bhimad Bazaar, Risin Patan and Jaruwapani where slope failures are expected
- Compaction will be done on the dumped spoils and a slope of 1V: 2H will be provided.
- Wherever possible, bioengineering works will be undertaken in dumped areas, and all disturbed areas will be backfilled, covered with topsoil and fully re-vegetated.
- Top soil will be saved and stockpiled for reuse during re-vegetation especially in the area proposed downstream of the tailrace outlet.
- Catch drains to collect and sub-surface drains to divert surface water to stabilize gullies in areas prone to slides.
- Erosion, bioengineering with combination of civil structures will be considered for slope stabilization works required along the fragile stretch.
- Bio-engineering works and revegetation will be implemented.

7.1.1.2 Operation Phase

It is likely that the reservoir Full Supply Level of 415 m and at higher elevation would aggravate the local landslides present throughout the upper reservoir area during the operation phase. It is proposed that the following actions will be undertaken:

- Watershed enhancement measures like afforestation programs, construction of check dams will be implemented
- Proper inspection of the shoreline erosion will be carried out.
- Protection embankment works with concrete blocks cover will be constructed in the vicinity of Bhimad Bazaar.
- Land acquisition program and stabilization of erosion prone in the risk zone area from Full Supply Level to 10-m high above will be implemented.
- Selective planting of ground cover and trees at the base of areas susceptible to erosion in tributary stream leading into the Seti River will be done.
- Land acquisition program and stabilization of erosion prone areas with suitable tree species in the vicinity of the Wantang Khola, the Pedhi Khola and Tutuwa will be done.

However, it is difficult to estimate the risk of slope failure and measures for them. The situation of landslides and their treatment needs a comprehensive study by the qualified expertise in soil and watershed management techniques in the detail design stage.

7.1.2 Land Take and Landuse

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

The impact on land use in the project facility area can be mitigated by selecting the appropriate layout of the project facilities. In order to minimize the impact, GIS Map will be used to finalize the layout of the project facilities, especially the construction facilities. The layout of the construction facilities are determined considering the following aspects to minimize the impacts on the communities of Beni Patan and Shivapur, which includes:

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

7.1.2.1 Construction Phase

The following mitigation measures have to be implemented to reduce the impact on the landuse:

- Permanent landtake and natural slope disturbances will be minimized.
- Excavated materials will be properly dumped and disposed.
- Proper management and location of the project facilities, camps etc. Camps will be relocated in lower value cultivation land.
- Reclaim land use and maintain the existing land slopes specially along the access road.
- Bio-engineering along with civil structures to prevent erosion and landslides will be adopted.

7.1.2.2 Operation Phase

No mitigation measure is recommended.

7.1.3 Air Quality

The following measures are recommended to control air pollution in the project area.

7.1.3.1 Construction Phase

- Spraying of road surfaces with water will be done to minimize the generation of dust.
- Maintenance of all vehicles and construction machinery will be done.
- Construction vehicles complying with GoN emission standards will be used.
- Batching plants, crushing plants and the diesel generators will be provided with controlled stacks.
- Respirators to the laborers working close to the construction sites will be provided.

7.1.3.2 Operation Phase

No mitigation is proposed for the operation phase since the magnitude of impact will be low.

7.1.4 Noise and Vibrations

The following measures have been proposed to minimize the impacts of noise and vibrations,

7.1.4.1 Construction Phase

- Workforce camps will be located at least 500 m from the construction sites to protect the people from noise pollution.
- Regular maintenance of all equipment as per manufacturers' specifications will be done
- Earmuffs or plugs to the labourers will be provided as per the requirement.
- Blasting operations will be conducted using limited detonators and in small lots.
- Warnings system will be given prior to blasting
- Compensation will be given to house owners if structural damages occur as a direct result of project construction.
- The construction work will be limited to daytime as far as possible.

7.1.4.2 Operation Phase

No mitigation required during this phase.

7.1.5 Microclimate

7.1.5.1 Construction Phase

No mitigation required during this phase.

7.1.5.2 Operation Phase

No mitigation possibly required.

7.1.6 Downstream impacts

7.1.6.1 Construction Phase

No special mitigation measures will be provided for the downstream impacts during the construction

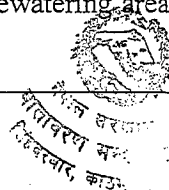
7.1.6.2 Operation Phase

The long-term mean monthly flow for the driest month of February at the intake site is $23.7 \text{ m}^3/\text{sec}$. As per the Hydropower Development Policy, 10% of this flow or the minimum required quantum as identified in the ELA (which ever is higher) has to be released. During the non-peak hours in the dry season, compensation flow equivalent to 10% of the minimum average flow of $2.4 \text{ m}^3/\text{s}$ will be released. Regarding the environmental flow, a new water policy was issued in 2005. However, it is not formulated in the appropriate laws and regulations. According to the New Policy, the required environmental flow is defined as 10% of the minimum monthly average flow in respective month. A comparison between the required environmental flow based on the EIA method and that proposed by the new Water Policy case is given in Table 7.1.

Table 7.1 Comparison of Unregulated and Regulated Flows in the Seti & Madi River

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

This shows that the Madi Khola with a mean monthly discharge of $14 \text{ m}^3/\text{sec}$. effectively mitigates the mainstream Seti River flows. The length of the dewatering area is only 2 km between the dam site and the confluence with the Madi River.



A warning system should be installed at the riverbank after the powerhouse to warn the people about peaking releases. The local residents should be educated about the functioning of the system.

Table 7.2 Mitigation Costs for the Downstream Effects to Communities

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

7.1.7 Sedimentation and River Morphology

The Seti River, which originates from the Annapurna Range contains a high sediment yield. In the feasibility study, the annual sediment load in the Seti river system has been calculated as about 6240 t/km² / year. Fluctuation of the reservoir may induce slides in those areas, which have steep slopes and contains loose cemented materials in areas like Bhimad Bazaar, Chore Patan and Wanten Khola and Badarkuna etc. The sediment will be fed abruptly to the reservoir when landslides occur in these areas due to bank erosion. Besides this, changes in land use practices in the upper catchment area may also contribute to the increased sediment yields over a longer term since the project has also cultivated and fragile areas. Therefore, to control sedimentation the following measures will be adopted:

7.1.7.1 Construction Phase

- Progressive rehabilitation of disturbed areas - as distinct parts of the project are completed they will be progressively rehabilitated.
- Installment of sediment controls - progressive installation of sediment basins and traps will be done.
- Control of run-off - installation of permanent and temporary drainage works early in the construction programme to collect and convey storm water will be done.
- Removal of topsoil from disturbed areas and stockpiles at identified suitable sites for later revegetation.

7.1.7.2 Operation phase

- Sediment control measures will be regularly maintained to an operable state.
- A laboratory to measure sediments regularly will be established near the project site.

7.1.8 Water Quality

7.1.8.1 Construction phase

- The waste generated from batching plants, truck washdown, run-offs will be diverted to the settling tanks before disposal.
- Berms will be made around the storage tanks to control spillage of oil into the ground.
- Used oils will be collected and stored in suitable storage tanks and disposed through incineration.
- Toilets and septic tanks in all camps will be provided (4 toilets per 100 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.

7.1.8.2 Operation phase

The quality of the water in the reservoir will change significantly. Provision will be made to release the compensation flow from the epilimnion layer (top layer). The oxygen content at the top layer will be more.

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

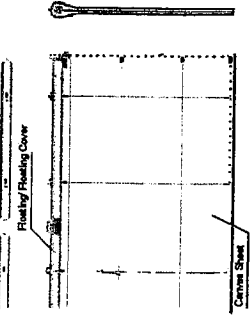
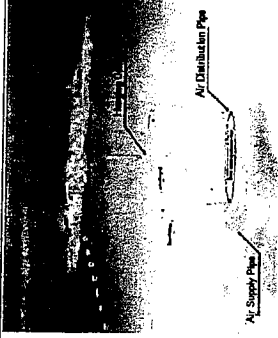
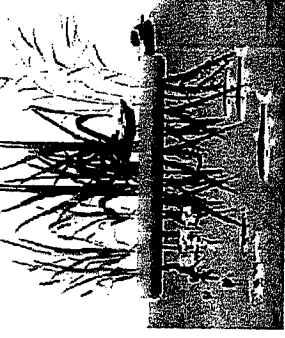
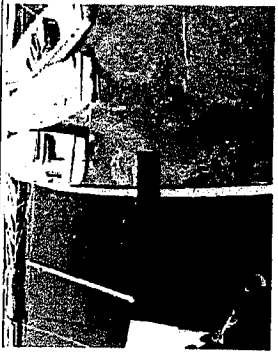
- Installation of a fraction fence;
- Installation of a aerator;
- Installation of vegetated floating inland; and
- Input minerals

Table 7.3 shows the comparison study for the above alternatives. As a result of the comparison study, it is proposed that the installation of the fraction fence is most attractive measures from the viewpoint of low cost and easy maintenance. This method has been introduced in some dams in Japan and its effectiveness is confirmed. The fraction fence is composed of impervious sheets to connect with a float. Its purpose is to lead the inflow of nutrients to the deep layer of the reservoir by changing the flow downward by fence. Consequently, it is expected to decrease the breeding

of the phytoplankton by controlling the photosynthesis. Especially, since the transparency of the Seti river is low, the fraction fence is expected to work effectively. Furthermore, it is expected to evacuate the nutrients with the daily generating operation by leading the water flow to the medium layer-providing intake of waterway.

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

Table 7.3 Comparison of the Measures for the Eutrophication in the Reservoir

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

7.1.9 Seismicity

7.1.9.1 Construction phase

No mitigation measures required

7.1.9.2 Operation phase

No mitigation measures required

7.1.10 Changes in Water Table

7.1.10.1 Construction phase

No mitigation measures required

7.1.10.1 Operation phase

No mitigation measures required

7.1.11 Spoil Handling and Disposal

7.1.11.1 Construction phase

In order to control potential erosion of the deposited spoil the following measures will be implemented. Spoil banks will be constructed along the banks of the Seti river.

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

7.1.11.2 Operation phase

- Spoil disposal sites will be rehabilitated progressively using suitable bio-engineering measures wherever feasible

7.2 Biological Environment

The biological environment of the project site will be directly affected through the removal of vegetation, creation of a reservoir and changes to river hydrology and by the influx of large construction workforce. However, an important consideration is that the lands to be directly acquired for project structures do not represent an unique habitat. That means the habitat in the

project impact area is generally common to the other regions of Nepal. The following mitigation measures are recommended to minimize the adverse impacts on the biological environment that may arise during construction and operation phases of the Upper Seti Storage Hydroelectric Project.

7.2.1 Vegetation

The mitigation measures for the affected forests and vegetation are mainly on the compensational planting and payment of indemnity for lost firewood and fodder resources. The measures are proposed for construction and operation phases respectively.

7.2.1.1 Construction Phase

a) Control of Illegal Felling

In order, to avoid the felling of the trees in the adjoining forest of the construction sites by inflow of the construction workforce and related activities, the following measures will be implemented:

- Prohibition on the use of firewood in the construction camps and labor camps for cooking purpose. The contractor will be have responsibility for the provision of the alternative fuel in the construction camps and labor camps. The contractor will provide kerosene and LPG in the construction and labor camps to reduce pressure on forest resources. Special instructions will be given to its workforce to refrain from collecting firewood and other forest products.
- Prohibition on the felling of the trees in the adjoining forest areas by the construction workforce. The contractor will be responsible for the management.

(b) Utilization of Forest Products

Forest products from government-managed forests will be utilized as per forestry regulations. Trees that are likely to be removed will be counted, marked and harvested with the proper forestry techniques by involving technical staff from the respective District Forest Office. Wood logs of felled trees will be transported to the nearest road head and stockpiled. The project will manage the stockpile until the District Forest Office auctions the timber.

The products from Community Forests, Leasehold Forest and private land recovered during site clearance will be handed over to the concerned owners. It is indicated that the actual volume of trees will be compensated for the Private Forest. However, the owners of such areas are permitted to log all the trees for timber, poles or fuelwood. In addition, the compensation is estimated based on the fuel wood volume and grazing land for the Community Forest, which is a more special case, as these are multiple used areas administered by local Forest User Groups (FUG). Most of the Community Forests are located in the Seti River at lower elevations, which would also be affected by the project. It is indicated that at least 9 Community Forests are affected to varying degrees involving some 900 members of FUGs at Full Supply Level of 415 m. Compensation for the fuelwoods and fodders will be done based on the norms regulated by the Department of

Forestry as shown in Table 7.4. Clearing costs of the forest area of the reservoir with FSL 415 m is presented in Table 7.4

7.2.1.2 Operation Phase

a) Replacement Plantation

As per the "Guideline for utilization of forest land and other land use" issued in 2006 by the Forest Department to regulate the ratio of lost to planted tree is 1:25. According to this, the total estimated number of trees affected is about 160,000 and the replacement trees required equals almost 4 million trees with Full Supply Level of 415 m. This quantity is likely to alter when the District Forest Office undertakes a more detailed survey of the actual areas affected and the types and volumes of trees to be compensated is undertaken at the district level.

The replacement plantation aims to restore the forest to its original and to maintain its economic value as well as biodiversity in the area. Accordingly, indigenous species are applied as a technical norm for the plantation. For example, the indigenous trees such as *Terminalia alata* (Saj) and fast growing species e.g. *Albizia cinensis* (Siris) will be planted to restore the Mixed Open Forest. *Schima wallichii* (Chilaune), *Bauhinia vahlii* (Bhorla) and *Desmodium oojeinense* (Sadan) will be planted for Hill Sal Forest, Khair/Sisoo forest, *Dalbergia sisoo* (Sisoo), *Acacia catechu* (Khair), *Bombax ceiba* (Simal), *Sapium insigne* (Khirro) will be planted for compensational plantation. The amount of trees to be planted, areas of plantation required, the costs, etc. are shown in Table 7.4.

Table 7.4 Cost for the Vegetation Clearance in the Reservoir at FSL 415m

S N	Management Types	Million NRs.
1.	National Forest (Protection Forest)	2.73
2.	Community Forest	0.93
3.	Private Forest	0.06
	Total	3.72

Note: The cost calculation is based on Forest Norms, 2003 for area delineation, resource accounting and clearing activities.

(b) Impact on Rare, Endangered and Threatened Plant Species

Gittha (*Dioscorea deltoidea*) of the Appendix II of the CITES categories is found in the project alignment. Similarly, Sal (*Shorea robusta*), Khair (*Acacia catechu*) and Simal (*Bombax ceiba*) found along the alignment has been banned for the transportation, export and felling for the commercial purposes under the Forest Act 1993, GoN. However, these species are found in other parts of the country. These species will be used for compensational plantation.

No permanent core colony of endangered and rare plants species is found in the project area.

c) Non-Timber Forest Products

Plants for Non-Timber Forest Products will also be used for compensational plantation in the project area

The compensation for the trees in the National Forest area is composed of the cost required for the plantation in accordance to the policy of the Department of Forests that the ratio of replacement of trees is 1:25. The volume of trees will be compensated for the Private Forest area. In addition, the compensation includes fuelwood volume and grazing land for the Community Forest area. The cost estimation above is summarized in Table 7.5.

Table 7.5 Estimate of Forestry Loss due to Reservoir at FSL 415 m and Associated Compensation

	Commercial Trees & Other Assets	Replacement at 1:25 Trees MOAF	Project Area Losses- ha (Area required for plantation 1:25, ha)	Reservoir Compensation NRs '000	Current Estimate Based on:
1. National Forest					
Timber - Tree Numbers	126,287	3,157,175	311.5 (717.5)	198,900	- NRs 280,000/ha of Replacement Trees as per average of NESS Supplementary EIA & Sindhuli Roads Construction Project (SRCP) Agreement with Department of Forestry (DoF)
Fuel Wood - m ³	-	-	-	-	
Fodder Resources - LU	-	-	-	-	
2. Community Forest					
Timber - Tree Numbers	33,025	825,625	105.6 (187.6)	52,014	- NRs 5,500/m ³ of timber (DoF Reg'n)
Timber Volume m ³	712	-	-	19,580	- NRs 2,650/ m ³ of fuel wood (DoF Reg'n)
Fuel Wood - m ³	469	-	-	6,214	- NRs 500 per Livestock Unit (LU)
Fodder Resources-LU	2,441	-	-	6,103	- There is a need to consider Fuelwood & Fodder Resources in Community Forests
					- Production loss for 5 years will be compensated.
3. Private Forest					
Timber - Tree Numbers	2,665	-	5.29	-	
Timber - Volume - m ³	623	-	-	3,427	
Fuel Wood - m ³	-	-	-	-	
4. Grass & Shrubland-LU	652	-	102.5	1,630	
5. Totals of All Lands					
Timber - Tree Numbers	161,967	3,982,800		250,914	
Timber - Volume - m ³	1,335	-		23,007	
Fuel Wood - m ³	469	-		6,214	
Fodder Resources - LU	3,093	-		7,733	
Total Forest Land Losses				287,868	
6. TOTAL FOREST LANDS			422.39 (905.1)		

7.2.2 Wildlife

7.2.2.1 Construction Phase

a) Loss of Habitat

Adverse environmental impacts on wildlife by the Project can be lessened if proper attention is paid to management. Vulnerable natural areas which support diverse wildlife will be carefully protected during the construction phase. To maintain the habitat of the wildlife, cutting and felling trees during the construction phase will be minimized. The workforce will be provided alternatives of kerosene rather than fuel wood so that alternative supplies save local forests which in turn protect wildlife. Local forest management including provision of the habitat protection activities will be implemented in associated with the local communities and Forest User Groups.

It is recommended to save endangered animals by a rescue operation using boats during the filling of the reservoir and relocate them to compatible ecosystem in nearby forests. The reptiles, particularly Asiatic Rock Python and Golden Monitor Lizard, may be found during clearing vegetation. As these are slow moving creatures, may be entrapped in the reservoir water and perish. The Project authority will seek assistance from the Department of Wildlife and National Parks in this regard.

The Project's labor force will be made conscious of the intrinsic value of wildlife. Due attention will be provided to protect rare and endangered species of the Project area.

b) Hunting and Poaching by the Labor Force

Hunting and trapping will be strongly prohibited by incorporating an appropriate clause in the Tender Documents (Contract Document) to ban hunting in the project area. The contractors will be advised to place information and warning signs at each construction site regarding the fauna. Common animals like mongoose, fox, jackal, squirrel and monkey will be protected by the local people, who will be encouraged through publicizing wildlife protection program. Furthermore, measures to control access to sensitive areas to avoid illegal hunting, poaching, fishing or illegal felling of trees need to be considered.

c) Environmental Awareness for Conservation (EAC)

Environmental Awareness for Conservation (EAC) is suggested to minimize the adverse impacts on local wild fauna. People need more awareness of the importance of fauna, conservation requirements and indirect impacts due to deforestation such as landslides and flooding. The project will facilitate the implementation of an EAC program with the help of local NGOs, CBOs, IUCN and other National organizations and possible partners for the program.

The labor force of the Project will be made conscious of the intrinsic value of wildlife. Due attention will be provided to protect rare and endangered species of the Project area. Hunting and trapping of wildlife will be restricted to traditional areas and poaching will be banned. Common animals like mongoose, fox, jackal, squirrel and monkey will be protected by the local people, through wildlife protection program.

Table 7.6 Mitigation Cost on Wildlife

Particulars	Total Cost Million NRs
Capture & Release of Wildlife including 2 Reptile Species	0.5

7.2.3 Aquatic and Fisheries

The following mitigation measures and enhancement programs are recommended to minimize the adverse impacts on fish and aquatic life that may arise during construction and operation phases of the Upper Seti Storage HEP.

7.2.3.1 Construction Phase

(a) Muck Disposal Plan

Spoil materials will be disposed at the proposed spoil disposal sites. Larger materials will be placed near the outside edge of the berm while finer phyllite materials will be placed in the inner areas. During the dry season when baseline turbidity is low, the river will be protected from any increase in suspended sediments. A detail muck disposal plan will be prepared throughout the construction period, and the spoil disposal at the proposed sites will be modified based on the monitoring results. Other options for spoil disposal sites as well as alternative uses of muck should be explored.

(b) Water Quality Protection Measures

Water quality protection measures will be applied during construction and operation phases. The construction contractor will develop a waste management plan, which details the use, storage and disposal of toxic, solid and sanitary wastes and materials. All batching plant wastewater and truck washdown will be diverted to a settling basin for treatment prior to discharge. The storage sites will be enclosed by dikes and storage areas will be lined to minimize potential surface and ground water pollution in the event of spills. Wastewater will be mixed into natural stream/river water before treatment. Used oils and lubricants will be collected regularly in drums/barrels or tanks to ensure safe disposal. Settling basins will be used to collect slurry for settling heavy particles and other materials, which can be recycled or incinerated.



7.2.3.2 Operation Phase

(a) Riparian Release

The methods available to assess the relative merits of the proposed riparian release are in 'Stream Flow Incremental Methodology' (IFIM Bovee 1982), the "Tenant Method" (1976), the 'NGRP Method' (Northern Great Plains Resource Program 1974) and the 'Wetted Perimeter Method' using outputs of HEC II simulations. In order 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 with modification adopted in the Kali Gandaki A HEP (EIA study). Flow conditions with different regulated flows are evaluated for different months.

The study indicates that with the release $2.4 \text{ m}^3/\text{s}$ of water the ecological condition of the river stretch between the intakes to the Madi Seti confluence will be minimum in January and April and fair from February to March. The riverine condition in July to August is optimum to outstanding due to the availability of higher flows than required for hydroelectric generation. The aquatic habitat in the month of October to December and May to June will severely be degraded and aquatic life will survive only in pool sections of the Seti river.

(b) Fish Trapping and Hauling Program

A fish trapping and trucking program will be done in conjunction with the hatchery for the Upper Seti Storage HEP. This program is well developed and refined in most dam projects in European countries. The program is under implementation in the Kali Gandaki "A" Hydroelectric Project as a pilot scheme. This is low cost locally available labor-intensive technology and can be easily implemented in any dam project of Nepal. The program includes collection of migratory species downstream and upstream of the dam during the migratory season and released into the river to facilitate up and downstream migration. This program is helpful for the collection of necessary brood stocks for the proposed hatchery. The Seti river provides suitable habitats for diverse species and breeding technology for most of the collected or reported species which are not available in Nepal. The fish trapping and hauling program will be suitable mitigation measures for such types of fish species.

As breeding technology for species like Cat fish and Jalkapur is not available in Nepal, trapping and hauling is proposed to minimize the impact on such species. The species will be collected from the downstream of the dam and will be released in the upstream of the reservoir so that they can enjoy the available upstream habitat.

(c) Trash Rack

There are a number of mitigation options practiced to minimize fish entrainment in the powerhouse turbine. Some of the practiced options, though feasible from the technical point of view are too costly such as vertical travelling screens, drum screens, inclined screens and

stationary screens, while some others are not technically feasible to be incorporated in the selected intake design such as collector channel screening and flushing. Some other options such as electrical fields, lights and acoustical systems are still in the testing phase and their effectiveness to deter fishes is still not soundly based. Besides, the change in physical conditions (turbidity, suspended solids) of water in the dry and wet season affects the efficiency of electrical and light systems. (Bell 1990).

The design engineer will visit and consult the existing storage project to collect practical experiences with operation/design staff of NEA to make the system most effective. This issue will be covered in the advance phase of the project.

(d) Enforcement of Aquatic Animal Protection Act

Fish aggregate in the intake and powerhouse will be susceptible to legal and illegal harvests. The project management will develop some enforcement mechanism in association with the local administration, local leaders and Fisheries Development Division, GoN and Nepal Fisheries Society (NEFIS) to ban illegal fishing in the project area.

(e) Fish Hatchery Development

The establishment of a fish hatchery is one of the most acceptable mitigation measures for dam projects on the native fish fauna. Hatcheries generally play an important role in fish conservation and reservoir fishery development in developing countries. In recent years their efficiency has been increased with better knowledge of the biological and reproductive requirements of fishes. In Nepal there are 3 commercial fish hatcheries namely Pokhara Fisheries Research Center, Trishuli Fisheries Research Center and Fattepur Fisheries Development Center. Recently a fish hatchery is under construction in the Kali Gandaki A Hydroelectric Project undertaken by Nepal Electricity Authority. The Kali Gandaki A hatchery aims to propagate Mahseer, Copper Mahseer, Snow trout and other indigenous species. A similar hatchery will be developed for USSHEP.

(f) Establishment of Hatchery

A hatchery generally plays an important role in fish conservation and reservoir fishery development. The stocking of fry of indigenous long distance and mid-range migratory species in the reservoir and upstream of the reservoir will replenish the natural population affected by the project. The fish hatchery will also compensate the unavoidable loss in the Seti river and its basin also.

The proposed hatchery will produce fish fry of migratory fish species as well as other declining fish species. Indigenous fishes will include mahseer (*Tor tor* and *Tor putitora*) copper mahseer (*Neolosocheilus hexagonolepis*), snow trouts (*Schizothoracichthys prokatus*, *Schizothorax richardsonii* and *Schizothorax plgiostomus*), minor carps (*Labeo deroi* and *Labeo angara*) and other economically important species. The hatchery development also includes breeding and

rearing facilities of exotic carps to promote aqua culture in the area and for reservoir fisheries development. The exotic species includes planktivores and herbivores carps such as silver carp (*Hypophthalmichthys molitris*), bighead carp (*Aristichthys nobilis*) and grass carp (*Ctenopharyngodon idella*). The proposed hatchery will be a small size raceway type structure so that it could be run by lifting the water from the Seti river. A deep tube well will also be a suitable option. The fry and fingerlings produced in the hatchery will be stocked in the reservoir and upstream of the reservoir. The hatchery will produce 2.5 million fry annually

(g) Strengthening of Kaligandaki 'A' Hatchery

This program is recommended as an alternate to a fish hatchery. It is proposed that the Kali Gandaki A hatchery would be expanded to cater for the fisheries mitigation measures as it was originally proposed for such purposes. The capacity of Kali Gandaki 'A' Project's fish hatchery can be readily doubled and production of native fry and fingerlings negotiated with the operator, who will be under contract to NEA.

The effectiveness of the applied measures may be varied in terms of success depending upon the local field conditions, expertise applied and behavior of the existing aquatic fish species. Any plans to provide for fish trapping and hauling or a fish ladder structure at the dam are both uneconomical and could in no way compensate for the impacts of the Project. It is proposed that proper and adequate provision of a fish hatchery is the most viable method. However, the implementation of the fish hatchery program needs the further detail study.

Initially on 3 locations the Seti river (downstream of Damauli), Phedi Khola (a reservoir tributary) and Madi Khola (just upstream of the quarry site) were examined for the fish hatchery facilities. The costs of a hatchery program for 5 years vary at these sites between NRs. 119.3 million and 129.8 million. From these results, the extension of the fish hatchery at Kaligandaki A Project is proposed as an attractive alternative for the Project. The Pokhara Fisheries Research Center at Pokhara can also be considered for the same purpose.

(h) Open Water Stocking Program

The open water stocking program is recommended to explore the reservoir potential and to minimize the impact on indigenous cold water fishes. The open water stocking in the reservoir will be conducted to utilize the potential of the reservoir as well as to mitigate fish loss. Due to thermal stratification in the reservoir different habitats will be available for an open water stocking program where different species can be introduced. The estimated area for open water stocking in the reservoir is 726 ha.

(i) Stocking in Upstream of Reservoir/ Riverine Condition

The open water stocking will be done to minimize the impact of the project on the native fauna. The open water stocking will include the indigenous current loving fish. The estimated area

(j) Cage fish Culture

Although the cost for the hatchery development and research would essentially be a part of the operation phase, the costs on this item will be disbursed at the start of the construction works and preparation of hatchery facilities and supplying of fish fry will be ready for the dam closure period.

Table 7.7 Mitigation Costs for Fisheries

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

Note: Cost breakdowns are based on local market price

7.3 Socio-economic and Cultural Environment

The following mitigation and enhancement measures have been proposed to ameliorate the possible negative impacts identified during the study and to enhance the positive impacts. The measures outlined at this time are intended to mitigate the potential adverse impacts of the project and enhance the positive impacts, which involve changes to the baseline conditions. It is

important to note that the detailed version of the Environmental Mitigation Plan is prepared and will be finalized at the Detailed Design Stage of project development. The proposed mitigation measures to mitigate adverse impacts have been described in Sub-chapter 7-3.1. Similarly, enhancement measures to enhance beneficial impacts have been described in Sub-chapter 7-4.

7.3.1 Acquisition of Land and Property

7.3.1.1 Construction Phase

The construction of the Upper Seti Storage Hydroelectric Project requires the permanent acquisition of 151.2 ha of cultivated land owned by 838 families and approximately 20 ha of temporary land acquisition. Out of 838 households, 86 will lose their residential houses due to the construction of the reservoir and project facilities sites. The proponent will provide appropriate compensation to all of the PAFs at the prevailing market price.

I) Compensation Policy for the Project

The Government of Nepal does not have a separate policy for dealing with the displacement and resettlement caused by the hydropower development projects, but implements the resettlement and rehabilitation program for the displaced people by formulating project specific policies to satisfy the needs of the respective donor agencies. The resettlement policies of Hydroelectric Projects, namely Kaligandaki A and Middle Marsyangdi have been examined in dealing with Resettlement and Compensation issues of Upper Seti Storage Hydroelectric Project.

The Land Acquisition Act 1977, Water Resource Act (1992) and Water Resource Regulation (1993) are the key legal documents that has been followed for the compensation procedures.

The following compensation policies will be followed for distributing compensation

a) The permanent loss of land (agricultural, residential, commercial and forestry)

- APs whose land (agricultural, residential, commercial and forestry) which will be acquired permanently for project main component (dam, powerhouse, tailrace, switch yards, reservoir inundation area etc.) and facility sites (access roads, batching yards, camps, spoil disposal yards etc.), the land will be paid at replacement rate based on the valuation of lands by the Compensation Fixation Committee (CFC). Such land parcel registration will be transferred to the developer.
- If the remaining land parcel after permanent acquisition is too small and the APs does not own adjoining plot and is willing to dispose the land, the entire plot will be acquired at the replacement cost.
- Landowners of the risk zone that is a 10 m vertical distance from the FSL will be compensated in cash at the replacement cost as per NEA's practices. The CFC in consultation with local government and APs shall decide the replacement cost of the land.

- Landowners of the permanently acquired land in three Risk Zones, namely Wantang Khola, Phedi Khola, and Tittuwa will be compensated in cash at the replacement cost. The CFC in consultation with local government and APs will decide the replacement costs of the land.

b) The loss of crop/plants/trees

- Crops that will be damaged during project construction shall be compensated to APs based on the current fair market value determined by District Forest Office, District Agriculture Office or other government agencies to the maximum of one year production.

c) The loss of houses and other structures including utility facilities

- Houses and other structures including utility facilities (electricity, telephone, water supply, toilets, bio-gas plants etc.) shall be compensated based on their replacement cost which is the cost of materials and labor in the locality or as evaluated by the district norms at the time of relocation. No depreciation will be applied. Additionally, the associated land plots of the houses shall be provided as Middle Marsyangdi Hydroelectric Project did. The house owners/structure owners shall be responsible for dismantling the affected house/structure and shall own salvageable materials.

d) The loss of community facilities and resources

- The project affected community facilities (such as temples, irrigation canals, footbridges, graves and ghats (a ghat is a Hindu cremation place which is a small and open platform-like structure at river bank) will be compensated at replacement cost or restored to their previous condition or replaced in areas identified in consultation with affected communities and the relevant authorities.
- The standing stock of forest products in the Community Forests will be the property of the Community Forest User Groups or will be according to the prevailing laws.
- The compensation for the resources such as Community Forests and religious forests, grass land or shrub land will be included the loss of fuel wood volumes and grazing lands.

e) The loss of government property

- Government infrastructure and facilities including utilities affected by the project will be repaired or replaced or compensated at replacement costs in consultation with the relevant departmental authorities.
- Government forest areas will be acquired in consultation with the Department of Forestry and any trees therein will be the property of Department of Forest as per the prevailing laws.

f) Grant of disturbance compensation

- Disturbance compensation equivalent to the daily minimum wage for one person in the project-affected area multiplied by 180 days will be compensated as disturbance compensation to the affected households. This grant will be used to defray the affected household's daily

expenses while adjusting to their new environment.

g) *Transportation allowance to displaced households and owners of the affected community structures*

- For APs of acquired house structure and owners of affected community structure, an additional transport allowance of NRs. 18,000¹ as a grant will be paid to cover the transportation of the salvaged materials.

h) *Land Plot Grants to Relocatee*

- For APs, whose residential house structure is acquired by the project and has to relocate his residential location, will be granted a land plot as a gift plot close to the existing residential area if available. Since there are no appropriate large resettlement sites within or near the project affected areas, the relocatee will be provided an amount equivalent to the gift land area rather than the land plot in consultation with them irrespective of the relocatee's affected residential land size². The gift plot equivalent to one Ropani land (508m²) is proposed based on the experience of Middle Marsyangdi Hydroelectric Project.

i) *Compensation for business losses*

- Compensation for business losses in amount up to NRs 30000 will be paid or based on daily income whichever is lower, as reflected on income tax return multiplied by the number of days of business stoppage due to the project. However, it should not exceed 90 days.

j) *House Rental Allowances*

- House rental compensation @ rate of NRs. 200/day for 180 days will be compensated to the affected households. This grant will be used to rent the house close to the new construction site of the house.

Based on the discussions with the local people, observations at the site and from the conclusions made by the environmental team, compensation will be provided using two methods, namely:

- Cash Compensation; and
- Land-for-Land and House-for-House Compensation.

I. *Cash Compensation*

The appropriate method of compensation in rural Nepal is the land-for-land and house-for-house compensation for the affected households from past experiences of similar projects. However, due to land scarcity and steep terrain in and around the project impact area, it is difficult to find appropriate agricultural land. In addition, it is not feasible to provide land-for-land compensation

■ 1 The rate of transportation allowance was set based on the rate taken by Middle Marsyangdi Hydroelectric Project in consideration with price boost.

in another location for those HHs who lose only a certain percent of agricultural land around the vicinity of the project area. This method will encounter numerous hurdles in the implementation phase and maintaining fairness is very difficult which may raise disputes among the affected families and project management such that the construction process will be delayed. Therefore, cash compensation will be the best option for those HHs who lose certain portions of their land holdings only. One-time compensation is suitable for HHs who lose only small portions of their land holdings. One-time compensation is not appropriate for people losing houses, as they do not tend to last very long and after a short and pleasant period, those compensated easily find themselves in difficult situations. The people tend to use the cash in unproductive way.

According to the GoN laws and regulations, it is mandatory to provide cash compensation for the acquired land and property. Compensations paid and settled immediately after acquisition are administratively much simpler and economically cheaper than those that last over a long period. The authorities of the project also prefer the aforementioned procedure under normal circumstances. According to those receiving compensation they have a series of inconveniences. One-time compensations are agreeable when they are received, but for various reasons, they do not tend to last very long and after a short and pleasant period, those compensated easily find themselves in difficult situations.

Direct cash compensation is appropriate for households that lose only a small portion of their land holdings, or to households that have other forms of income generation schemes they wish to invest in.

II. Land-for-Land and House-for-House Compensation

In this particular project, the number of households to be relocated due to the construction of the project is 86. Out of those 86 HHs, 40 HHs will be displaced due to the construction of the reservoir and the remaining 46 HHs will be displaced due to the construction of project facilities such as access road, base camp and spoil disposal sites. The HHs in the reservoir area will lose their land and residential houses. However, the remaining 46 HHs will lose their residential houses and some portion of their cultivated land only. Thus, the former 40 HHs residing at the reservoir area need a detailed resettlement and rehabilitation package at the appropriate location around the project vicinity on land-for-land and house-for-house basis and the remaining households need nearby resettlement of their present settlement such that these HHs can cultivate their remaining agricultural land without any trouble or difficulties. For HHs losing house and larger portion of land multiple-time compensation is proposed. With this mode of compensation the people losing their house and being resettled will benefit as the compensated amount will be properly utilized.

The resettlement activities to be pursued by of the project will be guided by the following basic policies:

- Land acquisition and involuntary resettlement shall be avoided where feasible or minimized

to the extent possible through the incorporation of social considerations into project design options.

- Where population displacement is unavoidable, individuals, households and community losing assets, livelihood and other resources shall be informed and consulted
- Affected Persons (APs) shall be compensated at replacement costs for all losses and damaged assets. The absence of legal titles to lands, property, and facilities shall not be a bar to compensation.
- APs shall be fully compensated and resettled before their houses are demolished and their land and facilities are acquired.
- A resettlement plan shall be prepared and consulted with APs in advance of the implementation of the project
- The resettlement plan implementation shall be monitored
- The resettlement shall be executed as part of the development project.
- After RP implementation, the economic and social conditions of the APs should be improved or at least maintained.

The detailed resettlement plan for the relocated households is given in Appendix F.

Cost Estimates for Compensation and Benefits of Affected Persons/Households. The cost estimates for the proposed compensation and benefits of affected persons/households are summarized below.

Table 7.8 Cost Summary (In Million of Rs.)

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

Note

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

7.3.2 Affected Infrastructure**7.3.2.1 Construction Phase**

The construction of the Upper Seti Storage Hydroelectric Project will inundate 2 gravelled motorable roads, 6 suspension bridges, 20 foot trails, 1 irrigation channel and 2 electricity distribution lines. In addition, the construction and operation of the project will have impacts on 7 community structures such as resting places, temple and cremation places. The project proponent will construct these infrastructures and community structures at the appropriate location in coordination with the local users and local governmental bodies such as the District Development Committee (DDC) and Distribution Consumers Service (DCS) of Nepal Electricity Authority, etc before the construction of the project.

7.3.2.2 Operation Phase

No mitigation required.

7.3.3 Water Supply, Sanitation and Health**7.3.3.1 Construction Phase**

Due to the construction activities, the existing water supply system may be damaged and sources of supply may be disturbed. In addition, due to the influx of approximately 2500 workers in this small settlement area, the pressure on the existing water supply, health and sanitation system will increase. Thus, to mitigate these problems, a systematic and adequate water supply system will be



developed in co-ordination with the local community. While doing so, community participation will be sought.

A joint program on health and sanitation will be launched in association with the existing NGOs and INGO and other local communities during the construction phase. In addition, health posts will be strengthened in association with the District Public Health Office. Prior to this, certain medical facilities will be provided by the project health centers.

Implement community health and sanitation programmes and campaigns as follows:

- A separate water supply system will be provided in the construction camps.
- Toilet facilities will be provided to the construction workers. (1 toilet for every 15 labourers)
- Improvement and assistance will be given to the existing local health care facilities.
- Family planning education programmes will be provided.
- Health check-up for workers and documentation of health status will be regularly done
- Health care facilities at the camps with sufficient labor and medicines to cater for the control of an epidemic outbreak will be provided
- Awareness programmes against girl trafficking and STDs such as HIV/AIDS will be given.
- Free condoms to workforce and local villagers will be provided

7.3.3.2 Operation Phase

No mitigation measures are required during this phase.

7.3.4 Safety and Occupational Health

During the construction and operation phases the possibility of occupational health and safety hazards will be increased. The contractor and the proponent will arrange community awareness programmes in collaboration with the local NGOs and communities to mitigate such types of potential hazards.

Together with this, the following mitigation measures will be implemented to minimize the impacts.

7.3.4.1 Construction Phase

- Warning systems in the blasting sites, and key project sites in case of unprecedented hazards will be provided.
- Safety kits such as mufflers, helmets, gloves, boots etc. will be provided to the construction workers with strict instruction to use them during the construction.
- Occupational health program and clinical health services will be implemented
- Fencing of high-risk construction sites and provision of signboards to prevent accidents will be done.
- Entrance into the hazardous areas will be prohibited.

- First aid kits at each working sites will be provided.
- Fire fighting gear at vulnerable areas and training to the involved workers on fire fighting will be provided.

7.3.4.2 Operation Phase

- Warning systems in the downstream area about water level fluctuations during the operation period of the project will be provided.

7.3.5 Vulnerable Groups

7.3.5.1 Construction Phase

Women will benefit from the project activities and get equal opportunities for job in the project. Therefore, special steps while implementing mitigation measures will be taken:

- Employment for women from the project affected areas will be encouraged.
- It will be ensured that the employment regulations do not conflict with the Nepalese laws and international regulations and conventions signed by Nepal.
- It will be ensured that salaries, job facilities, incentives to women are at the same level as men.
- Awareness and information campaigns for encouraging women's participation in the project regarding recruitment procedures, level of wages and type of work will be carried out.
- Supervision and action will be taken against girl trafficking in the area.
- It will be ensured that no children under the age of 16 are employed in the project.
- Child Concern Program in the affected area will be supported.
- Men from occupational castes identified about the baseline study will get priority for the employment.

7.3.5.2 Operation Phase

No mitigation measures are required during this phase.

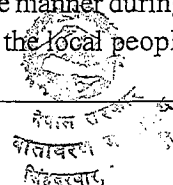
7.3.6 Inflow of Workers

Due to the influx of a large workforce during the construction phase, there may be a conflict of interest among workers and the local people. This may create disputes and cause tensions at the project site. The following mitigation measures are recommended to mitigate these impacts.

7.3.6.1 Construction Phase

The following mitigation measures are proposed at this phase:

- TVs and Radios, etc. will be provided at camp sites.
- Special instruction to workers will be given to act in a responsible manner during and after working hours, respecting the rights, properties and practices of the local people.



- Prohibition will be made on all workers to live outside the construction camps.
- Prohibition will be made on the use of alcohol and gambling in the project worksites, camps and nearby villages.
- Prohibition on the movement of labourers in the villages after 7 PM will be made .
- Provision of adequate security (police patrolling) in the construction affected areas and settlements will be made.

7.3.6.2 Operation Phase

Trainings to maximize the skills of the local people to hold permanent jobs with the project will be initiated to minimize the tensions between the permanent staff and local communities. Priority will be given to women and members of the directly affected households.

7.3.7 Downstream Effect

7.3.7.1 Construction Phase

- In the further stage of the project, topographic survey in the downstream river course and detailed hydraulic examination such as increased speed of the downstream water level in water discharge for power generation will be conducted.
- During construction phase the rafting company will be notified of the construction schedule and the danger sites.
- The horizontal seismic coefficient for the design of high dam of Upper Seti project has been taken as 0.15 as a mitigation measures for seismic risk
- An evacuation plan for the settlement downstream of the dam will be made during the detailed design phase .

7.3.7.2 Operation Phase

During operation following measures will be adopted:

- A siren system will be installed in the section between dam site and tailrace. The siren system will be installed, at least, at 2 sites in the vicinity of confluence of the Madi River. The sound of siren reaches area within 500 m radius from the siren.
- Information board will be provided to make people aware of the danger area.
- Information dissemination and public awareness campaign for rafting operators and participants by some modes such as brochure and newspaper should be arranged
- Patrolling activity will also be provided
- Danger area and safe period and river stretch for rafting have to be determined in further stage of the project.

7.4 Enhancement Measures

In general, due to the implementation of the project, the region will experience positive impacts. However, to promote equity and justice during the utilization of benefits, the following will be considered:

7.4.1 Construction Phase

- Funds and technical support will be provided for capacity building of the affected VDCs, DDCs and community-based organizations
- Mechanism to resolve inter- and intra-district conflicts will be instituted regarding matters of jobs, market opportunities, and licenses for small scale industries.

7.4.2 Operation Phase

- Rural electrification will be prioritized on the basis of proximity to the project impact area.
- Formulation and implementation of transparent rules and regulations will be done to expedite an equitable intra-district distribution of royalties. VDCs most affected by the hydroelectric project will receive a fair share of the benefits from the project.
- There will be accountability on the part of the national government, the DDC and the VDCs regarding the expenditure of royalties. Regular auditing and monitoring of impacts of royalties on growth, social equity and environmental justice will be done

The total estimated cost for mitigation measures recommended in this chapter is summarized in Table 7.9.

Table 7.9: Mitigation Cost

S.No.	Items	Cost in Million NRs.	Ref
1	Physical Environment	3.8	Table 7.2
2	Vegetation Clearing	3.7	Table 7.4
3	Compensatory Plantation	287.9	Table 7.5
4	Wildlife	0.5	Table 7.6
5	Fishery	76.5	Table 7.7
6	Social	1081.4	Table 7.8
Total		1453.8	-

7.5 Enhancement Measures

The construction of the Upper Seti Storage Hydroelectric project will provide the local communities and the region itself with numerous opportunities for socio-economic development. Although the project is located near the National Highway exposed to development, nevertheless it is envisaged that the interior rural area will benefit immensely from project implementation. While direct and indirect job creation may be considered the primary benefit, there are nevertheless a range of opportunities which will open to government, private sector and the local communities to both build upon, and enhance positive impacts of the project. Some of the enhancement measures from the area which will benefit are designed in Social Action Plan given in Appendix G. Summary of the estimated cost for SAP is given in Table 7.10.

Table 7.10: Cost Summary for SAP

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

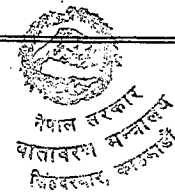
Note: The above cost estimates are based on lump sum from the experience of Middle Marsyangdi Hydroelectric Project.



Table 7.11 Matrix of Environmental Impact Mitigation Measures

Potential impact	Magnitude	Duration	Extent	Mitigation measures		Agency to be Consulted
				Action		
Physical Environment						
<u>Watershed condition</u>						
Possibility of Soil erosion and landslides	H	ST	L	Proper disposal of muck, construction of retaining structures, minimization of land clearance		MOFSC, DDC, VDC
Change in existing drainage system	M	ST	L	Minimize natural slope disturbance		MOFSC, DDC, VDC
<u>Landuse and landtake</u>						
Acquisition of land (650 Ha)	H	LT	L	Appropriate compensation, reclaim and maintain the land using overburden soil and vegetation work		MoEnv, MoE, VDC, DDC
Change in landuse	H	LT	L	Reclaim and maintain the land using overburden soil and vegetation work, minimize landtake		MoEnv, MoE, VDC, DDC
<u>Microclimate</u>						
Increase in humidity in the vicinity of the headworks site, possibility of fog in the morning	L	LT	L	No mitigation measures		
<u>Airquality</u>						
Airpollution due to construction activities	M	ST	SS	Construction activities to be done during the day time, spraying of construction area with water etc.		MoEnv, MoE
<u>Noise and Vibration</u>						
Disturbances to the local people	M	ST	SS	Construction activities to be done during the day time, fencing of construction sites, etc.		MoEnv, MoE,
Impact on the existing houses and structures due to vibration	M	ST	SS	Compensation to the people in case of development of cracks etc, blasting to be in done using detonator in small quantities, phases		MoEnv, VDC, DDC
<u>Hydrology and Morphology</u>						
Change in flow downstream	M	LT	L	Compensation release of 2.4 m ³ /sec, control of boulder collection from riverbed		MoEnv, MoE
Fluctuation of discharge downstream	H	LT	L	Warning systems and sign boards informing the local people about the danger		VDC, MoE, MoEnv
<u>Water Table</u>						
Change in water table	L	LT	R	no mitigation measures		MoE/MoEnv
<u>Water Quality</u>						
Increase in turbidity and sediment content	H	ST	L	Preventing dumping of muck into the river etc		MoEnv, MoE
Detioration of water quality due to spillage of oils, paints, cement slurry, fecal coliform	M	ST	L	Proper handling of oils etc and good house keeping, restriction of open defecation.		MoEnv, MoE
<u>Impact due to muck Disposal, stock piling and quarrying activities</u>						
Increase in turbidity and sediment content in the river due to erroneous dumping	M	ST	L	Disposal at appropriate places with proper slopes; bioengineering works; slope stabilization works at quarry areas, bio-engineering works		MoEnv, MOFSC
Possibility of land erosion and landslides	M	ST	SS	Proper Planning of dumping areas, provision of retaining structures for slope stabilisation		MOFSC
Change in river course in case of excessive quarrying from river banks	M	ST	SS	Avoid excessive quarrying especially from river beds and banks		MoEnv, MoE, MoFSC

Construction phase		Potential impact	Magnitude	Duration	Extent	Mitigation measures	Agency to be Consulted
Biological Environment							
Construction phase	Loss of forest resources	H	LT	L	Compensatory plantation and improved forest management	DOF, DFO, CFUG	
	Loss of 422 ha forestland	L	LT	SS	Afforestation programmes	DOF, DFO, CFUG	
	Loss of habitat	L	LT	SS	Protection of rare and endangered species	DOF, DFO, CFUG	
	Pressure on existing forest resources due to the influx of workforce						
	Felling of Trees for fuel wood	M	ST	L	Supply of alternate energy source like LPG and Kerosene	MOST, DOF, MOS	
	Disturbance to wildlife and wildlife habitat	L	ST	SS	Control of illegal hunting and poaching	MOFSC, MoEnv	
	Illegal poaching of wildlife	M	LT	L	Compensatory plantation	MOFSC, MoEnv	
	Habitat loss						
	Impact on Aquatic flora	H	LT	L	Riparian release of 2.4 m3/s; Releasing of fish fingerlings at the upstream	MoEnv	
	Reduction in fish number						
Loss in Habitat	H	LT	L	No mitigation measures	MoEnv		
Socio-economic and Cultural Environment							
Construction phase	Project Affected Households						
	86 families to be relocated	H	LT	L	Adequate compensation, Resettlement plan to be made prior to relocation	VDC, MoE, MoEnv	
	Approximately 838+C24 families affected due to landslide	H	LT	L	Adequate Compensation and according to the agreed procedures/rates	VDC, DDC, MoEnv	
	Loss of arable land (agricultural production) 660 metric tonnes/year						
	Loss of yield, impact on the economic status of the local people	H	LT	L	Yield and production support activities; loan support and income generation activities, training	VDC, DDC, MoEnv, MoA	
	Impact on the cultural practices						
	Disruption of cremation sites	M	LT	L	Rehabilitation and construction of affected cremation sites	VDC	
	Disruption of the traditional way of living	M	ST	L	Awareness programmes	VDC, DDC	
	Impact on Disadvantaged Groups of People						
	Work burden on women , child labour	M	ST	L	Ensure no children employed by project, ensure suitable works for the women	VDC, DDC, MoEnv	
	Impact on Community Services and Institutions						
	Pressure on the existing infrastructures due to influx of workers	H	ST	SS	Development of adequate infrastructure, establishment of subsidized work	VDC, DDC, MoEnv	
	Social instability and conflict	L	ST	SS	Increase in Police security	VDC, DDC	
	Impact on health and sanitation						
	Increase in HIV and other diseases	M	ST	L	Public awareness programme, free distribution of condoms, providing health facilities, water supply	VDC, DDC, MOH	
Impact on Safety							
Possibility in work related injuries, Vehicle accidents etc	M	ST	SS	Warning Systems, Sign Boards, fire fighting gears, safety training for workers, safety awareness programs	MoEnv		

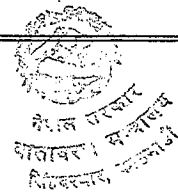


Environmental Impact Assessment

Potential impact	Magnitude	Duration	Extent	Mitigation measures	Agency to be Consulted
<u>Construction Labour Force Impact</u>					
Increase in incidence of diseases, increase in prostitution, increase in gambling, law and order	M	ST	L	Provision of social infrastructures and facilities, clean sanitation program, awareness training, Prohibition of gambling and alcoholism.	VDC, DDC, MoEnv
<u>Impact on tourism</u>					
Disturbances to tourist visiting the Vyas Caves	L	ST	L	Inform the tourist about the construction activities using sign boards and notices in critical areas	VDC, DDC
Impact on the white water rafting	M	ST	R	Warning systems to inform the tourist about the construction activities	VDC, DDC
Impact on Local Economy and People's behavior due to increase in Economic Activities	H	ST	L	Job opportunities for local people, training program, provision for market	VDC, DDC
Impact on religious Historical and Archeological Sites	M	ST	SS	Protection of the religious sites, co-ordination with local bodies for protection work	VDC, DDC
<u>Existing wateruse rights and Downstream Release</u>					
No existing water uses from the river	L	LT	L	Compensation release of 2.4 m ³ /s	VDC, DDC, MoE
Physical Environment					
<u>Watershed condition</u>					
<u>Shoreline erosion</u>					
Possibility of Soil erosion and landslides	H	LT	L	Protection works and bio-engineering programmes in critical areas, periodic inspection of the watershed and shoreline	MoE, MoEnv, VDC, DDC
Change in existing drainage system	L	ST	L	Afforestation programmes in critical areas, periodic inspection of the watershed	MOFSC, DDC, VDC
<u>Landuse and landtake</u>					
Acquisition of land 650 ha	L	LT	L	Proper inspection and maintenance of road slopes to reduce the changes in existing drainage system	MOFSC, VDC
Change in landuse	L	LT	L	The temporary land to be returned back to its owners	MoE, MoEnv, VDC, DDC
<u>Microclimate</u>					
Increase in humidity in the vicinity of the reservoir and possibility of fog in the morning	M	LT	L	No mitigation required	
<u>Airquality</u>					
Airpollution due to construction activities	L	ST	SS	No mitigation required	MoEnv, MoE, DDC, VDC
<u>Noise and Vibration</u>					
Disturbances to the local people	L	ST	SS	No mitigation required	MoEnv, MoE, DDC, VDC
Impact on the existing houses and structures due to vibration	L	ST	SS	No mitigation required	
<u>Hydrology and Morphology</u>					
Change in flow downstream	M	LT	L	Compensation release of 2.4 m ³ /sec. control of boulders collection from riverbed.	MoE, MoEnv
Fluctuation of discharge downstream	H	LT	L	Warning systems and sign boards informing the local people about the danger	MoEnv, MOFSC, DOR

Potential impact	Magnitude	Duration	Extent	Mitigation measures Action	Agency to be Consulted
Water Quality					
Deterioration of water quality in the reservoir (depletion of oxygen)	H	LT	L	No mitigation required	MoEnv, MoE
Impact due to <u>muck Disposal, stock piling and quarrying activities</u>					
Increase in turbidity and sediment content in the river due to erroneous dumping	L	ST	L	Bio-engineering works to be continued in the dumping areas	MoEnv, MOFSC
Possibility of land erosion and landslides	L	ST	SS	Bio-engineering works to be continued in the dumping areas	MOFSC
Change in river course in case of excessive quarrying from river banks	L	ST	SS	No mitigation required	MoEnv
Biological Environment					
Loss of forest resources					
Loss of 422 ha of forest	L	LT	SS	Continuation of Afforestation programmes	MOFSC, CFUGs
Loss of rare and endangered species	L	LT	SS	No mitigation required	
Pressure on existing forest resources due to the influx of workforce					
Felling of Trees	L	ST	L	No mitigation required	MOFSC, CFUGs
Disturbance to wildlife and wildlife habitat					
Illegal poaching of wildlife	L	ST	SS	Control of illegal hunting and poaching	DNPWC
Habitat loss	L	LT	L	Forest Management Support	DF0, CFUG
Impact on Aquatic flora					
Reduction in fish number	M	LT	L	Riparian release of 2.4 m3/s; Releasing of fish fingerlings at the upstream, stocking of fish in the reservoir	MoE, VDC, MoEnv
Loss in Habitat	M	LT	L	Release of fish fingerlings especially in the downstream region	
Socio-economic and Cultural Environment					
Project Affected Households					
86 families to be relocated	L	LT	SS	Continue monitoring of the economic status of relocatees	VDC, DDC
Approximately 838 C29 families affected due to landtake	L	LT	L	Temporary land acquired during the construction phase will be returned	VDC, DDC, MoEnv
Loss of arable land (agricultural production) 660 tones/year					
Loss of yield, impact on the economic status of the local people	L	LT	L	No mitigation measures	VDC, DDC, DoA
Impact on the cultural practices					
Disruption of the traditional way of living	L	ST	L	No mitigation measures required	VDC, DDC
Impact on Disadvantaged Groups of People					
Work burden on women, child labour	L	ST	L	No mitigation measures	VDC, DDC, MoEnv
Impact on Community Services and Institutions					
Pressure on the existing infrastructures due to influx of workers	L	ST	SS	No mitigation measures	VDC, DDC, MoEnv
Social instability	L	ST	SS	No mitigation measures	

Operation Phase



Potential impact	Magnitude	Duration	Extent	Mitigation measures Action	Agency to be Consulted
Impact on health and sanitation Increase in HIV and other diseases Impact on Safety	L	LT	L	No mitigation required	VDC, DDC, MoH
Fluctuation of flow from the tailrace outlet Sudden release of water downstream of dam Impact on Law and order	M M	LT LT	L SS	Warning systems, Sign Boards Warning Systems, Sign Boards	VDC, DDC VDC, DDC
Increase in incidence of diseases, increase in prostitution, increase in gambling, law and order Impact on tourism	L	ST	L	No mitigation required	VDC, DDC
Disturbances to tourist visiting the Vyas cave Impact on the white water rafting	L	LT	L	No mitigation required	
Impact on Local Economy and People's behavior due to increase in Economic Activities Impact on religious Historical and Archeological Sites	H L	LT ST	R L	No possibility of rafting within 10 km downstream of the powerhouse, siren system Job opportunities for local people, training program etc	VDC, DDC
Existing water use rights and Downstream Release No existing water uses from the river	L	ST	SS	No mitigation required	VDC, DDC
	L	LT	L	Compensation release of 2.4 m ³ /s for the riparian ecosystem	VDC, DDC, MoE

Magnitude H-High, M-Moderate, L-Low
Duration LT-Long Term, ST-Short Term
Extent SS- Site Specific, L-Local, R-Regional

CHAPTER EIGHT

PUBLIC CONSULTATION

8.0 Introduction

This section discusses and outlines the consultation plan for the project. It also gives all the Government and the public consultations that have taken place during the course of the EIA study.

The involvement of the public from the conceptual stage of the project is essential for the success of any development activities. The National EIA Guidelines states that community participation or public involvement is one of the main parameters for the success of any development project. The EPR 1997 also make mandatory of holding one Public Hearing in one of the affected Village Development Committee or the Municipality.

As per EPR 1997, public involvement is mandatory during the Scoping for EIA study of the hydroelectric project. The EPR 1997 specifies that "In regards to any proposal requiring EIA, the proponent shall publish a notice in any national level daily newspaper, enquiring the VDC or Municipality where the proposal is to be implemented, as well as the schools, hospitals, health posts and concerned individuals or institutions of that area to put forward in writing their suggestions concerning the possible impact of the implementation of the proposals on the environment within a 15 day time period". It further states after the publication of the notice, "anyone who wishes to offer his opinion and suggestion in that connection may offer his opinion and suggestions to the concerned proponent within 15 days from the date of publication of such notice..." The objective of this is to inform the public of proposed project development and provide a reasonable time to gather their concerns, comments suggestions and recommendations concerning potential project impacts.

During the Upgrading Feasibility Study, the JICA Study Team involved the local public in additional field investigation. The JICA Guidelines stipulates that a series of stakeholders meetings need to be held 3 times during the Feasibility Study by the recipient Government with the assistance of JICA in order to classify the proposed project as Category A that has significant adverse impacts on the environment and society. Thus, 3 Stakeholder Meetings were held by NEA with the assistance of the JICA Study Team

Public Participation in the Upper Seti Storage Hydroelectric Project was organized in the following ways:

8.1 Approaches for Public Involvement

8.1.1 Public Consultation during the Scoping Phase

A Public Notice was published in the National Daily Newspaper "Gorkhapatra" on 4th February 2001 for the Scoping study. The main objectives of the notice were:

- to inform the public about the project itself and the VDCs/ Municipality to be affected
- to request the concerned people, organization, NGOs and VDCs/Municipality to send comments and suggestions regarding the project.

After the publication of the notice, the environmental team visited the project site for the Scoping exercise. There was less response in the written form from the local people about the project. The suggestions, comments and information received from all the affected people, organizations, NGOs and VDCs/ Municipality offices during the Scoping phase have been incorporated while preparing the report.

Some suggestions from the local people received during the Scoping Phase:

- ✦ Appropriate fishery program for the affected fishermen families,
- ✦ Minimisation of soil erosion and landslides,
- ✦ Rural electrification
- ✦ Training for local people and project employment
- ✦ Skills development training to the affected people
- ✦ Use of reservoir for tourism such as motor boats
- ✦ Compensation at locally prevailing market price, and
- ✦ People's locally elected representatives to be included in the compensation process and Compensation Fixation Committee.

8.1.2 Public Hearing Conducted by NEA

The primary objective of the Public Hearing held on January 25, 2004 at Vyas (Damauli) Municipality, Tanahun was to inform the public about the project and collect feedback, public concerns and views.

Advance notification about Public Hearing in the National Daily Newspaper.

A fifteen-day notification was made in the National Daily "Gorkhapatra", requesting the VDC/Municipality as well as schools, hospitals, health posts and concerned individuals or institution of the project area, to suggest in written form the possible impacts on the environment due to the implementation of the proposal. Invitation letters were also sent to the concerned VDCs, relevant personalities of DDC, political leaders and senior government officials of the concerned Ministry.

Besides these, interaction with the project affected people and local residents in their respective village were carried out prior to the Public Hearing. The objective of such an interaction was to inform them on time about the hearing and request them to participate in it.

Brochure Publication and distribution

The EIA major findings, in the form of booklets in Nepali language were circulated before the meeting. The brochure was simple and easily comprehensible by the local people. It

consisted of description of the project, impacts of the project and mitigation measures for the same.

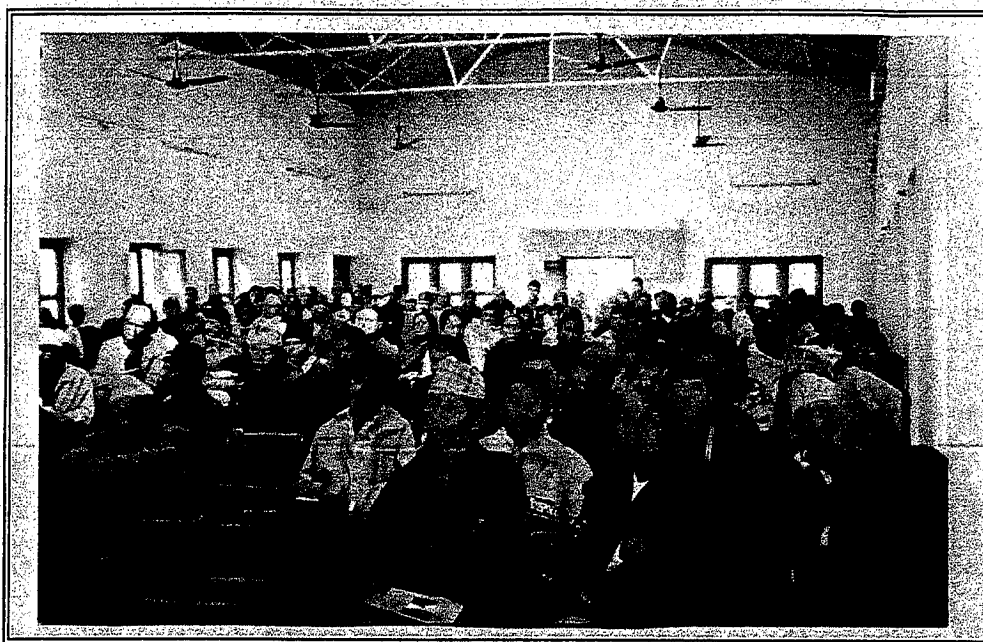
The project brochure written in Nepali, not only provided information about the project, but also included information with regard to the planning process and major EIA issues, mitigation measures, monitoring process and environmental enhancement measures etc.

Exhibition of layout and photos

At the hearing various project, related layouts and photos were displayed for the participants.

8.1.2.1 Public Hearing on 25 January 2004

As per EPR 1997, in order to disseminate the information and to interact with the local people and their representatives about the project, a Public Hearing meeting about the EIA process was held on 25 January 2004 at the meeting hall of the District Development Committee, Tanahu. More than 200 people participated in the hearing. A brief project brochure in Nepali was distributed to the participants. This Public Hearing also helped people to find out whether the issues considered during the Scoping Phase were incorporated in the EIA process.



Participants of the Meeting



Local people registering their name.

Glimpses of Public Hearing conducted by NEA in January 2004

The concerned Village Development Committee's chairman, District Development Committee member, representatives of different political parties, District Administrator, and other representatives from MoE, MoFSC and the Project Manager expressed their views during the hearing. The other participants addressed their concerns through questions and answers.

The hearing started with the welcome speech from Mr. Vishnu Bahadur Singh, chief of SRCL, NEA. The project manager Mr. Girija Nandan Mishra explained on various technical aspects of the project. He also explained the urgent need of the project. Similarly, the EIA coordinator Mrs. Annu Rajbhandari, NEA presented on the various social and environmental measures proposed to minimise the impacts and enhance the livelihood of the project affected people including compensation and resettlement issues.

Mr. Sagar Rimal, representative from MoFSC requested the people to provide their valuable suggestions. He further added that the information and suggestions obtained from the local people of the affected area play a vital role in project construction and operation.

Mr. Dinesh Ghimire, representative from MoE emphasized on the need of project. He also explained about the EIA process including importance of public feedback for the implementation of project.

Besides this, the following local people highlighted on the following points

Bharat Mani Pande, Programme Officer, District Development Office, Tanahun

- Good public participation
- Overall development of district
- Execution of good suggestion from stakeholders
- Implementation of Project helps to increase revenue
- Project might helps for the sustainable development of the project

Arjun Prasad Subedi, Assistant Chief District Office, Tanahun

- First big project in district
- Public participation helpful in Project activities
- Full support and cooperation for the project implementation

Sundar Bahadur Gurung, Deputy Mayor, Vyas Municipality, Tanahun

- Requested for the reasonable compensation for the acquisitive land.
- Requested for the suggestion from local personalities by letter as well.
- Explained the needs of electricity.
- Suggested for plantation.
- Programme is useful

Further clarification on the proposed measures to minimized the social and environmental concerns were addressed through questions and answers during the meeting by the Project Manager, Coordinator, Hydroelectric Engineer and other NEA personnel. The meeting was chaired by the Vyas Municipality vice president Mr. Sundar Gurung.

8.1.2.2 Major Environmental and Social Concerns raised in the Public Hearing

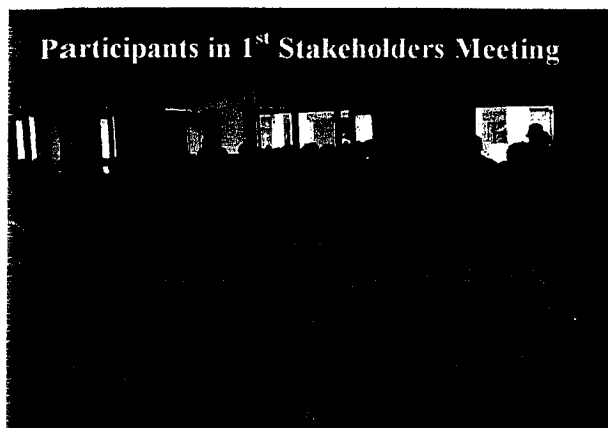
At the end of the meeting a question and answer session was held where the people actively participated. Inquiries and responses of the local people mostly focused on:

- Process of land acquisition and compensation
- Fixation of price be liberal and at replacement cost
- Down stream release
- Infrastructure development (viz. road, electrification, drinking water irrigation, communication etc.)
- Employment opportunity for displace and other project affected family
- Fisheries
- Tourism (boating in reservoir area)
- Water quality
- Air quality
- Noise level due to blasting
- Stability of slopes
- Plantation programme
- Water supply and sanitation
- Management of explosive material
- Communicable disease
- Law and order situation
- Public health and safety
- Social and economical condition of the displace families
- Price rise
- Use of building material, trees and other belonging after receiving compensation for the same.
- The options and provision for the people desiring to relocate voluntarily, elsewhere than resettlement site,
- Their school be extended and reconstructed.
- Rural electrification to the surrounding villages,
- Request to explore other resettlement areas before taking final decision.

8.1.3 Stakeholder Meeting conducted by the JICA Study Team in association with NEA as per the JICA Guidelines

The JICA Guidelines stipulates that a series of stakeholders meetings need to be held during the Feasibility Study by the Recipient Government with the assistance of JICA if the proposed project is classified as Category A to incorporate the significant adverse impacts on

the environment. During the Upgrading Feasibility Study, three stakeholder meetings were conducted by the JICA Study Team with the assistance of the NEA Team.



Participants in the 3rd Stakeholder Meeting in Risin Patan and Damauli

8.1.3.1 Advance notification

Prior to the stakeholders meeting notices were published in the National Daily "Gorkapatra" and local newspaper "Bhanjang". A local FM program "Machhapuchhre" and local TV program also announced about the meetings. Invitation letters were also sent to the affected VDCs, concerned Ministries, concerned local government organizations, political parties, concerned NGOs, media, universities and other relevant stakeholders. Furthermore, NEA and the Study Team pasted a copy of the Public Notice in several villages of the affected VDCs requesting them to participate.

In all the stakeholder meetings, a Nepali brochure summarizing the results of Supplemental Environmental Study conducted by the JICA Team in Nepali was distributed to participants.

The details of the meetings are given in tabular form below:

Table 8.1 Details of the Stakeholder Meeting

	Date	Venue	No of Participants
1 st Stake holder meeting	June 2, 2006	Damauli	450
	June 7, 2006	Kathmandu	56
2 nd Stake holder meeting	Dec 1, 2006	Damauli	600
	Dec 6, 2006	Kathmandu	74
3 rd Stake holder meeting	May 4, 2007		350
	May 5, 2007	Rising Patan	400
	May 6, 2007	Damauli	600
	May 10, 2007	Kathmandu	56

8.1.3.2 Major Environmental and Social Concerns raised in the Stakeholder Meeting

The major concerns and feedback from the Stakeholders' Meeting conducted by the JICA Study Team has been tabulated below:

Table 8.2 Suggestions, Feedback and Comments from the Participants¹

1	The proposed project is requisite and essential in terms of development of the country as well as in Tanahu District. The project should be implemented smoothly without any disturbances as observed in the Middle Marshyangdi Hydro Electric Project.
2	Consultation meetings should be carried out in each affected VDCs to provide more specific and detailed information on the inundated areas, the exact location and compensatory and employment measures. Other environmental mitigation measures should be provided in the next stakeholder meeting.
3	The proposed project needs to provide the maximum benefits to the local society.
4	Due consideration should be given to the compensation and resettlement issues including identification of the entitlement and the timing for the compensation, the formation of compensation fixing committee, and the amount of compensation and measures for those who have no legal titles.
5	The priority for the provision of employment opportunities should be given to, particularly the directly affected families and the affected VDC people. Detailed information should be provided as soon as possible.

¹ Regardless of caste and ethnic groups, these suggestions, feedback and comments were made by the participants.

6	As one of the alternative mode of transportation for inundated roads, due consideration should be given to road construction. The road from Bhimad or Rising Patan to the Dam site, or Damauli needs to be constructed.
7	New suspension bridges should be constructed or other modes of transportation should be considered for inundated suspension bridges.
8	The mitigation measures to protect Bhimad Bazaar from erosion should be seriously considered and undertaken. The information about whether gabion walls will be constructed in the possible hazardous areas during project construction should be provided to the local people.
9	The affected community forests and grazing lands need to be delineated. The mitigation measures should be provided to the affected Forest User Groups.
10	Electricity facility should be given to the affected and local people in Tanahu District at a subsidized rate or cheaper rate.
11	Mitigation measures for fisheries should be addressed. Particularly, fishery development activities should be carried out in reservoir areas
12	Various development needs such as support for drinking water and schools should be considered and undertaken.

A suggestion was received by the Ministry of Environment from Mr. Chandra Prasad Bhattarai On 065/11/23, project affected local from Vyas Municipality. His main concern was that he wants an adequate compensation (based on the prevailing price) for two plots of land which will be affected by the project. Mr.Chandra Prasad Bhattarai,s application (included in Appendix J) has been considered. Compensation of the affected plots will be paid after the verification of the land plots, at replacement rate based on the valuation of lands by the Compensation Fixation Committee (CFC).

He recommends that the project should provide health, education, employment opportunities for the people leaving in the affected area. He further recommends that the project should provide some percentage of shares to the local people. Considering this, provision for health, education, employment opportunities and trainings have been proposed for the affected community in the Social Action Plan while the allocation of shares for the local people will depend on the mode of construction and will be further discussed during the Detailed Design Phase.

CHAPTER NINE

ENVIRONMENTAL MANAGEMENT PLAN

9.0 General

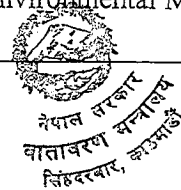
This chapter on Environmental Management, Monitoring and Audit is formulated in accordance with Nepalese EIA requirements. The National EIA Guidelines (1993) and requirements of Nepal's Environmental Protection Rule, 1997 give monitoring and auditing functions vital positions in the Environmental Management Plan (EMP) whilst the Mitigation Plan is separated from it. Under this definition the mitigation measures, responding to identified impacts, are first formulated as a stand alone mitigation measures. Based on this the EMP is assembled to present the detailed management, monitoring and auditing requirements that apply.

An Environmental Management Plan (EMP) outlines the mitigation, monitoring, and institutional measures that should be taken during project implementation and operation periods so as to avoid or control adverse environmental impacts, and spell out the actions needed to implement these measures. It should also provide a crucial link between alternative mitigation measures evaluated and described within the EIA report, ensuring the measures are implemented. Likewise, it provides the estimated investment requirements and commitments/guarantees to carry out the proposed plans. The EMP is based on the experiences of previously constructed hydroelectric projects of similar nature, and findings of the EIA study, Social Action Plan (SAP), Resettlement Plan (RP), review of other EMPs and relevant Government Acts, Regulations and Guidelines prevailing in Nepal

9.1 Environmental Management Office of the Project

As per the Nepalese Environmental Protection Rules, Environmental Management of the project is the responsibility of the proponent. As for the Upper Seti/ Storage HEP, NEA and NEA-Project Management Office (PMO) will have the responsibility for Environmental Management of the Project. NEA has a separate Department under Engineering Services "Environment and Social Studies Department" to look into environmental matters of different phases of projects, planned under implementation and operation phase. The Department has adequate human resources to undertake the Environmental Management of the Project.

A separate Environmental and Social Monitoring Unit (ESMU) within the project will be established to ensure that the mitigation and monitoring actions recommended by supplemental environmental studies are duly implemented, monitored, assessed, evaluated and disseminated to the stakeholders for feedback and improvement. The proposed ESMU will comprise of two sub-units, namely RP and SAP Implementation Sub-unit (RSISU) and Environmental Monitoring



Sub-unit (EMSU). The staff members of NEA with similar past experiences will be assigned for the first sub-unit to implement RP and SAP. The latter sub-unit will be managed by the consultants with experience in environmental monitoring of the hydroelectric projects in the past. The project ESMU will be established at least 8 months before the civil construction tender award of the project. The ESMU will function directly under the Project Manager. However, the EMSU will be responsible to co-coordinating the project's Supervising Consultant, whereas RSISU will coordinate with NEA – ESSD and the stakeholders of the project such as Local VDCs, DDCs, NGOs, CBOs, and affected parties, DoED, MoE, and MoEnv (Figure 9.1).

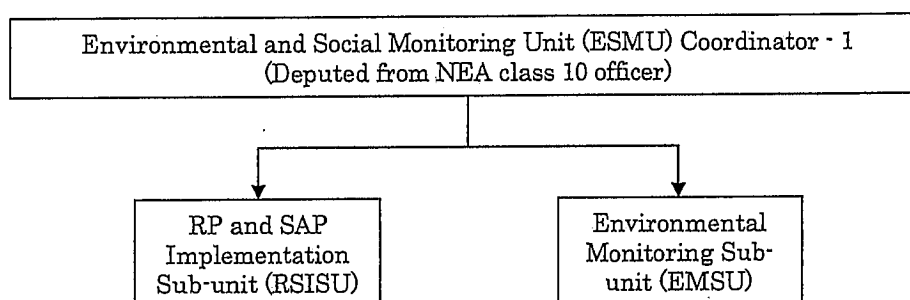


Figure 9.1 Organization Framework of ESMU

If a private party takes over the project, during the construction phase, the project company* will take over all rights and responsibilities associated with the implementation of this EMP. There are a number of key stakeholders to be involved in the project environmental and social management. The key stakeholders and their main roles and responsibilities are presented below.

Table 9.1 Environmental Management Roles and Responsibilities

Organizations	Roles and Responsibilities	Timings
MoEnv	<ul style="list-style-type: none"> Ensure that the environmental measures and cost are included in the project documents and tender clauses Monitoring of the overall project Auditing of project performance 	<ul style="list-style-type: none"> Prior to Final Project approval At least once a year during construction After two years of project completion - operation phase

* Project Company refers to a special purpose company established for the sole purpose of owning and running the HEP during the period of its license

MoE/ DoED	<ul style="list-style-type: none"> Ensure that the environmental measures and costs are included in the project documents and tender clauses Monitoring of the overall project 	<ul style="list-style-type: none"> Prior to Final Project approval At least twice a year during construction and once during operation
NEA Board/ NEA/ NEA- ESSD/USSHEP - PMO	<ul style="list-style-type: none"> Ensure that the EIA and EMP measures are incorporated in the final project design and costs. Acquire necessary permits and approval for project construction and operation. Ensure that the project construction activities are in accordance with legislative requirements. Implementation of repair and maintenance of project components including environmental safeguards as recommended by EMP, MoE, DOED and MoEnv Monitoring and record keeping regarding environmental measures and impacts as per EMP Ensure public participation and involvement in all phases of project implementation 	<ul style="list-style-type: none"> Prior to contract award Before construction During construction continuously During operation continuously During operation continuously Project period continuously
Panel of Experts (PoE)	<ul style="list-style-type: none"> Review and recommend the final design of the project and ensure that the EMP measures are included in the design and Tender Review monitoring and auditing reports of the supervising consultants and Project- Environmental Monitoring Sub-unit (ESMU) and recommend corrective measures to meet the objectives of EMP 	<ul style="list-style-type: none"> Prior to contract tendering in Detail Design Phase During construction phase every six month
Detail Design Consultants	<ul style="list-style-type: none"> Incorporate environmental mitigation measures as per POE recommendation in the design, project cost and tender documents Include EIA recommendations in the design, project cost and tender documents 	During Detail Design Phase
EIA Consultant	<ul style="list-style-type: none"> Verify and improve upon the earlier EIA reports and EMP and recommend environmental measures to Detail Design Consultants Verify and prepare detailed programs for Affected Persons/Affected Families and communities and recommend final RP costs to Detail Design engineers Verify and complete RP and recommend final RP measures and costs to Detail Design Consultants 	During Detail Design Phase
Supervising Engineers	<ul style="list-style-type: none"> Approval to civil construction as per design Monitoring of civil construction as per detail design Ensure that the EMP provisions are implemented and recorded Ensure that the Project corrective actions are duly implemented. 	Continuously in Construction phase

SSHEP -ESMU	RSJSU: <ul style="list-style-type: none"> Implementation, and supervision of land acquisition, compensation and resettlement as per RP and record keeping of these Implementation, and supervision of SAP as per SPAF Liaison with other Nepalese authorities for EMP/RP/SPAF items Information Dissemination through Public Information Center and other media and collection of feed back through regular consultation with the various stakeholders Distribution of the Project's bimonthly monitoring reports of EMSU to different central and local level stakeholders Project grievance and complaint handling EMSU: <ul style="list-style-type: none"> Monitoring of natural environmental, RP and SAP mitigation measures as per EMP/RP/SPAF by EMSU and recommend concerned engineers and sections for corrective actions and bi-monthly report preparation Environmental impact and compliance monitoring of construction works as per EMP by EMSU and recommend corrective actions to supervising engineers and bi-monthly report preparation. 	Pre-construction and construction phase, continuously
Construction Contractor	<ul style="list-style-type: none"> Implement civil construction as approved by supervising engineers Implement mitigation measures as specified in EMP and recommended by Supervising engineers Front line Monitoring and record keeping of environmental mitigation measures as per EMP through a special monitoring unit Maintain good public relationship with the project area people 	Construction phase continuously
NGOs, CBOs, VDCs, Municipality and DDCs and other stakeholders	<ul style="list-style-type: none"> Monitor that the environmental and social mitigation measures are implemented in all stages of the project as per EMP, RAP, SPAF Ensure that the public participation and involvement in the project implementation is maximized by the project owner, consultants and contractors. 	Project period

EMP structure for different phases of project development and implementation are illustrated in Figures 9.2 (a) and 9.2 (b)

9.1.1 Pre-construction Phase

The EMP for the preconstruction phase will include land acquisition and compensation, resettlement and rehabilitation, public concern issues, co-ordination with line agencies and local NGOs and INGOs. The allocation of an adequate budget for the implementation of preconstruction measures and followup for contract clauses that need to be incorporated in tender documents are the other activities to be managed or conducted during the pre-construction phase. NEA will have the prime responsibility for dealing with pre-construction issues.

During this phase, co-ordination and approval of Community Forest User's Group will be sought for felling the trees within the project construction area.

During this phase a Price Fixation Committee will also be formed to deal with all the compensation matters. This committee will comprise of Chief District Officer, Chief District Land Administration and Revenue Officer, Project Chief, Representative of District Development Committee as legal member and Representative of the affected households.

9.1.2 Construction Phase

This phase is the most critical as it requires expertise and resources to manage the construction phase impacts. The implementation of the suggested mitigation measures outlined in Chapter 7 with the EMP is a vital tool and is dependent on liaison with local VDCs, DDCs, NEA central office and other line agencies. The Project Company will be responsible for carrying out the requirements for mitigation and implementing the EMP through an approach to be formulated by them. At this stage it is merely the control functions that can be described under the management approach.

The ESMU will be responsible for implementing day to day Environment Management Plan. The ESMU which will consist of experts from Environmental and Social Studies Department of NEA, Ministry, local administrators and other qualified personnel and consultants from the local market.

This Unit may serve as a communication channel between the project and the local communities and VDC officials, and cooperate with other NGOs and INGOs development organizations. The ESMU will work in close co-ordination with VDC, DDC, NGOs, INGOs and contractors. A project compensation unit (RSISU) will also be established under the Environmental Unit will oversee that compensation aspects are handled with the required care by the project company. A separate unit will be formed which will have direct link with the ESMU to deal with resettlement issues.

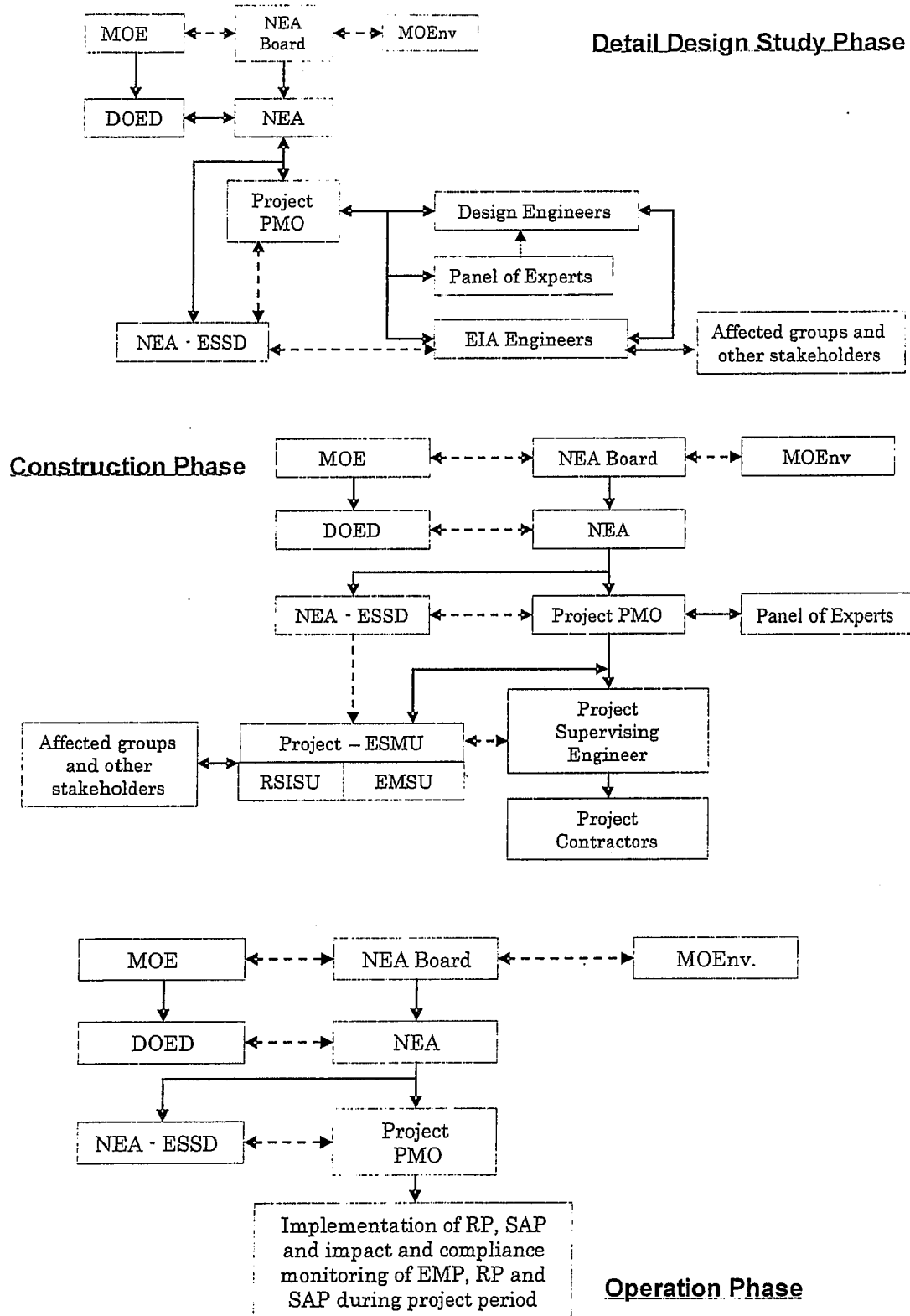


Figure 9.2 Environmental Management Plan Structure

9.1.3 Operation Phase

An environment unit will be formed under the Plant Manager for monitoring during the operation phase. This unit will consist of the representatives from NEA. Regular monitoring will be done for parameters like compensation releases; water quality and forest cover etc.

9.1.4 Reporting Requirements

The ESMU will prepare and disseminate a report containing information on the implementation status of the environmental protection measures and monitoring results quarterly during the construction period and annually during the operation phase. The unit will also prepare and disseminate the environmental compliance report annually and make it public in order to provide the people and concerned organizations an opportunity to evaluate the environmental soundness of the project.

9.2 Environmental Monitoring

The Environmental Monitoring Program is required to ensure the effectiveness of environmental mitigation measures. Monitoring is an important element of environment management as there is always some uncertainty as to the extent of the project impacts on the natural environment as well as the socio-economic and cultural environments. Therefore, this section mainly outlines the monitoring program for three different phases of the project mainly pre-construction, construction and operation.

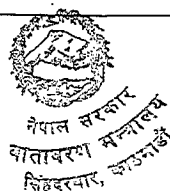
9.2.1 Need for Environmental Monitoring

It has been stipulated in Environmental Protection Rules, 1997 that an Environmental Monitoring Plan is required to monitor and evaluate the impact on the environment by the implementation of a development project. As mentioned in the EPR, Ministry of Energy will be responsible for the monitoring activities. However, the agencies like Ministry of Environment, Ministry of Forest and Soil Conservation and other relevant ministries will be consulted during the entire monitoring period.

The monitoring plan should list all the parameters that will be monitored, the monitoring spots, and frequency of monitoring and the agencies responsible for monitoring.

Nevertheless, during the detailed design, the mitigation and monitoring plans will be prepared directly by or on behalf of the licensee. Environmental monitoring activities for the Upper Seti Storage hydroelectric project are similarly expected to be divided into 3 parts:

1. **Baseline Monitoring:**
2. **Compliance Monitoring:**
 - i) Construction Phase
 - ii) Operation Phase



3. Impact Monitoring:

- i) Construction Phase
- ii) Operation Phase

9.2.2 Baseline Monitoring

The primary concern during this phase will be to implement the field data collection programs needed to enhance the knowledge of the baseline conditions. The baseline data collection during the EIA will not be sufficient for this purpose as there is no time series data and the objectives were to identify potential issues and mitigation approaches. Therefore, the following of prequisitive during baseline collection would be needed.

Priorities in regard to baseline monitoring include:

- i) Hydrological and sediment data collection;
- ii) Analysis of fish behavior, species composition, hatchery;
- iv) Survey and documentation of endangered wildlife;
- v) Survey and documentation of endangered and protected plant species;
- vi) Survey and documentation of the operation of the existing community managed forests; and
- vii) Survey and documentation of existing agriculture practices, land use patterns etc.:

a) Pre-Construction Phase

It will be necessary to confirm that all the procedures regarding land acquisition and compensation have been properly set out and followed in the pre-construction monitoring.

Priorities for the pre -construction monitoring will be mainly the following:

- Acquisition, Compensation and Rehabilitation Plan (ACRP) or equivalent resettlement;
- Verification that the EIA mitigation recommendations relevant to the contractor's responsibility are incorporated in the tender specifications;
- Verification that all Government permits and approvals are in place prior to construction; and
- Verification that land, property, crop and livestock disturbance compensation valuations have been completed prior to construction etc.

9.2.3 Impact Monitoring

Impact monitoring will again focus on key indicators to assess whether the impacts of the project involving change to the baseline conditions have been accurately predicted and whether the mitigation and enhancement measures are sufficient and effective.

a) Construction Phase

The impact monitoring during this stage will focus on key indicators to assess whether the impacts have been accurately predicted, and whether the mitigation measures are sufficient and effective. The main parameters to be measured of the Upper Seti Storage HEP will likely include:

- Air, water quality and noise level monitoring;
- Flow and sediment yield monitoring;
- Quality of potable water supply to work camps and affected villages;
- Reconnaissance forest monitoring;
- Community Forest monitoring;
- Revegetation and slope stabilization monitoring;
- Public safety and security monitoring;
- Health and sanitation monitoring;
- Additional wildlife and fish stock monitoring;
- Social impact monitoring;
- Monitoring of disposal areas and hazardous waste dump areas for leaching or run-off;
- Employment monitoring; and
- Monitoring the frequency and extent of consultations and meetings with the local people.

b) Operation Phase

The main parameters to be measured during the operation phase impact monitoring for the project will include:

- Adaptation of resettlement households to their new homes and communities;
- Demographic changes in the project impact area and watershed areas;
- Rural and urban land uses (controlled and uncontrolled land use changes of the project impact area and watersheds of the river);
- Socioeconomic impacts resulting from the project (including changes to pre-project agricultural, pastoral and fishing practices);
- River water quality monitoring;
- Reservoir water quality monitoring
- Flow and sediment yield monitoring;
- Quantity, intensity, timing and geographical distribution of rainfall;
- Soil moisture conditions at various times of the year;
- Changes in drainage and other factors that affect storm water runoff;
- Sedimentation problems in downstream areas;
- Reservoir shoreline erosion monitoring in the reservoir formed especially in settlements near to the reservoir like Bhimad Bazaar, Risin Patan and Jaruwapani

- Monitoring river bed conditions and slope erosion downstream of the damsite and powerhouse sites;
- Quality of potable water supply to worker colonies and affected villages;
- Reconnaissance forest and land use change monitoring;
- Community Forest monitoring;
- Effects of access and control measures on wildlife habitats and wildlife populations;
- Illegal fishing, hunting, trapping and tree felling monitoring;
- Public safety and security monitoring;
- Health and sanitation monitoring;
- Wildlife and fish stock monitoring;
- Social impact and employment monitoring;

As the project is a reservoir type special consideration will be given to fish species impact monitoring. Regular sampling and analysis will assess the following:

(a) Aquatic Life

- Seasonal factors relating to stream flow regime;
- Adaptability of migratory fish in the newly formed reservoir;
any new type of fish species identified in the area due to reservoir formation;
- Measurement of discharge contribution of downstream tributaries;
- State of gravel beds and fish breeding in the reservoir area and downstream zones;
- Fish migration data, seasonal fish and aquatic life diversity, water quality and fish catches etc.
- Monitoring of tender clauses; and
- Monitoring of riparian release.

9.2.4 Compliance Monitoring

The compliance monitoring will focus on determining that the prescribed mitigation and enhancement measures are being properly carried out.

a) Construction Phase

In this phase the GoN licensing entity (MOE/DOED) oversees and ensures the implementation of the required mitigation measures according to GoN guidelines and approved mitigation plan

b) Operation Phase

The compliance monitoring will focus on determining that the prescribed mitigation and enhancement measures in the operation phase are being fully and properly carried out by the owner and Government agencies or NGOs involved in the operation phase. The important issues will be identified after the Monitoring Program is finalized during the Detailed Design. However, issues minimally will include:

- Adequate fisheries protection (security and operating provisions) at the damsite and powerhouse;

- Adequate wildlife management in the project area;
- Adequacy of community relations, reporting and problem solving mechanisms;
- Adequacy of control of permanent workers from abstaining from illegal practices such as encroaching on Community Forests and illegal hunting, fishing or timber cutting;
- Proper and continuous treatment of permanent colony wastes and sewage;
- Adequacy of worker health and safety programs; and
- Provisions for public safety and warning systems for peaking releases

The detailed Environmental Management Program will be elaborated during the construction phase of the project, reflecting the final design and alignment considerations made by the project Company and approved by the Project manager of the Upper Seti Storage Hydroelectric Project. A monitoring plan shall be developed based on the mitigation/enhancement measures identified for significant and moderate environmental impacts. The Environmental Monitoring Plan including the key parameters to be monitored is presented in Table 9.2. This covers both the pre-construction/construction and operation stages. The baseline information collected during the EIA will generally serve as the benchmark data.

9.2.5 Monitoring Location and Agencies Responsible for Environmental Monitoring

As mentioned in the EPR, Ministry of Energy will be responsible for the monitoring activities. However, the agencies like Ministry of Environment, Ministry of Forest and Soil Conservation and other relevant ministries will be consulted during the entire monitoring period. The EMSU shall carryout monitoring works with the Supervising Engineers and prepare bi-monthly monitoring reports during the construction phase. Compliance monitoring will be done regularly whereas the impact monitoring will be done at the middle and at the end of construction phase. In general, methods such as observation, inspection, review of official records, interviews, counting and measurements will be used for monitoring.

9.2.6 Reporting Mechanism

The construction contractors will maintain daily records of the mitigation implementation and monitoring works during the construction phase to demonstrate compliance with the environmental management. The EMSU shall carryout monitoring works with the Supervising Engineers and prepare bi-monthly monitoring reports during construction phase. EMSU will also maintain the records of any corrective actions recommended to the contractor and its performance. The bi-monthly reports produced by EMSU in co-ordination with other sections of RSISU shall be distributed to the stakeholders for their comments and suggestions after the approval by the Project Manager. ESMU will compile the Final Environmental Monitoring Report of the construction phase within 3 months of the construction completion and submit to the Project. The project will distribute the report to stakeholders to get feedback and provide the database of environmental management works of the project for future use.

Table 9.2 Environmental Monitoring Plan

Project Phase	Parameter	Method and Scope	Location	Frequency	Responsibility	Cost (NR)
1. Baseline Monitoring						
<i>A. Physical Environment</i>						
Watershed	Erosion, slope stability	Observation	Upstream of dam, around the project area		NEA	
River Hydrology	Flow rate of Seti and its tributary/Madi	Gauging Station and measurements	Upstream of dam, powerhouse area, Madi Khola		NEA	
River Water quality	pH, DO, BOD, COD, Acidity, Alkalinity	Water sampling and testing and comparison to ambient standards	Upstream of reservoir, powerhouse, Madi river		NEA	
Air Quality	TSP, PM, CO ₂ , NO ₂ , etc	Sampling, measurements and tests	Project area		NEA	
<i>B. Biological Environment</i>						
Fish population, spawning and migration	Identification of aquatic species, spawning area, migratory habitats	Aquatic life and ecology survey (fish, phytoplankton, zooplankton and aquatic insects)	7 baseline stations	Every six months (dry season and wet season) for 5 years	Contractor/ EMSU-PMO-NEA	NRs 1 million
Wildlife	Wildlife number, foot marks	discussions with local people, footprint observation	In and around the project area			
Forest cover and management	Forest cover, density	Discussions with users group, observation, local people and District forest Office	In and around the project area			
<i>C. Socio-economic and Cultural Environment</i>						
Settlements	Growth of settlements	Observation	In and around the project area	Once a year		
Health and sanitation	Diseases prevailing in the area, outbreak of diseases	Discussions with local people, information from the local health posts and District Health office	Project area and adjacent VDCs	Once a year		
2. Impact Monitoring						
<i>A. Physical Environment</i>						
Land acquisition	Dust (TSP/PM10)	Measurement of ambient air quality	Jhaputar and Damauli (close to the District Public Health Office)	Three times a year in dry season (Nov., Feb., and May). Baseline data shall be taken	Contractor	NRs 5.3 million (lump sum including air, water, noise, spoil management, land erosion, etc.)
Vegetation clearing/tree cutting						

Table 9.2 Environmental Monitoring Plan

Project Phase	Parameter	Method and Scope	Location	Frequency	Responsibility	Cost (NR)
Excavation works ▪ Foundation works	a) Graveling of road and its maintenance b) Control on vehicle speed c) Watering of roads d) Careful handling the contaminant or dumping of dusty materials e) Covering of exposed areas and site restoration f) Provision of dust mask to drivers and workers	Compliance of mitigation measures for air pollution	a) Along the construction road b) Along the construction road c) Along the construction road d) Temporary waste stock facility and disposal site e) Excavated area f) Construction sites	before construction in dry season (April/May) a) Once a three months b) Once a day c) Once a day d) Once a week e) Once a week f) Once a week	Contractor	Part of contractor's contract
	Flow velocity, discharge, water temperature, pH, conductivity, total suspended solids (TSS), total phosphorous (T-P), Total Kjeldahl Nitrogen (TKN), ammonia (NH ₃), nitrate, nitrite, dissolved oxygen (DO), and BOD ₅	Water sampling and analysis	1) upstream of the reservoir, reservoir area (close to dam site), 3) confluence with the Madi River, 4) immediate downstream of the tailrace outlet	4 times a year in 4 seasons (November, March, June, and September)	Contractor/EMSU-PMO-NEA	Included in the lump sum cost mentioned in air quality (dust) measurement.
▪	a) Adequacy and operation of water supply and sanitation facilities at engineers camps, construction camps and construction sites b) Collection of solid waste and safe disposal practices at engineers camps, construction camps and construction sites c) Awareness program on health and sanitation d) Prohibition on open defecation and solid waste disposal e) Storage facilities for fuel, lubricants, spent oils, and	Compliance of mitigation measures for water pollution	a) Engineers camps, construction camps and construction sites b) Engineers camps, construction camps and construction sites c) All over the construction site d) All over the construction site e) Storage facilities f) Treatment facilities g) Batchling plant aggregate washing plant, and tunnel discharges h) All over the construction site	a) Before project and every 3 month b) Once a week c) Every six month d) Once a week e) Before project and every 3 month f) Before project and every 3 month g) Once a three months h) Once a day	Contractor, EMSU	Part of contractor's contract

Table 9.2 Environmental Monitoring Plan

Project Phase	Parameter	Method and Scope	Location	Frequency	Responsibility	Cost (NR)
	toxic chemicals f) Treatment facilities for waste water of batching plant, aggregate washing and tunnel seepages and its effective operation g) Water quality test for discharge of treated wastewater from batching plant aggregate washing plant; and tunnel discharges h) Disposal of construction spoils only in designated areas					
▪	Noise level a) Placement of noise arresting equipment b) Correct fitting of silencers, mufflers and acoustic shields c) Maintenance of plant and equipment d) Blasting restriction provisions as negotiated e) Blasting design and follow ups a) Vegetation clearance only to required limits b) Excavation works only to required limit by the design c) Side casting of excavated earth d) Management of spoil in the designated area e) Maintenance of toe protection structure, and drainage structure at spoil disposal; and sedimentation tank at batching yard, spoil disposal	Measurement of noise level Compliance of mitigation measures for noise Compliance of mitigation measures for land instability and erosion	▪ Jhaputar and Damauli (close to District Public Health Office), and Bellar (near the school) a) Construction site near the residential area b) Construction vehicles and machineries c) All over the construction sites d) Blasting site a) Along the project boundary such as ESL 415m area for the reservoir, dam site, and project facility sites. b) All over the construction site c) All over the construction site d) All over the construction site e) Batching yard, spoil disposal area and tunnel discharge areas f) Along the access roads	▪ Twice a year Baseline data shall be taken before the construction. a) Once before construction b) Once a three months c) Once a three months d) Once a day e) Once a three months f) Once a week a) Once a month b) Once a week c) Once a day d) Once a day e) Once a month f) Once a month	Contractor/ EMSU-PMO-NEA Contractor, PMO-NEA Contractor, PMO-NEA	Included in the lump sum cost mentioned in air quality (dust) measurement. Part of contractor's contract Part of contractor's contract

Table 9.2 Environmental Monitoring Plan

Project Phase	Parameter	Method and Scope	Location	Frequency	Responsibility	Cost (NR)
B. Biological Environment						
Land acquisition	Identification of illegal tree cutting and poaching	Compliance of mitigation measures for illegal tree cutting and poaching through frequent patrol activity	▪ All over the construction site and adjacent area	Frequent and at random patrol	Contractor	Part of contractor's contract
Vegetation clearing/tree cutting						
Excavation works						
Foundation works						
	Number of habitat loss identified before construction	Habitat loss around the project sites	▪ All over the construction site and adjacent area	Every four months	Contractor/ EMSU-PMO-NEA	NRs 1 million
	Number of wildlife species	Species occurrence around project sites	▪ All over the construction site and adjacent area	Every four months	Contractor/ EMSU-PMO-NEA	
	Damage to habitat and/or death of wildlife due to construction activity	Construction disturbances around project sites	▪ All over the construction site and adjacent area	Once a week	Contractor/ EMSU-PMO-NEA	
	Implementation of the proposed measures based on designated schedule	Mitigation measures compliance for wildlife conservation	▪ All over the construction site and adjacent area	Every four months	Contractor/ EMSU-PMO-NEA	
	Adequate implementation of the mitigation measures	Observation of compliance of contractual mitigation clauses	▪ At the designated location of the measures	Every three months	PMO-NEA	Part of contractor's contract



Table 9.2 Environmental Monitoring Plan

Project Phase	Parameter	Method and Scope	Location	Frequency	Responsibility	Cost (NR)
c. Socio-economic and Cultural Environment						
	Monitoring compensation	Housing assets, living conditions, income etc.	Project affected and resettled area	Three times a year in dry season	EMSU/NEA Contractor	
	Health issues/ sanitation	Record of diseases, inspection of camps	Project area and particularly camps	Twice in a year, whenever there is outbreak disease	Contractor	
	Occupational and Safety hazards	Records of accidents	Project area	Once a day	EMSU/NEA Contractor	
	Tourism	Records of tourist entering the area	Project area	Once a year	EMSU/NEA Contractor	
	Employment	Records kept by management	Project area	Once a month	EMSU/NEA Contractor	
	Law and Order	Records, inspection	Project area	Once weekly	EMSU/NEA Contractor	
	Impact on Women/Children	Record of women employment; children education; Inspection on Child Labour	Project area	Once weekly	EMSU/NEA Contractor	
	Changes in social values, cultural heritage, religious practices etc	Observation, record of new behavior; cultural festivals etc.	Project area	Before project and after project	EMSU/NEA Contractor	
	Indirect economic benefits	Trade and business revenues	Project area	Before project, during the project and after the project	EMSU/NEA	
2. Operation and Maintenance Period						
<i>A. Physical Environment</i>						
Operation and maintenance of dam	Flow velocity, discharge, water temperature, pH, conductivity, total suspended solids (TSS), total phosphorous (T-P), Total Kjeldahl Nitrogen (TKN), ammonia (NH ₃), nitrate, nitrite, dissolved oxygen (DO), and BOD ₅	Water sampling and analysis (except reservoir area)	1) Upstream of the reservoir; 2) Confluence with the Madi River; 3) Immediate downstream of the tailrace outlet	5 times a year in 4 seasons (November, March, beginning of June before the sediment flushing operation, end of July after the sediment flushing operation, and September)	EMSU-PMO-NEA	NRs 3 million for 20 years

Table 9.2 Environmental Monitoring Plan

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

Project Phase	Parameter	Method and Scope	Location	Frequency	Responsibility	Cost (NR)
1. Compliance Monitoring / Construction/operation						
	a) Compliance to release of environmental flows at Seti b) Compliance to restriction of fishing activities below tailrace c) Compliance to fish stocking, fish release in the reservoir and downstream area	<ul style="list-style-type: none"> Compliance of mitigation measures for aquatic lives 	a) Dam site b) Downstream area of the tailrace c) reservoir and downstream area	a) Daily b) Daily c) Once a year for project life	ESMU-PMO-NEA	Part of project operation cost
Incorporation of EIA recommendations into project documents		Review of detailed design, project specifications and tender documents				
Incorporation of Environmental considerations mentioned in the tender documents in the contractors proposed work plans		Review of proposed work plan				
Integration of mitigation measures in the detail design and contract documents		Review process				
Filling gullies with construction wastes	Land stability	Site observation				
Compensatory release downstream of the dam	Flow rate (m ³ /s)	Site observation				

Note: ESMU- Environmental Monitoring Sub-unit under Environmental and Social Monitoring Unit of PMO, NEA

9.2.4.1 Monitoring Cost

The monitoring cost is estimated based on the assumption that most of the persons will be deputed from NEA, EMSU particularly for RSISU. Table 9.3 below gives the monitoring cost for the monitoring unit EMSU. The total monitoring costs are illustrated in Tables 9.3, 9.4, 9.5. and summarized in Table 9.6.

Table 9.3 Remuneration for Human Resources

SN	Position	Numbers	Period (yr)	Project Allowance/month (NRs.)	Total NRs. Million
1.	ESMU - Section chief (Environmental Management – Team Leader consultant)	1	5.66	90000	6.11
2.	Environmental Engineer (ESMU)	2	5.66	60000	4.08
3.	Sociologist (ESMU)	2	5.66	60000	4.08
4.	Part time consultant (socio-economist/ Terrestrial ecologist/ Aquatic ecologist)		3.33	60000	2.40
5.	Office runner (ESMU)	2	5.66	10000	0.68
Total					17.34

Table 9.4 Support Facilities

SN	Particulars	Unit	Cost	Total NRs. (Million)
1.	Computers and printers	10 sets	150000.00/unit	1.50
2.	4 wheel drive vehicles	5 nos	3000000.00/no	15.00
3.	Furniture		Lump sum	0.00
4.	Other equipment (camera, tape recorders, power point projector, pH meter, turbidity meter, flow meter, photocopier etc.)		Lump sum	0.00
5.	Office consumables	5.66 years	40000/month	2.72
6.	Telephone and electricity	5.66 years	15000/month	1.02
7.	Vehicle operation including Driver, Fuel and O & M (4 vehicles)	5.66 years	45000/month/vehicle	12.23
Total				32.47

Table 9.5 Information Dissemination and Feedback

SN	Particulars	Years	NRs./yr	Cost NRs. (Million)
1.	Information through internet and web page	5.66	75000	0.42
2.	Information dissemination through FM	5.66	100000	0.57
3.	Regular stakeholder meetings in the project area	5.66	125000	0.71
Total				1.70

Table 9.6 Summary of Administrative and Management Costs for ESMU

SN	Particulars	NRs. Million
1.	Consultant Remuneration	17.34
2.	Support facilities	32.47
3.	Information Dissemination and Feedback	1.70
4.	Various Survey Work	2.0
Grand Total		53.51

9.3 Environmental Auditing

This section outlines the scope of the environmental auditing programs for the Upper Seti Storage Hydroelectric Project. Based on the Environmental Protection Rules, 1997, an environmental audit will be required 2 years after the commencement of the project.

9.3.1 Requirements for Environmental Auditing

Auditing refers to a general class of environmental investigations that are used to verify past and current environmental performance. In the context of the environmental management of a project, environmental impact auditing may assess the actual environmental impact, accuracy of prediction, effectiveness of environmental impact mitigation and enhancement measures, and functioning of pre-construction, construction and operation phase mechanisms.

9.3.2 Agencies Responsible for Auditing

As per the EPR, 1997, Rule 14, Ministry of Environment is legally responsible organization for the auditing activities. However, the agencies like the Ministry of Environment, Ministry of Energy, Ministry of Forest and Soil Conservation and other relevant agencies will be consulted during the auditing. Local NGOs and National NGOs may also be entrusted to carry out the task, if they are engaged to do so by the Government.

The results obtained from environmental impact auditing will be made available to the concerned agencies and interested groups. The auditing of the Upper Seti Storage Hydroelectric Project will focus on parameters as mentioned in Table 9.7.

9.3.3 Auditing Parameters

The Upper Seti Hydroelectric Project being a storage project, the auditing should focus on status of relocates, status of the affected villagers, land use pattern and infrastructure development, impacts of forest clearance, compensatory plantation, geological and soil condition especially around the shoreline of the reservoir. To summarize, the auditing will focus on main parameters like:

Physical Parameters

- Change in shoreline of the reservoir
- Reservoir water Quality
- The condition of the watershed
- Slope Stability
- Land use pattern and land take area
- Sedimentation and river hydrology

Biological Parameters

- Vegetation cover (increase and decrease)
- Numbers of trees felled
- Wildlife affected
- Change in the species of fish in the river and reservoir
- Fish migration
- Development of Fish hatcheries

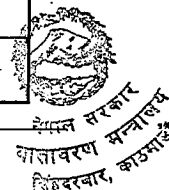
Socio-economic and Cultural Parameters

- Social status of the relocates
- Social status of the affected people (present and past income)
- Review of compensation paid
- Infrastructure development
- Other indirect benefits

Environmental Audit will be carried out after 2 years of project completion. The total cost for environmental auditing is estimated to be NRs 3,597,000 and 51,386 in US \$. The breakdown of the total cost is given in Table 9.8 below with the human resource requirements:

Table 9.8: Environmental Auditing Cost

Human Resources Requirement	Duration (Man months)	Rate (NRs)	Amount (NRs)
Environmental Engineer/Team leader	10	50,000	500,000
Biologist	6	40,000	240,000
Socio-economist	6	40,000	240,000
Statistician	6	50,000	300,000
Field Supervisors	6	15,000	90,000
Laboratory Analysis		Lump sum	200,000
Transportation Cost		Lump sum	500,000
Social Survey Cost		Lump sum	1,000,000
Cost for Report production		Lump sum	200,000
Total			3,270,000
10% contingency			327,000
Grand total in NRs			3,597,000
Cost in US Dollars			51,386



9.4 Environmental Management Cost

The total cost for implementing the Environmental Management Plan is estimated to be NRs 1,745,007,000 or US \$24,957,242.6 (exchange US \$ rate = Rs 70). This cost includes mitigation and enhancement cost, monitoring cost and auditing cost. The total Environmental Management Cost amounts to approximately 7.6 % of the total project cost.

Table 9.9 Environmental Management Cost

S. No	Environmental Management Cost		Cost in NRs	Cost in US\$
1	Environmental Mitigation Cost	Table 7.9	1453800000	20768571
2	Environmental Enhancement Cost	Table 7.10	236100000	3372857
2	Environmental Monitoring Cost	Table 9.6	53510000	764428.6
3	Environmental Auditing Cost	Table 9.7	3,597,000	51386
Total Cost		-	1,747,007,000	24957242.6

Table 9.7 Environmental auditing for Upper Seti Storage Hydroelectric Project

Parameters	Indicators	Location	Methods	Sources
Physical Environment				
Change in river morphology particularly downstream changes	Bank erosion, sand beaches	Downstream of power house, between powerhouse and dam site	Inspection	Local information, maps, photographs, observation
Water quality	DO, pH, BOD, COD etc.	Reservoir	Analysis of water samples	Analytical data
Watershed	Eroded and unstable area,	Upstream of reservoir area, in and around the project site	Observation	Existing maps
Shoreline erosion	Erosion and instabilities around the rim of the reservoir	Around the reservoir area	Observation	Local information, maps, photographs, observation
Land use pattern and landtake area	Change in the land use	In and around the project site	Inspection	Local information, maps, photographs, observation
Minimum release	Discharge in the river	Downstream of dam	Measurement of minimum release	Measurement and flow verification from local people
Water use and water rights	Flow in the river	Downstream of Dam	Inspection and information from the local people	Discussions with local people
Biological Environment				
Vegetation cover (increase and decrease)	decrease in the forest cover	In and around the project site	counting and visual observation	Local information, maps, photographs, observation
Numbers of trees felled	Number of cut tree stumps	In and around the project site	counting and visual observation	Local people, observation
Wildlife affected	Decrease in the number of wildlife seen	In and around the project site	interview with local people and observation, photographs	Local people, observation
Change in the species of fish in the river	Species of fish in the river increased and decreased	Reservoir area and downstream and upstream of reservoir area	sampling at the project sites	Local people, observation
Fish migration	Species of fish in the reservoir and river	Downstream and upstream of reservoir area	sampling at the project sites	Local fisherman, observation
Socio-economic and Cultural Aspects				
Economic status of the Relocates and affected people (present and past income)	Economic status of the local people	Project site and resettled sites	Questionnaire survey and interview of mainly relocatees and SPAFS	Local entrepreneurs, observation
Review of compensation paid out	Status of the affected people, beneficial use	Project site	Questionnaire survey and interview	Local people
Community development works	Numbers of development works, number of shops increased/decreased	Project site	Records from the local offices	Local people, observation
Health and safety	Out break of diseases especially water borne diseases and number and type of accidents/ diseases	Project site	Records from the health posts and hospitals	Medical records from local health post/hospital, interview
Water supply and sanitation	Epidemics, complains	Project site	Records, observation	Medical records from local health post/hospital, interview

CHAPTER TEN

REVIEW OF PLANS/ POLICIES, ACTS, RULES/ REGULATIONS, GUIDELINES AND STRATEGIES

10.0 General

Nepal has developed legislative requirements for assessing the environmental impacts of development projects. The Ministry of Environment (MoEnv) is responsible in prescribing legal measures to study and require mitigation of all potential sources of air, land and water degradation adversely impacting on the natural and social environments. This includes Ministry of Environment (MoEnv) authority to frame environmental rules, standards and guidelines and decide on future environmental permit requirements as appropriate. Ministry of Environment (MoEnv) is responsible for the administration of the National EIA process.

The prevailing Plans/ Policies, Acts, Rules/ Regulations Guidelines, Standards, Conventions Strategies, etc. which are required for the development of hydroelectric projects in Nepal have been reviewed while preparing the present EIA report and some of the important prevailing Plans/ Policies, Acts, Rules/ Regulations Guidelines, Standards, Conventions and Strategies with their relevancy in hydropower development have been discussed below. Besides these, the proponent will follow any other laws besides those already mentioned in the documents are attracted due to various activities that will be undertaken as part of the project.

As the Upgrading Feasibility Study of the Upper Seti Storage HEP has been conducted under the technical assistance of Japan International Cooperation Agency, the recently formulated JICA Guidelines have also been followed.

Under section (18) of EPA, any person who contravenes any of the provisions of the Act, or the Regulations or the Guidelines issued under the Act, shall be punishable with a fine upto Rs 50,000. If a proposal is implemented without the approval of (MoEnv) or a relevant Government agency, or the person implementing the proposal is not complying with the conditions of the approval or license, the authorized official is forced to close down that activity and may impose a fine of up to Rs. 100,000 on such person or organization.

10.1 Interim Constitution of Nepal, 2063

Article 35(5) of the Interim Constitution mentioned about environmental awareness to general public, minimization/avoidance of the impact of physical development works on environment and rare species with due emphasis of conservation. This article also deals with the biodiversity conservation, sustainable use of natural resources and equal distribution of benefits. Article 13 (3) stated that discrimination shall not be conducted based on color, origin, caste and language.

Article 13 (4) mentioned that equal wages shall be given to female for same kind of work.

10.2 Tenth Plan

The Tenth Plan includes five-year period of 2002 to 2007. The plan focus on infrastructure development, rational use of natural resources and use of biodiversity with due emphasis on environmental conservation and pollution control. Similarly priority has been given to increase the environmental awareness, health, education by using environmental, safety and rehabilitation measures.

The interim plan was developed by National Planning Commission, Government of Nepal for three fiscal (064/065 to 066/067) years. The interim plan emphasize the need of Unified Environment Policy, applications of environmental standards, preparation of environmental impact reports and implementation of cleaner production and energy efficiency program. The plan also emphasizes the need for the implementation of environmental monitoring and environmental auditing program.

10.3 Plans/ Policies

Nepal integrated the environment aspects in all its development activities and projects only from the early 1980s. Environment conservation was included in the policies since the Fifth Plan (1975-1980). Then the second milestone was taken during the Sixth Plan. The Sixth plan under the environment and land use policy emphasized the integration of environmental aspects into the construction of large-scale development projects. Then finally, in the Seventh Plan it was stated that the developmental programmes would be implemented only after an approved EIA study is available.

The plan outlined the need for carrying out EIA processes for industrial, tourism, transportation, water resources, urbanization, agriculture, forests and other development programmes to identify and mitigate adverse impacts on the environment. The Eighth, Ninth and Tenth five year plans have further emphasized the making of more effective EIA systems. The formulation of sectoral guidelines, promotion of participatory EIA system and inclusion of mitigation costs into the total project cost were some of the activities included in these 3 five year plans.

10.3.1 Nepal Environmental Policies and Action Plan, 1993 and 1998

Nepal Environmental Policy and Action Plan(NEPAP) is a Government Policy document of environment management with focus on incorporating environmental concerns into the biological and social components of the environment.

10.3.2 Hydropower Development Policy, 2001

The Hydropower Development Policy was promulgated in 2001. The main objectives of the policy include producing clean energy through the development of hydroelectric projects and to



help conserve the environment. It is stipulated that one of the policies is to extend the use of electricity for achieving a reduction in the utilization of fuelwood and to render necessary assistance in the conservation of forests and the environment. Some of the major policies are as follows:.

- To carry out hydropower projects of various standards and capacities to meet the interim and long term electricity requirements.
- To give emphasis to programs in rural electrification in order to render assistance in the development of agriculture production and cottage and small scale industries in the hills and the Terai region.
- To utilize indigenous labour, skills and resources as well as foreign investments and technology for the development of hydropower.
- To extend the use of electricity so as to minimize utilization of fuelwood and to render necessary assistance in the conservation of forests and the environment.
- To make the supply and distribution of electricity regular and reliable.
- To have maximum control in the leakage of electricity.
- To stimulate the consumers Demand Side Management for energy promotion.

10.4 Acts

10.4.1 Water Resources Act, 1992

The objectives of the Water Resources Act, 1992 is to make legal arrangements for determining beneficial uses of water resources, preventing environmental and other hazardous effects there of and also for keeping water resources free from pollution. The Act strives to minimize environmental damage to water bodies, especially lakes and rivers through environmental impact assessment studies and the proponents who wish to use water resources for various purposes should prepare EIA reports before a license can be granted. The Act stipulates that soil erosion, flooding, landslides or any significant impact on the environment should be avoided in all uses of water resources.

10.4.2 Electricity Act, 1992

The Electricity Act, 1992 is related to survey, generation, transmission and distribution of electricity. Electricity includes electric power generated from water, mineral oil, coal, gas, solar energy, wind energy etc. Under Section 3 of the Act, it is stated that the survey, generation, transmission or distribution of electricity without obtaining a license is prohibited.

10.4.3 Environment Protection Act, 1996

The Act considers that sustainable development is possible through proper consideration of interdependence between economic development and environmental conservation by minimizing adverse impacts on physical, biological and socio-economic and cultural environments, proper

use and management of natural resources, incorporation of environmental concerns in the development process and participatory role of communities and stakeholders.

10.4.4 Land Acquisition Act, 2034

One of the important acts that have a bearing on the implementation mechanisms and mitigation of adverse impacts of power projects is the Land Acquisition Act. This Act, 2034 covers all aspects of land acquisition and compensation of land and other assets. It authorizes the government to acquire land for public purposes by providing compensation to the private landowners.

The compensation paid under this Act will be given in cash. To decide the amount of the compensation, the Land Acquisition Act (1977) has made provisions for the constitution of a Compensation Fixation Committee (CFC). That committee consists of the CDO, Chief District Land Administration and Revenue Office, Project Chief or an officer designated by the CDO and the Representative of the DDC.

10.4.5 Forest Act, 2049

The Forest Act, 2049 (amendment 2055) recognises the importance of forests in maintaining a healthy environment. One of the major objectives of the enhancement and enforcement of the Forest Act is the promotion of a healthy environment. The Act requires decision-makers to take into account of all forest values, including environmental services and bio-diversity. It emphasises the development and implementation of an approved work plan for different categories of forests, i.e. community forests, leasehold forests, private forests and religious forests.

10.4.6 Soil and Watershed Conservation Act, 1982

In order to manage the watersheds of Nepal, the Soil and Watershed Conservation Act, 1982 was enacted. The act is devoted only to the protection of watersheds. 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 watersheds. The Act outlines the essential parameters necessary for proper watershed management.

10.4.7 Aquatic Animals Protection Act, 1961

The provision of the Aquatic Life Protection Act, 1961 (amendment 1999) obliges the proponent to construct a fish ladder at the dam site to ensure the movement of aquatic animals. If it is not possible, the proponent should establish a fish hatchery or a nursery, close to the dam site of the water resources projects, for artificial reproduction and ex-situ conservation (section 5 b).

10.4.8 Explosives Act, 2018

Implementation of the Upper Seti Hydroelectric Project will require explosives in the excavation works of road, tunnels, an underground powerhouse, aggregate quarry etc. As per the provisions of the Explosives Act, Article 4, the project needs a license for the procurement, storage, use and transportation of explosives for its purpose.

10.4.9 National Park and Wildlife Protection Act, 2029

In Nepal, all wildlife species within National Parks are protected from exploitation through the National Parks and Wildlife Protection Act, 2029 (1973). The Fourth Amendment to the Act was passed in 1993. The National Park and Wildlife Conservation Regulation under the Act was first issued in 1974, and re-issued in 1977. The Buffer Zone Management Regulation was passed in 1994, and applies to all parks and protected areas. The Department of National Parks and Wildlife Conservation (DNPWC) of Nepal is charged with protecting aquatic wildlife in Nepal under the Act.

10.4.10 Labour Act, 2049

This act was enforced by GoN in 2049/2/2. this act classified below 15 years as a child and 'nabalik' for the age group of above 14 years and below 18 years. The act has also made provision of labor court and department of labor. The act clearly mentions that the appointment letter should be issued for all the employees which include their working hours, working time, wages and other benefits. The act allows for a time bound contract for the human resources required for development work. The act specifies that working hours for the Nabalik and women must be within 6 AM to 6 PM which clearly restricts to deploy women in night works. The act also states that equal opportunity shall be given to women as men. Similarly working period for the other employees must not exceed 8 hours a day and 48 hours in a week. If some people work beyond that period, over-time allowances must be paid which is 150% of the normal per hour wages and such over-time must not exceed 4 hours in a day. According to this act wages rate of the employees shall not be less than the rate fixed by the concerned offices of GoN.

10.4.11 Local Self-Governance Act, 2055

The Local Self-Governance Act, 2056 contains several provisions for the conservation of soil, forest and other natural resources and implementation of environmental conservation activities. Section 28 and 19 of the Act provide that the Village and the District Development Committees are responsible for the formulation and implementation of the programs related to the protection of environmental bio-diversity. Section 96 stipulates that it is the duty of the municipality to protect the environment through the control of air, water and sound pollution. It also obligates the Municipality to maintain environmental cleanliness through the implementation of solid waste management, flood and landslide control programmes.

10.5 Rules / Regulations

10.5.1 Environment Protection Rule, 1997

The Environment Protection Rule (EPR) was endorsed in June 1997 and was made under the provisions of the Environment Protection Act. The EPR was recently amended in 2009. The EPR adopts the environmental assessment criteria mentioned in the EIA guidelines. However, the EPR establishes the administrative framework for assessing, exhibition and determination of the EIA, in terms of issues needing to be addressed and the format/layout of the EIA document.

10.5.2 Water Resources Regulation, 1993

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.

Rule 19 stipulates that the water resources committee shall publish a notice giving detailed information about the project to the people.

10.5.3 Electricity Regulation, 1993

Rules have been formulated for the implementation of the provisions made in the Electricity Act, 1992. Rule 12 (f) and Rule(g) are related to the EIA process which emphasize that the EIA report should include measures to be taken to minimize the adverse effects of the project on social, biological and physical environments and should also elaborate utilization of local labour, source of materials, benefits to the local people after the completion of the project, training to local people in relation to construction, maintenance and operation, facilities required for construction site and safety arrangements.

10.5.4 Local Self -Governance Rule, 2000

The Local Self-Governance Rule, 2000 contains several provisions for the conservation of soil, forests and other natural resources and implementation of environment conservation activities. The Section 28 and 19 of the Act provide that the Village and the District Development Committees are responsible for the formulation and implementation of the programs related to the protection of environmental bio-diversity. Section 96 stipulates that it is the duty of the municipality/ VDCs to protect the environment through the control of air, water and sound pollution. It also obligates the Municipality /VDCs to maintain environmental cleanliness through the implementation of solid waste management, flood and landslide control programmes.

10.6 Guidelines

10.6.1 National Environment Impact Assessment Guidelines, 1993

The National EIA Guidelines, 1993 developed by the National Planning Commission in conjunction with IUCN, set out the process for the environmental review and management of



infrastructure projects in all sectors and the respective roles of certain GON agencies and project proponents. These guidelines were part of a comprehensive program to develop the national and sectoral guidelines for establishing a national system for environmental impact assessment which was a part of GoN National Conservation Strategy and Nepal's Seventh Year Plan. The guidelines were endorsed by GoN on 27 September 1992 and gazetted on 19 July 1993.

The schedules attached to the Guidelines include:

Schedule 1	:	Projects requiring an IEE Report
Schedule 2	:	Projects requiring an EIA
Schedule 3	:	EIA based on project sites
Schedule 4	:	Projects requiring an IEE Report
Schedule 5	:	Format for Terms of Reference
Schedule 6	:	Environmental Impact Report Format

With regard to environmental management in the hydroelectric projects, the Ministry of Water Resources drafted a separate EIA Guidelines for the Water Resources Sector in 1993, which were revised by (MoEnv) in 1997. The revised draft EIA Guidelines for the Water Resources Sector, 2054 also contains steps for EIA report preparation.

10.6.2 Forest Produce Collection and Sales Distribution Guidelines, 1998

The guidelines Clauses 3 to 10 have specified various procedures and formats for getting approval for vegetation clearance, delineation of lands for vegetation clearance, evaluation of wood volume etc. and government offices and officials responsible for the approval, delineation and evaluation. These provisions have a direct relevance to the development of the project and need compliance to these provisions.

10.6.3 Community Forest Resource Survey Guidelines (2061)

The Community Forest Resource Guidelines (2061) gives the detail about of the Community Forest. It gives the composition, species, habitat, growth and economic value of plants in the community forest which are useful while giving compensation as well as for implementing enhancement programs especially to Forest User's Group.

10.7 International Conventions and Agreements

Nepal is signatory to a number of broader international conventions such as concerning habitats, biodiversity and cultural heritage protection which also must be taken into account during the EIA of projects which directly or indirectly affect the protected zones, or other properties covered by such agreements. For example, Nepal is currently a signatory to:

10.7.1 Biosphere Reserves

Power projects, which may be planned for lands, which are designated as UN Biosphere Reserves, national parks, nature reserves or conservation areas, will be affected by this UN Charter.

10.7.2 Convention on International Trade in Endangered Species (CITES)

Nepal is a signatory to this agreement (1975) which classifies species according to criteria where access or control is important (e.g., I - species threatened with extinction; II - species which could become endangered; III - species that are protected (CITES 1983); E - Endangered; V - Vulnerable, R - Rare).

10.7.3 International Tropical Timber Agreement

Nepal is signatory to the Plant Protection Agreement for the Asia and Pacific Region (1956).

10.7.4 Ramsar Convention (Ramsar)

Nepal is an international flyway for migrating waterfowls in South Asia. Because of the region's importance to wildfowl, especially as waterfowl habitat, Nepal has signed the Convention on Wetlands of International Importance [Ramsar] 1971. This agreement may have a bearing on development potential of wetland areas as hydroelectric sites and transmission routing.

10.7.5 World Heritage Site Convention

In recognition of its cultural heritage and the need to protect its antiquities, Nepal has signed the Convention Concerning the Protection of World Cultural and Natural Heritage [Paris] 1972. This convention will affect any project which might be sited on lands containing cultural or heritage resources.

The EIA must identify relevant international conventions and indicate how compliance is to be arranged and assured.

10.7.6 Biodiversity Convention, 1992

The convention contains a series of far reaching obligations related to the conservation of biological diversity and sustainable uses of its components. One of these obligations is the requirement for Environmental Impact Assessment. The purpose of an EIA in relation to biodiversity conservation is to identify in advance:

- The aspects of the project which is likely to have significant adverse effects on biological diversity at genetic species and ecosystem level, and
- The steps to be taken to avoid or minimize significant adverse effects to ensure that the proposed project comply with existing environmental legislation.

GoN has included 17 species of plants and 39 animal species in the protection list. If the project area is the core habitat of these species and the project activity will likely affect them, mitigation measures should be proposed and implemented to avoid and or mitigate the adverse impacts. Nepal is party to the convention on Biological Diversity and in accordance to Article 14 adequate attention should be given to minimize and or avoid the impacts

10.7.7 The Nepal Biodiversity Strategy, 2002

The Nepal Biodiversity strategy, adopted by GoN in August 2002, specifies the conduction of EIAs in accordance with the provisions of EPA 1996 and EPR 1997 to assess significant impacts of development activities on biodiversity. The strategy has given emphasis to ensuring effective implementation of the existing laws regarding EIA.

The National Biodiversity Strategy plan describes the protection and wise use of the biologically diverse resources of the country, the protection of ecological processes and systems, and the equitable sharing of all ensuing benefits on a sustainable basis, for the benefit of the people and to honour obligations under the Convention on Biological Diversity. Biological diversity in Nepal is closely linked to the livelihoods and economic development of most of the people, and relates to agricultural productivity and sustainability, human health and nutrition, indigenous knowledge, gender equality, building materials, water resources, and the aesthetic and cultural well being of the society.

The other relevant legislations, which are not mentioned above, have also been followed while preparing the EIA according to the requirement.

10.7.8 ILO Convention on Indigenous and Tribal Peoples, 1989 (No.169)

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 afresh 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 include the concept of territories, which covers the total environment of the areas which the peoples concerned occupy or otherwise use. The peoples concerned shall wherever possible participate in the benefits of such activities and shall receive fair compensation for any damages which they may sustain as a result of such activities. Article 16 (2) clearly mention that where the relocation of these peoples is considered necessary as an exceptional measures such relocation shall take place only with their free and inform 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.

10.7.9 JICA Guidelines

Since the Upgrading Feasibility Study of the Upper Seti Storage Hydroelectric Project is being done from the technical assistance of the Japanese Government JICA guidelines have been followed. JICA, which is responsible for technical cooperation in ODA, plays a key role in contributing to sustainable development in developing countries. The inclusion of environmental and social costs in development costs, and the social and institutional framework to make it possible to internalize environmental and social costs in development costs, are crucial for sustainable development. The internalization and the institutional framework are requirements for measures of environmental and social considerations, and JICA has been requested to take suitable considerations of environmental and social factors.

Under the above views, JICA considers the environmental and social impacts when implementing cooperation projects. The objectives of these guidelines are to encourage the recipient governments to take appropriate considerations of environmental and social factors as well as to ensure that JICA's support for and examination of environmental and social considerations are conducted accordingly. The guidelines outline JICA's responsibility and procedures, and requirements for the recipient governments to facilitate achievement of the objectives.

CHAPTER ELEVEN

CONCLUSIONS AND RECOMMENDATIONS FOR FURTHER STUDY

11.0 General

There are no significant environmental issues that will prevent advancing the project to the detailed design phase where the full environmental mitigation and monitoring plan will be developed together interactively with engineering design and tender specifications. One of the positive aspects of this project is that the project has a less number of people to be relocated for a reservoir type of project. Furthermore, the impact on agricultural production is also relatively less compared to other similar types of storage projects studied and identified by PDD, NEA.

The implementation of this project will be able to reduce the gap between power demand and supply. The project will also accrue direct economic benefit to GoN from royalties and revenues. Other direct benefit of the project will be from employment of the local people, reliable power supply during peak hours, rural electrification and improvement of infrastructures in the project impact area.

The following are the main conclusions and recommendations made from the Environmental Impact Assessment Study of the Upper Seti Storage Hydroelectric Project.

11.1 Conclusions

A. Physical Environment

- i) The project will permanently acquire a total area of 1034 ha out of which 151.2 ha is agriculture land and 422.5 ha forest land and 114.5 ha shrub land and greybeard area.
- ii) Peaking discharges will substantially change the natural daily flow from $127.4 \text{ m}^3/\text{s}$ for 6 hours in the dry season to no flow condition during the remaining hours of the day. The rapid variation of flow in this river section from peaking hours (6 hours) to off-peaking hours during the dry season will have limited, but mitigable physical impacts as the downstream of the river consists of a narrow gorge, though potentially having more significant impacts on the aquatic system
 - ◆ the irreversible change from a shallow fast flowing river to a deep water reservoir,
 - ◆ reduction in dry season flow patterns downstream of the dam from $23.7 \text{ m}^3/\text{s}$ in March to no flow and in the monsoon the flow will return to the base line conditions of $332 \text{ m}^3/\text{s}$ and,
 - ◆ daily peaking flow variations of $127.4 \text{ m}^3/\text{s}$ downstream of the powerhouse up to Trishuli confluence.

- iii) The fluctuating water level in the reservoir will increase the existing risk of stability in the inundated section of the Seti valley. The risk areas for this phenomenon have been identified as the area around Bhimad Bazaar, Wanten khola, Risin Patan and Jaruwapani.
- iv) The reservoir sedimentation studies presented in the Feasibility Study reveal that live storage of 167 Mm³ will be available after 25 years of reservoir operation.
- v) Compensation flow of 2.4 m³/s (10% minimum average flow) will have to be released downstream of the dam during non-peak hours for the survival of the aquatic ecosystem. This flow will be augmented by the flow from the Madi river with average discharge of

B. Biological Environment

- vi) Site clearing activities at the project site and creation of a reservoir will result in the loss of 422 ha of forest area. Altogether 9 ha of 6 Community forests will be inundated. The vegetation loss will take place both from government (dam and reservoir site), private and Community Forests. Loss of protected species such as Saj and Khair exist in the reservoir site.
- vii) Although 11 plant species included in the conservation lists of IUCN, CITES and the Government of Nepal were found in the study area, it is actually not very rich in terms of biodiversity. The flora in the project area is already disturbed and impacted by human activities, such as farming, cutting of trees, hunting and trapping, collecting various forest products, etc. Only residual populations of plants colonize near the human habitation zone and reservoir area. No permanent core colony of endangered and rare plant species are found in it. During the study 27 species of wildlife were recorded out of which 4 species are listed by the Government of Nepal. However the listed species are commonly found in other parts of Nepal
- viii) From the field study it was determined that 36 species of fish are found in the Seti river will be affected by project construction. Out of the 36 species recorded or reported from the Seti river 5 were long distance migrants, 6 were mid-range migrants and 21 were residents in habit A total of 471 fish of 19 species were collected from the Seti river during the field visit. Copper Mahseer contributes about 25.26% of the total catch. The composition of mahseer and minnows throughout the Seti river are 13.8 and 35%, respectively.
- ix) Habitat destruction, loss of spawning ground, possible increase in water pollution due to spoil disposal and other direct and indirect construction activities and increase in fishing pressure are the possible impacts likely to occur during the construction phase of the project. The operation phase impacts include changes of riverine habitat in the reservoir,

blockage of fish migration, de-watering of 2.0 Km river section for about 7.5 months during non-peak hours, reduced flow, changes in water quality and fish entrainment etc.

C. Socio-economic and cultural Environment

- x) The project will affect 838 households. The primary adverse environmental impact will be from the relocation of 86 (SPAF) households which will have to be resettled. As the relocation number is more than 25 households a full ACRP at the Detailed Design stage will be required (as per the World Bank Guidelines). Detailed property surveys of the privately held areas affected by the project will also be required during the Detailed Design stage.
- xi) Approximately 151.22 ha of agricultural land will be inundated which will lead to loss of crop production, which amounts to 660 tons per year. Agricultural enhancement programs will therefore be an important part of the mitigation and enhancement programs
- xii) During the EIA field survey, a preliminary survey was made to identify suitable and sufficient land within the proximity of the affected village for relocated S/PAF. However, it must be noted, that the identification of suitable land ideal for S/PAF from social, agricultural and economic aspects need in-depth evaluation and verification based on the availability of land and the willingness of affected person to buy it. This will require a detailed evaluation in the ACRP study to be undertaken during the Detailed Design stage.
- xiii) The main project facilities for the dam and reservoir will be located in 8 VDC's and 1 municipality of Tanahu district, a reported population level in 1991 of 304,496 people. Apart from involuntary resettlement, the second significant social impact from the construction project is expected from the sudden influx of 1,000-2,500 construction workers into the area.
- xiv) The EIA provides a provisional set of measures and a schedule for the environmental mitigation and enhancement measures and Environmental Management Plan reflecting the requirements for the pre-construction, construction and operation phases. The total cost for implementing the environmental mitigation and enhancement cost is NRs 168,99,00,000 over the life of the project including the pre-construction, construction and operation phases. This cost also includes the cost for the mitigation measures for aquatic life which is NRs. 1,17,00,000 with annual operation cost of NRs. 8,00,000.
- xv) The total cost for implementing the Environmental Management Plan is estimated to be NRs 1,745,007,000 or US \$24,957,242. This cost includes mitigation and enhancement, monitoring and auditing cost. The total Environmental Management Cost amounts to approximately 7.6 % of the total project cost.

11.2 Recommendations for further study

- xvi) The Resettlement Plan and the Social Action Plan are required to be further updated including cost estimates during the Detailed Design phase. Particularly, it is significantly necessary to develop the detailed design of the proposed Social Action Programs through consultation with the local people and other stakeholders such as INGOs and CBOs in the affected VDCs and municipality.
- xv) The mitigation measures recommended should be incorporated in the civil tender documents and specifications providing the environmental and social mitigation/enhancement requirements for the contractors to follow and bid on.
- xvi) Further investigation is required to be conducted on the inventory structure survey for the areas such as Wantang Khola, Phedi Khola and Tittuwa as well as project facility sites, which were not completely covered by the Supplemental EIA conducted by the JICA Study Team.
- xvii) Further investigation is recommended to identify land plots affected and affected land owners through collecting the cadastral maps for Jamune VDC.
- xviii) Further fish migration study with fish tags or telemetry, fish spawning and design of a fish hatchery is recommended during the detailed design study.
- xix) Further study on the baseline conditions is required during the detailed design study. The study recommended should include:
 - ◆ Hydrological and sediment data collection;
 - ◆ Analysis of fish behavior and species composition;
 - ◆ Detailed survey and documentation of endangered plant and wildlife;
 - ◆ Detailed mapping of ecologically sensitive areas;
 - ◆ Detailed survey and documentation of the operation of the existing community managed forests;
 - ◆ Detailed survey and documentation of existing agriculture practices.

References

Population of Nepal by Districts and Village Development Committees/Municipalities Central Bureau of Statistics, (Population Census) 1991, HMG/Nepal, 1993

Upgrading Feasibility Study on Upper Seti Storage Hydroelectric Project in Nepal, Environmental and Social Considerations Study Report, Japan International Cooperation Agency, Nepal Electricity Authority, February 2007, Electric Power Development Co. Ltd. Nippon Koei Co. Ltd

National Environmental Impact Assessment, Guidelines, IUCN, Nepal, 1993

Central Bureau of Statistics, ***Population Census-1991 General Characteristics*** Tables, Vol. I, Part-I, HMG/Nepal, 1993

Geology of Nepal Himalaya and Adjacent Countries by Chandra K. Sharma, January 1990

An Outline of the Himalayan: A Case Study of the Nepal Himalayan, Koshiro, Kizaki, 1994

Maps: district level land use map (1:50000 scale), district administrative map (1:12500 scale), and topographical map (1: 25,000 scale)

Statistical Pocket Book, Central Bureau of Statistics, HMG/Nepal, 1997.

Geological and Land Utilization maps

Landslide Studies and Management in Nepal, ICIMOD, Kathmandu, Nepal, 1996, B.N Upreti and M.R.Dhital

Environmental Impact Assessment, Guidelines for Water Resources Development, ESCAP-Environment and Development Series, United Nations, New York, 1990

Mammals of Nepal, Shrestha, T.K. 1997:

Birds of Nepal, Fleming, R.L. 1979:

Environment Impact Assessment Study of KL III HEP, Final Report METCON 1997

Kulekhani III Hydroelectric Project Supplementary Engineering study report for underground powerhouse, NEA, July 1998

Kulekhani III Hydroelectric Project Updated Feasibility Study report for 42 MW, Vol.1 NEA SRCL, July, 2000

West Seti Hydroelectric Project, Environmental Impact Assessment. Main Report, Volume I, SMEC INTERNATIONAL, 1997

Dudh Koshi Hydroelectric Project, Environmental Impact Assessment, Volume 2 of 4, EIA Executive Summary and Main Report, Canadian International Water & Energy Consultant (CIWEC), Kathmandu, Nepal.



NEPAL ELECTRICITY AUTHORITY
ENGINEERING SERVICES



**Environmental Impact Assessment
of
Upper Seti Storage Hydroelectric Project**

**FINAL REPORT
(Volume 2: Appendix)**

Submitted to:
Ministry of Environment
through
Department of Electricity Development
and
Ministry of Energy

Prepared and Submitted by:
Environmental & Social Studies Department
Engineering Services
Nepal Electricity Authority
Adwait Marg, Kathmandu

August, 2009

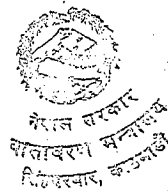


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Appendix A





श्री २ का सरकार

जलस्रोत मन्त्रालय

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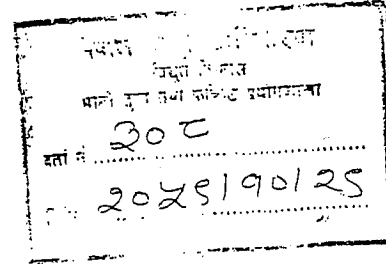
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सिंहदरवार, काठमाडौं

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च.नं.: - ९६९

मिति: २०५९/१०/०२

विषय: माथिल्लो सेती जलाशय युक्त आयोजनाको EIA को
Scoping र ToR बारे ।



श्री आयोजना अध्ययन तयारी तथा अध्ययन विभाग,
दरवारमार्ग ।

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- २- प्रतिवेदन परिमार्जन भएको पुष्ट्याई हुने गरी तयार भएको बुँदागत जवाफ सहित १- प्रति
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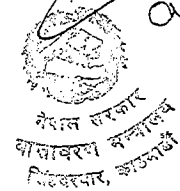
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✓ श्री माटो ढुङ्गा तथा कंक्रीट प्रयोगशाला,
स्वयम्भु ।

श्री देवी प्र. कृष्णकर्णिक
ज्जा-का + रिर्क
०९/२५



Nepal Electricity Authority

(An Undertaking of HMG/N)

TERMS OF REFERENCE

FOR

ENVIRONMENTAL IMPACT ASSESSMENT STUDY
OF

UPPER SETI STORAGE HYDROPOWER PROJECT

Submitted to:

Ministry of Population and Environment through
Department of Electricity Development
and Ministry of Water Resources

Prepared by:

Project Preparation and Studies Department,
In association with Soil, Rock and Concrete Laboratory

2001



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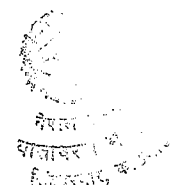


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Annex 1 Household Questionnaire and Checklists

Acronyms

ACRP	-	Acquisition, Compensation and Rehabilitation Plan
CBS	-	Central Bureau of Statistics
CITES	-	Congress of International trade of Endangered species
DOED	-	Department of Electricity Development
DFO	-	District Forest Officer
EIA	-	Environmental Impact Assessment
EPR	-	Environmental Protection Regulation.
EPA	-	Environmental Protection Act
EMP	-	Environmental Management Plan
EL	-	Elevation
FUG	-	Forest User's Group
FSL	-	Full Supply Level
IEE	-	Initial Environmental Examination
HEP	-	Hydroelectric Power
HMG/N	-	His Majesty's Government of Nepal
km	-	Kilometer
ha	-	Hectares
Hh	-	household
INPS	-	Integrated Nepal Power System
IUCN	-	International Union Conservation Nature
MOPE	-	Ministry of Population and Environment
MBF	-	Main Boundary Fault
MOWR	-	Ministry of Water resources
MFSC	-	Ministry of Forest and Soil Conservation
MW	-	Megawatt
MOL	-	Minimum Operating Level
NARC	-	National Agriculture Research Center
m	-	Meter
NGO	-	Non Governmental Organisation
NEA	-	Nepal Electricity Authority
NRDB	-	National Red Data Book
PAF	-	Project Affected Family
PPD	-	Project Preparation Department
SPAF	-	Seriously Project Affected Families
SRCL	-	Soil, Rock and Concrete Laboratory
VDC	-	Village Development Committee
TL	-	Transmission Line
TOR	-	Terms of Reference



1. Introduction

1.1 Purpose of Terms of Reference

The purpose of this terms of reference is to describe the requirements for the EIA study to be conducted for the Upper Seti Storage Hydropower Project with an installed capacity of 135 MW. This TOR is valid only for the EIA study of hydropower generation and excludes the transmission line component.

His Majesty's Government of Nepal under the provisions of the Environment Protection Act 2053 (1996) Article 24 has brought into the force the Environmental Protection Regulations 2054 (1997). According to the Environmental Protection Regulations (EPR), 2054 (1997) and the National Environmental Impact Assessment (EIA) guidelines it is mandatory to conduct EIA study of hydropower project with more than 5 MW capacity.

This regulation has also set forth format to prepare Terms of Reference (TOR). The purpose of this TOR is to guide and make a work plan while conducting an EIA of Upper Seti Hydropower Project of storage type which has an installed capacity of 135 MW. This project is located in Tanahu district of the Mid Western Development Region of Nepal and none of the project components lie in any national parks, conservation area, protected area and wildlife conservation area.

1.2 Project Background

To meet the increasing demand of Electricity, Nepal Electricity Authority has been constructing number of small and medium run-of-river hydropower projects (HEP) some of which has already started generating power while others like Kali Gandaki HEP and Chileme HEP, are under construction. However, the aforementioned run-of-river projects will generate surplus power in wet season while there will be deficit during the dry season. At present, the Integrated Nepal Power System (INPS) has only one seasonal storage project Kulekhani-1. Therefore, the system at present requires a storage type of project to fulfill the country's need for the peak load. In order to select a good storage project "the Identification and Feasibility Study of Storage Project" has been conceived. The main objective of this study is to identify medium sized storage projects in the range of 10-100 MW, which can be implemented in the near future. The study consists of three phases. From the first two phases, Coarse Screening and Fine Screening Upper Seti hydropower project has been selected as one of the best project whose feasibility study will be carried out in the third phase. Similarly, Environmental Impact Assessment Study will be conducted as part of the feasibility level study.



1.3 Objectives of the EIA Study

The main objective of the EIA study will be:

- To identify adverse environmental problems that may be expected to occur.
- To incorporate into the development action appropriate mitigation measures and to propose enhancement measures for beneficial impacts.
- To identify the environmental benefits and dis-benefits of the project, as well as its economic and environmental acceptability to the community.
- To identify critical environmental problems which require further studies and/or monitoring.
- To examine and select the optimal alternative from the various relevant options available.
- To involve the public decision-making process related to the environment.

1.4 The Project Proponent

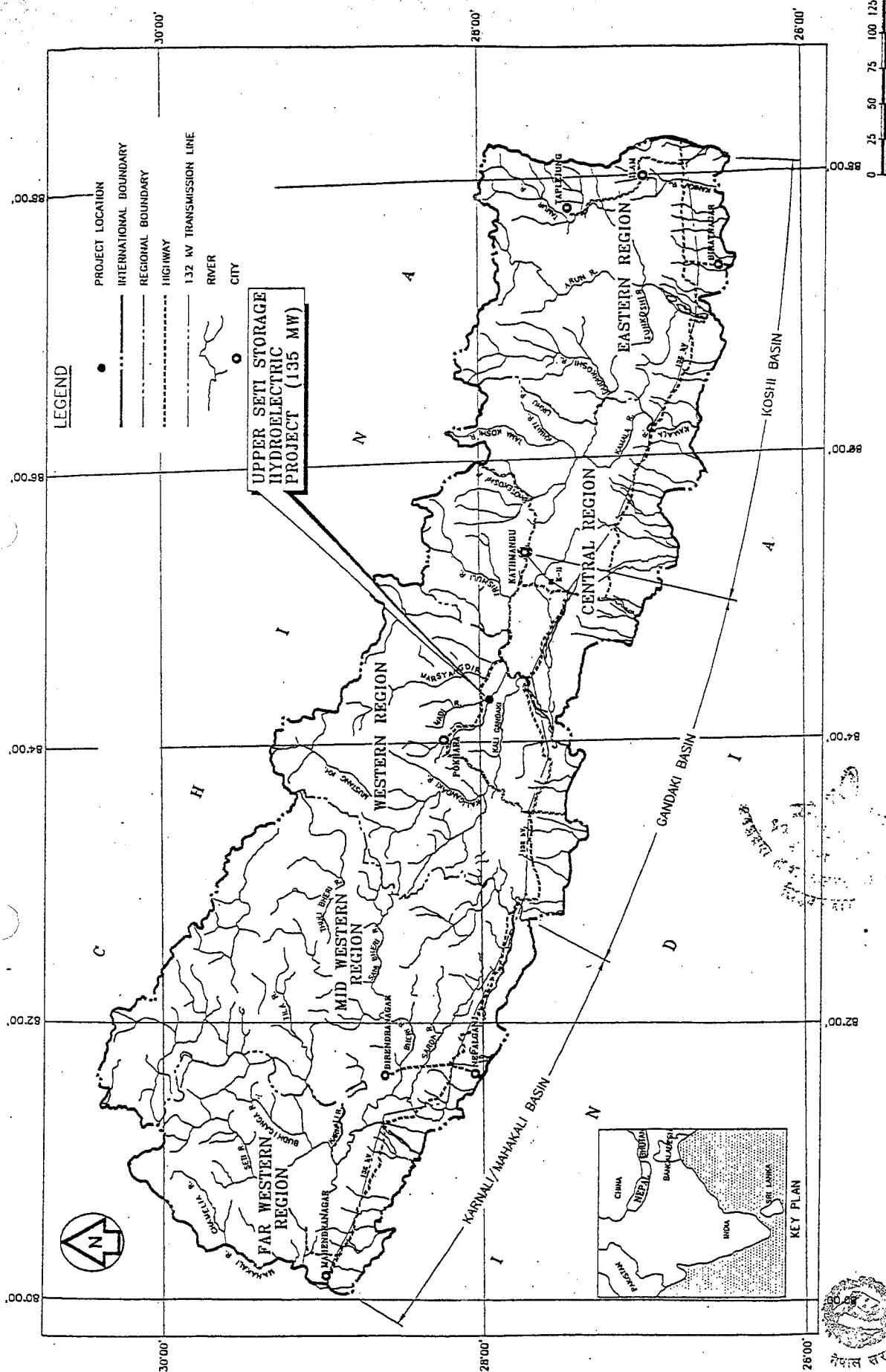
The Project Preparation and Studies Department, Development, NEA, Durbarmarg, Kathmandu is responsible for the preparation of the Scoping Document and Terms of Reference for EIA study. Nepal Electricity Authority is the only semi-government organisation in Nepal which is responsible for planning, construction and generation of hydropower projects. In the course of the study the environmental multidisciplinary study team will closely interact with the technical Team preparing the feasibility report of Upper Seti Storage Hydropower Project.

The Project Preparation and Studies Department, Development, NEA has already acquired the licence on B.S 2058/2/12 and the license will be valid up to B.S 2060 Baisakh for the feasibility level study including the Environmental Impact Assessment of Upper Seti Storage Hydropower Project. The licence is not issued for the transmission line.

2. Description of the Project

The proposed selected Upper Seti hydropower project with 135 MW capacity lies in the Tanahu District in the Western Development Region. The proposed project is located at Longitude 84°15'30" and Latitude 27° 57'14"N. The dams site and the power house site lies in Vyas Municipality (Damauli) and the reservoir extends in six VDCs namely Kahu- Shivpur, Kot-Durbar, Rani-Pokhari, Majhkote, Jamune, Bhimad and Chhan. and Vyas Municipality. The dewatered stretch will be in Pokharibhanjyang VDC.

The access is by Prithivi Highway up to Damauli and another half an hour walk is required to reach upto the dams site from the existing roadhead at Patan. A 4 km access road will have to be constructed to reach the dams site. Fig.1 shows the location of the proposed project.



Quesada



Upper Selt Storage Hydroelectric Project

नेपाल सरकार
सिन्धु नदी विकास मन्त्रालय
सिन्धु नदी विकास, काठमाडौं

The dam site is situated about 3 km upstream of the confluence of the Madi and Seti River and the powerhouse is located at the toe of the dam.

The project will constitute of five major components:

- Dam and reservoir
- Water Conveyance System
- Power Plant at the toe
- Access Road
- Transmission Line

The generated power is envisaged to be evacuated to the Damauli Bazaar substation by 5-km long 132 kV transmission line.

2.1 Salient Features

The proposed Upper Seti Hydropower Project has the following salient features:

Name of the Project	:	Upper Seti Hydropower Project.
Type of Scheme	:	Storage with annual peaking
Maximum Gross Head	:	109 m
Installed capacity	:	135 MW
Annual Energy	:	312 GWh
Dry Season Energy	:	181 GWh
Power Factor	:	0.555
Capacity factor	:	51.6%

Hydrology

Catchment Area	:	1502 km ²
Long Term Average Flow	:	119.7m ³ /s
Design Discharge	:	157.5 m ³ /s
1: 20 years flood at dam site	:	1145 m ³ /s
1:10000 years flood at dam site	:	3710 m ³ /s
PMF	:	5565 m ³ /s

Reservoir

Reservoir Surface Area	:	8.86 km ²
Reservoir length	:	27 km
Full Supply level	:	430 m

Minimum Supply level	:	371 m
Reservoir Gross volume (at FSL)	:	244.5 million m ³
Live Storage	:	197.9 million m ³
Useful life of the reservoir	:	50 years

Main Dam

Dam Type	:	Roller Compacted Concrete Dam
Dam height	:	119 m from the foundation level
Height from River bed level	:	121.0 m
Dam Crest length	:	150.0 m
River bed elevation	:	310 m
Spillway	:	10mx13 m, 4 no. radial gate

Headrace Tunnel

Type	:	Circular
Length	:	24 m
Finished Diameter	:	8.3 m

Dropshaft and high pressure tunnel

Drop Shaft Diameter	:	8.3 m with drop of 74 m
Length of High pressure Tunnel	:	140 m

Powerhouse

Type	:	Toe option
Turbine	:	Francis
No. of Unit and capacity	:	3, 45 MW each

Substation

Switch Yard	:	Outdoor Type
Power Transformer	:	Central Grid as required
Tailrace Tunnel	:	40 m long

Transmission Line

Length	:	5 km
Voltage	:	132 kV

Access Road	:	4 km, (width of road- 4 m)
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Economic Indicators

B/C ratio	:	1.41
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IRR	:	14.12
Cost/kW US \$:	1290
Specific Energy Cost	:	3.90
Total Project Cost:		US \$ 174 million

Fig.2 gives the layout of the whole project.

3. Study Methodology

Before, carrying out an EIA it is necessary to understand the following components of the project activities and the surrounding environment.

- Projects activities to be implemented;
- Setting of project, resource demands and the waste produced;
- Policies, regulations and guidelines to be known for EIA study and;
- Resources and environment likely to be impacted;

These activities will entirely guide and structure the methodology specific to the project. For the proposed project, the following methodology is suggested:

3.1 Study Area

The Upper-Seti Hydropower Project consists of various structures including the dam, reservoir, headrace tunnel, surge tank, penstock, powerhouse, and access road.

Considering this, the whole study area of the project shall be divided into four zones.

- 1) Upstream Zone
- 2) Downstream Zone
- 3) Inundated Zone (reservoir)
- 4) Project sites: access road, the powerhouse site, the quarry site and borrow areas

These will be further classified as:

Category A: Project area or High Impact Area

Category B: Surrounding area or Moderate Impact Area

Category C: Outlying areas or Low Impact Area

As shown in the Table 3.1 below:

Table 3.1: Classification of the Project Impact Area

Category A	Category B	Category C
The area of 7 VDCs namely Kahu-Shivpur, Kot-Durbar, Rani-Pokhari, Majhkote, Bhimad, Jamune and Chhan Damauli (Vyas) Municipality, which are under the reservoir, dam and powerhouse site, quarry site, access road and borrow areas	The whole area of 3 VDCs of the Tanahu District Kahu- Shivpur, Kot-Durbar, Rani-Pokhari, Majhkote, Bhimad, Jamune, Chhan ; and PokhariBhnajyang VDC which will be affected by the powerhouse discharge downstream: and Damauli Municipality	The whole of Tanahu District

The impact area has been shown in Fig.4.

3.2 Work Plan for the EIA Study

The following section outlines the methodology and the work plan to be followed in the EIA study.

3.2.1 Physical Environment

A walkover survey throughout the project site and in the reservoir area has to be carried out. Physical characteristics like landslides, soil erosion and land use pattern etc. will be examined. Vulnerable areas for landslides will be identified. Checklists will be used during the survey for the physical environment. Topographical maps and geological maps will be used and consulted during the study.

The survey will identify the sites, which shall be affected by noise and air pollution.

As the project is a reservoir type of project a detailed study on the water quality will be done. Water Quality test in the Seti river will be done for pH, Dissolved Oxygen, specific conductance, BOD, Sulphur, phosphorus, ammonia, temperature and dissolved oxygen etc. Throughout the field visit and survey, consultation with local people will be conducted for collecting information about the physical characteristics.

The following specific task for assessing the impact on the physical environment shall be followed:

- Task 1: Estimation of permanent land takes for project structures and for the reservoir.
- Task 2: Estimation of the minimum downstream flow release.
- Task 3: Assessment of the water quality.



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- | | |
|---------|--|
| Task 4: | Assessment of the possible water use conflicts in the downstream. |
| Task 6: | Assessment of stability and erosion problems around the project structures especially in and around the reservoir area and powerhouse site area. |
| Task 7: | Assessment of the daily peak flow operation in the downstream of the powerhouse |
| Task 9 | Assessment of the noise and air pollution during the construction period |
| Task 10 | Impact on microclimate due to change in riverine flow to lacustrine flow |

3.2.2 Biological Environment

As the project impact on the forest resources is expected to be significant, extensive survey on the vegetation in and around the project site and reservoir area survey will be done. At least 1 percent of the total forest area of each forest types or as required by concerned authorities will be sampled in and around the project area. Rare and endangered and wildlife species will be identified. Mapping of sensitive ecological sites must be done. Ethno-botanical information will be compiled using both primary and secondary sources. The forest type and management practices around the project area will be studied and identified. The total area of the affected forest in the project site will be estimated.

The wildlife in the area will be identified through direct observation and from the information given by the local people.

Study on the fisheries and aquatic life will be done through random sampling. The migratory behavior and the fish spawning areas along the river stretch will be identified and studied. Fishing techniques around the river will also be studied. The possibility of fish hatcheries will also be examined.

- | | |
|---------|--|
| Task 1: | Identification of types of forest and species of wildlife in and around the project site including the reservoir area. |
| Task 2: | Identification of rare endangered and protected plants, forest and wildlife. |
| Task 3: | Prediction of changes in vegetation after project implementation. |
| Task 4: | Impact of long distance and migratory and resident fish species and their habitats. |
| Task 5: | Impact of reduced flow on the aquatic life in the river. |
| Task 6: | Assessment on the possibility of establishing hatcheries around the project site. |
| Task 7: | Assessment of water quality deterioration of the water bodies (river, streams etc) near the construction areas during the construction period. |

3.2.3 Socio-economic and Cultural Environment

The socio-economic survey (on less than 10% of the affected households) will be conducted through sample household survey, group discussions, individual interviews and interviews with affected families. However, the all the households to be relocated will be surveyed. This survey shall give information about ownership, assets, occupation pattern, pre-project incomes and living standards, livelihoods strategies and access to support services and production inputs along with other demographic information e.g. Caste/ethnicity, religion, culture, gender issues, health and sanitation, occupational health and sanitation, migration, population, occupation, livelihood and age distribution.

Household questionnaire shall also be developed and pretested to assess the socio-economic cultural conditions of the directly an affected people. The sample questionnaire for the household survey and checklists for the socio-economic and cultural environment survey is given in Annex-1. The questionnaire and the checklists shall be modified as required.

Where as, the indirectly affected households will be surveyed by using simple checklists. This type of survey will provide information about population, agricultural activities, livelihoods, living conditions, access to public services, cultural characteristics and perception and concerns about the project.

The following tasks shall be carried out, but may not be limited to:

- Task 1: Identification of the houses to be relocated from the project affected area including the reservoir.
- Task 2: Proposal of resettlement scheme for the relocated people which addresses the past resettlement problems.
- Task 3: Estimation of loss in agricultural production and its impact on overall income of the local people.
- Task 4: Impact on the existing infrastructures the 4 suspension bridges and cremation sites due to the reservoir formation.
- Task 5: Assessment of socio-economic and cultural impact of construction activities and work force on the local communities and their economic, social, health and cultural conditions.
- Task 6: Assessment of socio-economic and cultural impact of the project on local communities during project operation.
- Task 7: Identification of health related problems especially from water related diseases and safety concerns during construction and operation of the project.
- Task 8: Assessment of the beneficial impact like rural electrification, employment opportunities, and irrigation development
- Task 9: Assessment of impact on Women and disadvantaged groups

-
- Task 10: Assessment of impact on religious and historically sites
- Task 11: Assessment of Child labour
- Task 12: Assessment of safety issues related to construction activities and downstream peaking releases

3.2.4 Public Involvement Plan

While conducting the EIA study, public consultation will be carried out to involve the public in all the activities carried out in the project area. In the scoping phase itself the public has been involved while identifying the major issues of the project. Based on the findings of the scoping study and taking into considerations the suggestions of concerned public the following plan for public involvement will be followed during the EIA study of Upper Seti Storage Hydropower project hydropower projects.

- 1) Public Notices have been issued in newspapers prior to the scoping exercise. Further public notices will also be issued later to inform the public about the meetings, new reports, and other activities concerning the project.
- 2) From the scoping phase itself, the affected public has been actively involved in the scoping study. During subsequent scoping field visit group discussions were held with concerned groups, government officials and with people in the project-affected villages. The people were given opportunities to put forward their ideas to the team who visited the site for the preliminary survey.
- 3) During EIA study, group discussions shall be conducted with concerned groups and government officials, NGOs, representatives from the affected VDCs and with people in the project affected villages.
- 4) After the completion of the EIA report, at least one public consultation meetings in the upstream, downstream and the reservoir site shall be conducted to incorporate the affected people's suggestion, inputs, ideas etc and to determine local perception about the project and to ascertain local development needs and potentials
- 5) After the completion of the EIA study, the report shall be made available to the public in the project-affected area and in Kathmandu.

In addition to the aforementioned plan, the EIA team shall perform other public consultation activities according to the requirements, situations and demands of the concerned public.

4. Review of Act, Policy, Regulations & Guidelines

4.1 General

The following Act, Policy, Regulations and Guidelines will be reviewed while preparing the EIA report.

- HMG laws and regulations on environmental review and impact assessment
- National Environment Impact Assessment Guideline, 1993
- Water Resources Act (1993)
- Nepal Environmental Policy and Action Plan 1993 and 1998
- Land Acquisition Act, 2034 (1977)
- Forest Act, 2049 (1993)
- Forest Regulations, 2051
- Forestry Sector Policy, 1997
- National Parks and Wildlife Conservation Act, 1973
- Soil and Water Conservation Act, 1982
- Environment Protection Act, 1996
- Environmental Protection Rules, 1997 (with first amendment, 1998)
- Forest Produce collection and sale\ Distribution Guidelines, 1998
- Resettlement Guidelines (Nepal Resettle Company)
- Aquatic Animal Protection Act 2039 (1982)
- Electricity Regulation 2050 (1993)
- Local Governance Act, 1999
- Electricity Act, 1992
- Hydropower Development Policy, 1992

Any significant issues related to water use conflicts will be identified and recommendations will be based on the Water Resources Act.

4.2 Project Related Legislative Framework

Regulations, quantitative and qualitative standards, and general guidelines will govern the undertaking of the EIA, including the following:

- HMG laws and regulations on environmental review and impact assessment;
- HMG standards for pollution control or abatement;
- Regional and local regulations or other rules covering the implementation of mitigation programs that may be sectoral in nature and/or require the participation of different HMG agencies or organisations;

The EIA will describe the pertinent regulations and standards governing environmental quality health and safety, protection of sensitive areas, protection of endangered species, siting, land use control, etc. at international, regional, district, VDC and Ward levels.

The team will identify any issues; avoidance or mitigation measures such as those associated with agreements on:

- Convention on International Trade in Endangered Species (CITES), 1975
- International Tropical Timber Agreement, 1956
- Ramsar Convention, 1971
- World Heritage site Convention, 1972

The EIA will also refer to the World Bank Guidelines especially on matters related to resettlement.

5. Time Constraint, Budget & Resource Persons

5.1 Time Constraint

The EIA report of the project should be completed within the period of about 6 months and another month will be required for the approval of the document by the MOPE. The detailed schedule for the study is given in Fig no. 3

5.2 EIA Budget

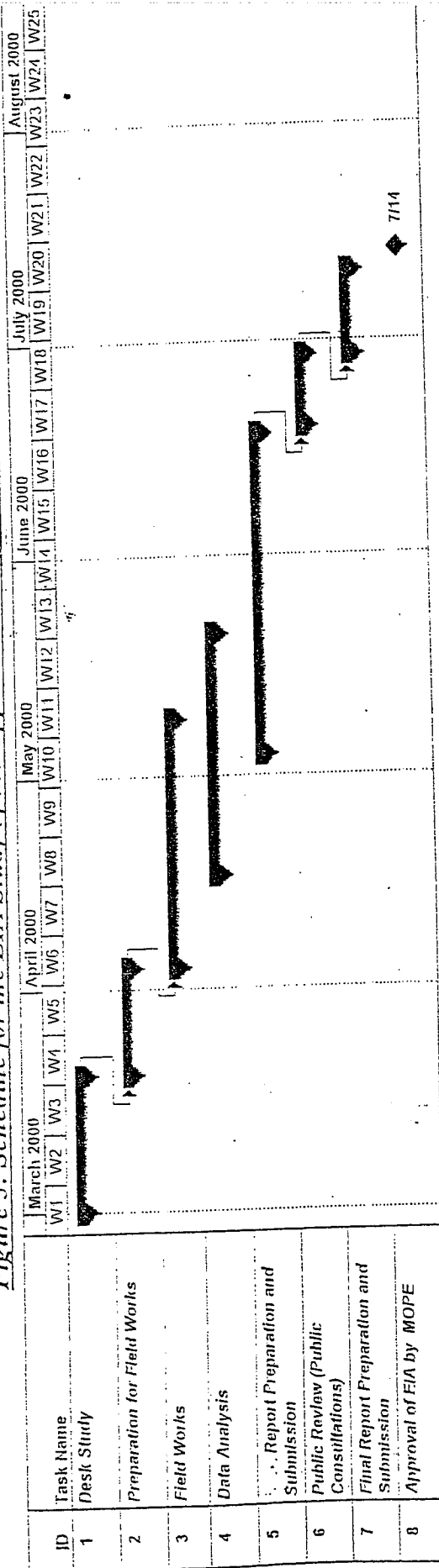
The total estimated budget allowance for the EIA study is approximately 1.2 million NRs.

5.3 Resource Persons

For the EIA study it is envisaged that the study shall compose of the following experts and a team leader will be required to co-ordinate the different tasks of the following personnel involved:

- 1) Team Leader (Environmental Engineer)
- 2) Hydropower Engineer
- 3) Resettlement Specialist
- 4) Watershed Management Expert
- 5) Geologist
- 6) Forester/Ecologist/Botanist
- 7) Sociologist/Anthropologist
- 8) Fisheries Expert
- 9) Research Assistants

Figure 3: Schedule for the EIA Study of the Upper Seti Storage Hydropower Project



Project: sched Date: Wed 4/18/01	Task	Summary	Project Summary	Rolled Up Split
	Milestone	External Tasks	Split	

- 10) Enumerators
- 11) Senior Experts for Review and Guidance
- 12) Computer Operator

6. Specific Environmental Effects

A reservoir type of hydropower project produces impacts on practically all-environmental parameters. However, some of the specific significant environmental issues of the proposed Seti Hydropower Project are discussed below:

6.1 Physical Environment

The major physical impact associated with the project will be the submergence of approximately 500 ha of forest and 380 ha of agricultural land.

Other important impact will be due to the construction of the dam, which will bring changes in the river morphology. The diversion of the water will also bring water use conflicts especially in the downstream of the river. Likewise, during the construction period the river water and the water bodies around will be affected by the disposal of excavated material, cement slurry, hazardous substances like oils and paints and from human waste.

The formation of the reservoir might cause water logging, soil salinity and lowered ground water levels in the vicinity of the reservoir. However, the problem due to change in groundwater level and water logging may not be significant as the major portion of the reservoir extends through narrow gorge.

Another impact will be on the water quality after the formation of the reservoir due to the phenomenon like eutrophication and thermal stratification etc. The main impacts have been listed below in table 6.1:

Table 6.1: Key Physical Impacts

KEY CONCERNS FOR THE PHYSICAL ENVIRONMENTAL IMPACTS	
Site Selection	
1	Landtake for reservoir and project facilities and access road .
2	Erosion risk or instability around the reservoir area and in the watershed, project facilities and access road
Construction Phase	
3	Potential for local air quality deterioration and noise pollution due to construction activities
4	Sediment and waste releases providing adverse water quality effects (depletion of dissolved oxygen in the reservoir, eutrophication etc)
5	Impact due to the disposal of muck or excavated material
6	Soil and water contamination due to construction related activities

7	Impact due to quarry site and borrow areas
8	Change in ground water regime
9	Impact due to vibration of structures
Operation Phase	
10	Sedimentation in the reservoir
11	Downstream impacts due to the peaking releases and due to the diversion of the flow
12	Water logging around the reservoir area
13	Shoreline erosion due to daily fluctuations in reservoir level
14	Downstream water use conflicts
15	Impact on microclimate due to change in riverine flow to lacustrine flow
16	Impact due to dewatering zone on the river morphology
17	Impact due to induced seismicity and rapid drawdown of water level in the reservoir
18	Landuse changes due to reservoir inundation
19	Degradation of river bed downstream of tail race
20	Change in water quality (Thermal stratification, depletion of oxygen and eutrophication etc)

6.2 Biological Environment

The formation of the reservoir will have significant impact on the environment. Around 500 ha of good forest along the reservoir will be inundated. Further more, the construction of the project structures and reservoir formation will lead to the loss of vegetation, loss of wildlife habitat, loss of farmland and grazing land and encroachment and submergence of forest land.

The use of wood for cooking purposes by the labourers will further put high pressure on the forest resources. There might be decrease in the wildlife due to poaching and illegal hunting by the labourers and local people around the project area.

The impoundment and reduced flow in the downstream of the river will change the hydrology of the basin thus affecting the aquatic environment of the river. The changes in the flow pattern change in water quality and sedimentation pattern will affect the migratory and spawning behaviour of the fish species.

Besides this, the construction activities near the riverside and dumping of the excavated materials will cause the deterioration of the water quality, which will also damage and reduce the spawning and nursing ground. The key impacts have been listed below.

Table 6.2: Key Biological Impacts

KEY CONCERNS FOR THE BIOLOGICAL ENVIRONMENTAL IMPACTS	
Site selection	
1	Impact on the forest and the wildlife present in and around the project area including the reservoir area.

	about 507 ha to be affected by the project including the access road
2	Impact on rare, endangered and protected species forest, vegetation and wildlife
3	Impact on migratory and resident fish
Construction Phase	
4	Loss of forest resources due to the clearance in the reservoir area
5	Loss, fragmentation or degradation of forest and wildlife habitat
6	Loss and impact on the fish species due to the diversion of the flow
Operation Phase	
7	Fish migration, spawning and fish kill in project facilities
8	Adverse wildlife impacts due to increased accessibility
9	Impact on ecology due to change in riverine flow to lacustrine flow
10	Loss or degradation of forest resources due to increased accessibility

6.3 Socio-economic & Cultural Environment

The main socio-economic impacts will be the relocation of 26 households from the reservoir area and due the construction of the project structures. The eight VDCs including Damauli municipality will be affected by the project implementation.. Another impact on the social side will be due to the submergence of the fertile cultivated land. This will lead to loss in agricultural production and seriously affect the lifestyle and economical condition of the local people.

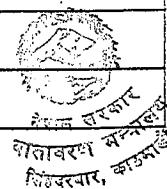
The impoundment will also submerge 4 suspension bridges and 2 cremation sites. The formation of the reservoir will intensify waterborne diseases in and around the reservoir and the project area.

As the size of the project is large the influx of labourers will be significant in number. The influx will have significant impact on the socio-economic and cultural impact on the local communities during the construction and the operation of the project. In addition to this, safety and health problem will also be induced due to the influx of construction workers. The generation of job opportunities for local adult male in construction activities will result in increased work burden and responsibility on women to look after children and farm.

However, with the construction of the project beneficial impacts like irrigation, employment opportunities, and rural electrification will be induced in the area. The impacts have been summarised below in table

Table 6.3: Key Socio-economic and Cultural Impacts

KEY CONCERNS FOR THE SOCIO-ECONOMIC & CULTURAL IMPACTS	
Implementation Phase	
1	Relocation of more than 26 families from the reservoir area
2	+ suspension bridges and 2 cremation sites to be affected by reservoir formation
3	Impact on the inundation of 380 ha of agricultural land
4	Impact on infrastructures
5	Impact on the settlements
Construction Phase	
6	Impact on law and order
7	Impact on religious and archaeological resources
8	Impact on occupational and safety hazards
9	Impact on local resources due to influx of outside workers
10	Impact on local economy due to sudden cash flow
11	Impact on sanitary and Health Situation
12	Impact on people earnings who are dependent on wood transportation business in Seti river
13	Impact due to impoundment of community forest on local people
14	Land acquisition and compensation issues
15	Child labour
16	Impact on the women and disadvantaged groups
17	Safety related issues to downstream population due to peaking releases from power house
18	Significant impact due to the influx of workers during the construction period on life style and culture of the local community
Operation	
19	Impact on local economy due to project completion
20	Impact on agriculture due to the change in ground water level in and around the reservoir area
21	Loss of agricultural production due to the land acquisition
22	Adverse induced development impacts



7. Analysis of the Alternatives to the Proposed Project

The EIA study should examine and describe all alternatives that were examined in the course of developing the proposed project and identify other alternatives, which would achieve the same objectives during the EIA study. Alternative ways are examined in order to maximize the benefits and minimize the adverse impacts. The EIA study shall compare alternatives in term of

potential environmental impacts, alternative sites, different reservoir level, designs, operational methods and technologies. Likewise, the EIA study shall also study alternative analysis in terms of method, time schedule and the raw materials to be used during construction.

As the project is a storage type alternative for compensation packages, resettlement plan and relocation areas etc. should also be analyzed. Similarly, the no-project alternative will also be discussed.

8. Development of the Environmental Mitigation Plan

The EIA study shall recommend pragmatic, feasible and cost-effective measures to address the potential adverse impacts of the project to acceptable levels. The mitigation measures and recommendations shall be presented as an Environmental Mitigation Plan. The Environmental Mitigation Plan give proposed work programs, activities, potential impacts, mitigation measures, schedules, staffing, and responsible institution or implementing the management plan and other necessary support services to carry out the mitigating measures.

Special consideration shall be given while making a resettlement plan for the relocated people. The total cost for the carrying out the mitigation measures shall be worked out and presented. The cost will be worked out in detail for the resettlement and rehabilitation cost and consultation with different agencies shall be done while working out the cost.

9. Development of the Monitoring Plan

To estimate the effects of project on environmental monitoring program shall be required for assessing the actual effects during project construction and operation. The monitoring plan should specify the physical, ecological and socio-economic parameters to be measured, sampling stations and sampling frequency. The proposed monitoring plan should also give the agencies responsible (for e.g. Project proponent, Contractor, HMG concerned agencies, VDCs, local NGOs) and the cost for carrying out and financing the monitoring works.

Monitoring should cover the following aspects:

- i) Socio-economic aspects,
- ii) Water Quality
- iii) Shoreline erosion
- iv) Operation of the dam to ensure minimum flow
- v) Vegetation and Forest resources
- vi) Fish
- vii) Wildlife
- viii) Landuse and erosivity
- ix) Irrigation agriculture and hydraulics

- x) Hydrology
- xi) Health and sanitation

The monitoring plan shall give the parameters, schedule and the frequency to be monitored in the monitoring plan.

10. Auditing Plan

An Auditing Plan shall be developed to assess the effectiveness of implemented mitigate measures. The auditing plan will discuss the auditing process and lists the auditing parameters. The concerned authority as per the Environmental Protection Regulation 1997, Section 13 and First Amendment, 1999 should carry out auditing.

Furthermore, the cost and manpower requirement shall also be given for the auditing plan.

11. Report Format & Deliverables

The ELA report shall be a comprehensible report. The report shall be concise and limited to significant environmental issues. The main text will focus on findings, conclusions and recommended actions, supported by summaries of the data collected and citations for any references used in interpreting those data. Hard and electronic copies of all reports, appendix maps, records, will be provided to the client.

The report shall be deemed to be final after approval by the Ministry of Water Resources.

11.1 Environmental Impact Assessment Report Format

The report shall be developed as per the format given in the EPR, 1997 but not limited to the following.

- an Executive Summary
- Introduction
- description of the environment; baseline information
- policy, legal and administrative framework
- assessment of environmental impacts
- analysis of alternatives,
- environment management plan
- public participation plan
- impact monitoring and auditing



- conclusion and recommendation
- list of references

11.2 Annexes of EIA Report

In addition to the information as required under EPR, 1997 following information may be included as appendices:

- Approved TOR.
- Copy of the Published Notice.
- List of people preparing the Environmental Assessment.
- Records of people participating in the public hearing meeting/lists of people interviewed.
- Maps, Data and Detailed Sheets.
- Field Questionnaire, Analysis result and Checklists.
- Unpublished Reference Documents.
- Relevant Photos.
- Recommendation.

All the necessary annexes of the EIA report shall be provided as Attachments.

12. Conclusions and Recommendations

Although the Upper Seti Storage Hydropower project is storage type the impact on the environment is expected to be minimum. One of the positive aspects of this project is that the project has low number of people to be relocated. Furthermore, the impact on the agricultural production is also relatively less compared to other similar type of storage project studied earlier.

The implementation of this project will be able to reduce the gap between power demand and supply. The project will also accrue direct economic benefit to HMG from royalties and revenues. Other direct benefit of the project will be from employment of local people, rural electrification and improvement of infrastructures in the project impact area.

Appendix B



अपर सेती जलाशययुक्त ज.वि. आयोजना

"Questionnaire for Baseline Household Information"

स्थान: Powerhouse/Dam/Reservoir Area/Camp Site मिति: समय:

अन्तर्वार्ता लिनेको नाम: Supervisor:

१. आयोजना क्षेत्र सम्बन्धि सामान्य जानकारी:

- (क) अंचल: (ख) जिल्ला:
(ग) गा.वि.स. (घ) वार्ड नं.:
(ङ) गाउँ/टोल: (च) उचाई(Altitude):

२. परिवार सम्बन्धि जानकारी:

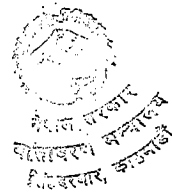
- २.१ (क) घरमुलीको नाम:
(ख) अन्तर्वार्ता दिनेको नाम:
(ग) लिंग: पुरुष () स्त्री: ()
(घ) जात:
(ङ) वैवाहिक स्थिती: विवाहित () अविवाहित ()
(च) पेशा: धर्म:

२.२ तपाईंको परिवार यस गाउँमा बस्नेको कति भयो ?

- (क) यहाँकै वासिन्दा
(ख) धेरै वर्ष अगाडी देखि (कति वर्ष पहिले आएको)
(ग) फिर्तन्तो/अस्थायी
(घ) अन्य

२.३ यदि तपाईं बाहिरबाट अउनु भएको भए कहाँबाट ?

- (क) नेपाल: जिल्ला
(ख) भारत तथा अन्य कुनै अन्तर्गत:



२.४ परिवारको प्रकार:

(क) एकल परिवार (छुट्टिएर बसेको)

(ख) संयुक्त परिवार

२.५ मानो नछुट्टिई बसेका परिवारका सदस्यहरु (घर मूली सहित) को बारेमा जानकारी:

क.सं.	घरमूली संगको नाता	वैवाहिक स्थिती	उमेर	लिंग	शिक्षा *	पेशा *	शौर्य तालिम	६ महिना भन्दा बाहिर बसेको	समय	कारण
१										
२										
३										
४										
५										
६										
७										
८										
९										
१०										

कोड:

*शिक्षा:

० - अशिक्षित

१ - प्राथमिक (कक्षा १ देखि ५ सम्म)

४ - माध्यमिक (कक्षा ८ देखि १० सम्म)

६ - प्रविणता प्रमाण पत्र सह

८ - उच्च शिक्षा

१ - साक्षर तर स्कूल नगएको

३ - निम्न माध्यमिक (६ देखि ७ सम्म)

५ - एन.एल.सी.

७ - स्नातक

*पेशा:

१ - कृषि गृहस्थ गृहिणी

३ - नौकरी

५ - अन्य

२ - कानून व्यवसाय

४ - मजदुरी

६ - अन्य

५ - शिक्षा

कारण:

१ - नौकरी

२ - स्वास्थ्य

३ - अध्ययन

४ - अन्य

३. स्वास्थ्य:

३.१ के तपाईंको परिवारको कुनै सदस्य गत वर्ष बिरामी भएको थियो ? थियो/थिएन

३.२ यदि बिरामी भएको थियो भने कति पटक र उपचारको लागि कति जिर्ण अपनाउनुभएको थियो ? विवरण दिनुहोस्:

७. सुविधाहर :

७.१ गन बरना तपाईंको घरना यहाँ उल्लेखित मध्ये कुन कुन भविष्यको सुविधाहरू ?

क्र.स.	पद	आएको वा नआएको	आएको ना गन बरना कतिभन्दा
१.	जे.टि, जे.टि.ए., अन्य कृषी अधिकृतहरू		
२.	जंगल सुरक्षा गाई तथा अधिकृत		
३.	अन्य:		

८. ऊर्जा तथा पानीको आपूर्ति:

८.१ यहाँको खानेपानीको स्रोत के हो ?

- (क) खोला (ख) नदि
(ग) झरना (घ) माईन बाट पानीको आपूर्ति

८.२ तपाईं प्रायजसो घरना बेलुका के बालुहुन्छ ?

- (क) नदितेल (ख) दिपौ
(ग) विजुली बत्ति (घ) झरो (च) अन्य:.....

८.३ तपाईं खाना पकाउनको लागि निम्न मध्ये के प्रयोग गर्नुहुन्छ?

- (क) बाउरा (ख) नदितेल
(ग) पसल, ढोड, आदि (घ) गुइठा
(ङ) अन्य:.....

८.४ यदि तपाईं बाउरा बालुहुन्छ भने एक महिनाको कति भारो बाउरा बालुहुन्छ ?

परिमाण्य भारिता:.....

८.५ तपाईं घरना बालुको लागि बाउरा कहाँबाट ल्याउनुहुन्छ ?

- (क) नजीकैको जंगलबाट (सानुदायिक, सरकारी)
(ख) आफ्नै जंगलबाट
(ग) अन्य:

८.६ तपाईंको घरना दउरा, पानी, ल्याउला ल्याउने कान मध्येजसो कतले गर्छ ?

- (क) बच्चाहरूले (ख) जवान दउरा
(ग) जवान महिला (घ) पुरो, महिला र बच्चा

८.७ तपाईंलाई यहाँ तल उल्लेखित सामानहरू संकलन गर्न कति समय लाग्छ :

दिन/महिना

- (क) बाउरा
 (ख) खाने पानी
 (ग) त्याउला, घाँस
 (घ) अन्य:.....

९. घरको वारेमा जानकारी:

९.१ के यो तपाईंको आफ्नै घर हो : हो होइन

९.२ के तपाईंसँग एक भन्दा बढी घर छन् ? संख्या:.....

९.३ यदि छन् भने, आफ्नो घरको वारेमा निम्न जानकारी दिनुहोस् ?

स्थान							
संख्या	आ.क्षे. भित्र	आ.क्षे. बाहिर	घरको तल्ला	घर निर्माणमा प्रयोग भएको सामग्री	छाना को प्रकार	बनेको वर्ष	घरको मूल्य

काँड:

निर्माण सामग्री:

- १ - ढुगा तथा माटो
 २ - ईटा, ब्लॉक ब्लक
 ४ - ब्लॉक
 ३ - काठ
 ५ - अन्य

छाना:

- १ - फल, खर
 ३ - पल्लो तला
 ५ - अन्य:.....
 २ - प्लेट, टाइल
 ४ - सिमेन्ट ढलान

९.४ तपाईंहरूको घरमाथुवा जनावरको लागि छुट्टै गोठ छ : छ छैन

९.५ यदि छ भने कति वटा छ ?

आयोजना क्षेत्र भित्र:..... आयोजना क्षेत्र बाहिर:.....

१०. आयोजना वारेमा जानकारी:

१०.१ तपाईंलाई यो आयोजनाको बारेमा केहि जानकारी छ : छ छैन

४.७ के तपाईको जग्गाना भएको गत वर्षको उत्पादनले तपाईको परिवारलाई पर्याप्त भयो:

पर्याप्त भयो

पर्याप्त भएन

४.८ यदि अपर्याप्त भयो भने कति महिनाको लागि पुगेन ? महिना

४.९ आफ्नो उत्पादित खाद्यान्न अपर्याप्त भएको बेला आफ्नो परिवारलाई कसरी खुवाउनुहुन्छ ?

१. न्छुन गरेर

२. दैनिक ज्यालादारी काम गरेर

३. घरको अन्य सामान बेचेर

४. जंगली खाद्यान्न पदार्थ खाएर

५. भारि बोक्ने काम गरेर

६. अन्य:

५. पशुपालन:

५.१ तपाई कुनै पशुपालन गर्नुहुन्छ?

पालेको छु

नलेको छैन

५.२ यदि चाल्नुहुन्छ भने निम्न विवरण दिनुहोस्:

क्र.सं.	पशुको नाम	संख्या	उत्पन्न	स्थानीय	दुध/दिन	चराउने तरिका
						कृषि/बा चराउने
१	गाई					
२	गोरु					
३	भैँसी					
४	रागी					
५	मैडा बाख्रा, खैसी, बोकल					
६	सँगुर					
७	कूडरा					
८	हाम					
९	अन्य:					

५.३ तपाई प्रतिदिन कति भारि ब्रान प्रयोग गर्नुहुन्छ ?

५.४ तपाईको बागिना कति प्रकारका डाले आनका लख्खर छन्:

१.

२.

३.

४.

५.

६.

६. आम्दानी तथा खर्चको विवरण:



६.१ आम्दानी तपाईको गत वर्षको आम्दानीको श्रोतहरु उल्लेख गर्नुहोस् ?

क्र.सं.	विवरण	विक्रि परिमाण	आम्दानी रु.
१. कृषी तथा पशुपालन बाट आयः			
(क)	खाद्यान्न		
(ख)	फलफूल, तरकारी		
(ग)	पशुपालन		
(घ)	दुग्ध उत्पादन		
(ङ)	अण्डा, कुखुरा		
२. अन्य श्रोत			
(क)	नोकरी, सेवा		
(ख)	ज्याला मजदुरी		
(ग)	निवृत्तीभरण		
(घ)	व्यवसाय		
(ङ)	घरेलु उद्योग		
(च)	पेशागत सेवा		
(ज)	माछा मार्ने		
(झ)	अन्यः.....		
	जम्मा आयः		

६.२ खर्चः

कृपया, तपाईको घरना गत महिना भएको खर्चको विवरण दिनुहोस् । (आफ्नै घरना उत्पादीत वस्तु यस्तो समावेश नगर्नुस्)

क्र.सं.	विवरण	मुल्य रु. (गत महिना)	मुल्य रु. (गत वर्ष)
१	चामल, दाल, नक्का, आदि		
२	कपडा		
३	तेल, धुन, तृप्त, चिनी, चिया आदि		
४	मासु, माछा		
५	नदितल, दाउरा		
६	औषधी		
७	शिक्षा		
८	गहना, भाडा कुरा किन्दा		
९	जग्गाको भाडा		
१०	जग्गा, गाई वस्तु, किन्दा		
११	यात्रा, दुवानी		
१२	चाडपर्व		
	अन्यः.....		

उमर	लिङ्ग	विरानी नातिनको घरको संगको नाता	रोगको प्रकार *	उपचारको कालिन *	तजिकको दुरी
१-५					
६-१५					
१६-३०					
३०+					

संकेत:

* उपचार १ - उपचार नगर्नेको

को कालिन

३ - छुट्टा

४ - अन्तर्गत

५ - श्रमधो गनन

* रोगको प्रकार

१ - अल्लो

२ - कडा रक्ता

३ - जमे आउने

४ - अन्य:

२ - आने अल्लो

४ - अन्य रोग

६ - ग्राइभेट बिनानिक

२ - नेट हुने

४ - छारे रोग

६ - लुतो

४. कृपा:

४.१ तपाईं अथवा तपाईंको परिवारको कुनै सदस्यको नाउना आफ्नै जग्गा छ ?
छ छैन

४.२ यदि छ भने कति छ रोप्नेना (हल गोर वा विज) भन्नुहोस् :

	खेत		वारी		चरण, जंगल		कैफियत
प्रकार	आयोजना क्षेत्र भित्र	आयोजना क्षेत्र बाहिर	आयोजना क्षेत्र -भित्र	आयोजना क्षेत्र बाहिर	आयोजना क्षेत्र भित्र	आयोजना क्षेत्र बाहिर	
आफने							
कनाई आएको							
कनाउन दिएको							
जग्गा							

४.३ तपाईंको वारीना उत्पादन हुने मुख्य वाली के हो र यस बाट कति आम्दानी गर्नुहुन्छ?

वाली	खेत (रोपनी)	वारी (रोपनी)	उत्पादन (मुरी)	विक्री परिमाण	जम्मा आम्दानी
खाद्यान्न वाली					
धान					
गहुँ					
नक्र					
कांगो					
दलहन					
अन्य:					



नगदे वाली					
आम					
नारी					
जम्बू					
अन्य:					

४.४ तपाईंको घरमा कुनै फलफूलको बोटहरु छन? छ छैन

४.५ यदि छ भने निम्न विवरण दिनुहोस्:

फलफूलको नाम	बोटको संख्या	गत वर्षको उत्पादन	
		परिमाण	बेचको मूल्य
क. कागती			
ख. चुन्तला			
ग. आम			
घ. मेवा			
ङ. अम्बा			
च. लिची			
छ. कटहर			
ज. केरा			
झ. अन्य:			
जम्मा:			

४.६ कृपया तपाईंले आफ्नो बारीमा हालने गनुभएको कम्पोस्ट र रासायनिक मलको विवरण दिनुहोस्:

बारीको नाम	बिउको परिमाण प्रति रोपनी	मल को परिमाण प्रति रोपनी	
		कम्पोस्ट मल (डोको)	रासायनिक मल (के.जि.)
धान			
मकै			
कांदो			
गहुँ			
आलु			
दाल			
तेलहन			
तरकारी, सागपात			
अन्य:			

मा.विद्यालय
 बैंक
 पशु चिकित्सालय
 प्रहरी चौकी
 टेलिफोन, टेलिग्राफ अफिस
 कृषी कार्यालय
 बजार
 अन्य:.....

११. सरदार पशुपालनको संख्या:

मैती, रांगो
 गाई, गोरु
 भैंडा, बाख्रा
 अन्य:.....

१२. जलविद्युत आयोजनाबाट जग्गा अधिग्रहण गरिने सन्वन्धमा केहि जानकारी छ?

छ छैन

१३. जग्गा अधिग्रहण गरिदा दिईने क्षतिपूर्ति सन्वन्धमा केहि जानकारी छ?

छ छैन

१४. आयोजनाबाट अन्दाजी कति हेक्टर जग्गामा अत्तर परेको छ?

पावरहाउस हेडवर्क्स ट्रा.लाईन प्यामन

खेत

सिंचाई नहुने (वारी):.....

अन्य:

आयोजनाले अधिग्रहण गर्ने सानुदायिक जग्गाको क्षेत्रफल (रोपनीमा).....

आयोजनाले अधिग्रहण गर्ने सरकारी जग्गाको क्षेत्रफल (रोपनीमा).....

१५. यस्त गाउँका कुनै सदस्य यस आयोजनामा काम गर्ने ईच्छुक हुनुहुन्छ ?

यदि हुनुहुन्छ भने निम्न जानकारी प्रदान गर्नुहोस्:

क्र.सं.	नाम,थर	उमेर	लिंग	शिक्षा	तालिम/ सिप	आशा गरिएको काम
१						
२						
३						
४						

काड:

आशा गरिएको काम: १ - दश जनशक्ति २ - अधिग्रहण जनशक्ति ३ - अन्य:

१६. आयोजनाबाट प्रभावित भौतिक संरचना (स्कूल, पुल, मन्दिर आदि)

नाम	प्रभावित पार्ने तत्व	अनुगन्तन गर्ने तारिका
.....
.....
.....

१७. आयोजनाले प्रभावित मानिसलाई पुनर्वास गराउने कुनै उपयुक्त ठाउँ छ ?

.....

१८. गाउँमा कार्यान्वयन भएका विकाससिल आयोजनाहरूको विवरणः

आयोजनाको नाम	कार्यान्वयन गर्ने संस्था
.....
.....

१९. गाउँमा अवस्थित सरकारी, स्थानीय अथवा गैर सरकारी संस्थाहरूको विवरणः

संस्थाको नाम	संस्थाले गर्ने काम
.....
.....

२०. गाउँमा अवस्थित आयोजनाबाट प्रभावित साना उद्योगहरूको संख्याः

साना उद्योगको कार्य	स्थान/गाउँ
.....
.....

२१. आयोजना क्षेत्रमा अवस्थित धार्मिक क्षेत्र, जस्तै मन्दिर, पाटी को संख्याः

नाम	स्थान
.....
.....
.....

२२. गाउँमा संचालन हुने सामाजिक, सांस्कृतिक तथा व्यवस्थापिक कृयाकलापहरूः

.....
.....

अपर सेती जलाशययुक्त ज.वि. आयोजना

Checklist for Socio-economic Survey

१. गाउँ/ठाउँको नाम:
आयोजना स्थलबाटको दूरी:
आयोजनाको ढाँचा: (ड्याम/पावरहाउस/जलाशय क्षेत्र)
गा वि.स. (आयोजनाबाट प्रभावित क्षेत्र भित्र परेको/नपरेको)

२. जनसंख्या सम्बन्धि विवरण:
अनुमानित घरधुरी:.....

अनुमानित जनसंख्या:	महिला	पुरुष	जम्मा
१ देखि १० वर्ष सम्मको
११ देखि ५९ वर्ष सम्म
६० वा यत्न देखि माथी

मुख्य पेशा:.....

जाती / धर्म:

अनुमानित घरधुरी/%

- १.....
२.....
३.....
४.....

३. कति समय देखि यहाँका बासिन्दा यस गाउँमा बसोबास गर्दै आएका छन् ?

एक पुस्ता देखि
दुई पुस्ता देखि
दुई पुस्ता भन्दा अगाडी देखि

बाहिर गएको संख्या कुन ठाउँमा गएको कति समय देखि जागृको कारण

४. सानान्यता एक परिवारसँग कति जग्गा छ ?

आनुमानित रकम

सिँचीत (खेत)
सिँचाई नलाग्ने जग्गा (पाखो/वारी)
खरबारी
जंगल
अन्य:.....



नेपाल सरकार
सामाजिक विकास मन्त्रालय
सिन्धुखोला, काठमाडौं

पानी लगाउने तरिका तथा औषत बास उत्पादन	राज्य समय	कालन समय	उत्पादन/शपना
धान
मकै
कोदो
दाल
गहुँ
आलु

६. उत्पादित खाद्यवस्तुको पर्याप्तता:

घर (प्रतिशत)

१२ महिना को लागि नै पुग्ने
६ देखि ९ महिना को लागि पुग्ने
३ देखि ६ महिनाको लागि पुग्ने
३ महिना भन्दा कम समयको लागि पुग्ने

.....
.....
.....
.....

७. गाउँमा स्वच्छ खाने पानीको स्रोत:

गाउँमा स्वच्छ खानेपानीको सुविधा
पानी भर्न लाग्ने औषत समय

८. स्वास्थ्य:

गाउँमा वढी देखा पर्ने रोगहरु:

१..... २.....
३..... ४.....

उपचारको तरिका:

१..... २.....
३..... ४.....

९. उपभोक्ता समूह (खानेपानी, सिंचाइ, जंगल):

उपभोक्ता समूहको नाम	जन्मा संख्या	महिलाको संख्या
.....
.....
.....

१०. तपाईंको घर वा गाउँबाट निम्न सुविधाहरु कति टाढा छन्:

सुविधाहरु
स्वास्थ्य पोष्ट
अस्पताल
हुलाक
नि.मा.विद्यालय

१३.२ तपाईंको परिवारको कुनै सदस्य यस आयोजनामा काम गर्न ईच्छुक हुनुहुन्छ ?

जोड्नुहुन्छ भने निम्न जानकारी प्रदान गर्नुहोस्:

क्र.सं.	प्रदन्तुलोगको नाम	उमेर	लिंग	शिक्षा	तालिम स्थान	आशा गरिएको काम
१						
२						
३						
४						

कोड:

आशा गरिएको काम: १ - दल जनशक्ति

२ - अर्धदल जनशक्ति

३ - अन्य:



१०.२ यदि छ भने तपाईंको विचारमा यस आयोजनाले यस क्षेत्रमा के कस्तो प्रभाव पार्दछ?

- (क) जागीर पाउने सम्भावना बढे हुन्छ
- (ख) जागीर पाउन गाह्रो हुन्छ
- (ग) बाहिर बाट अधिक मात्रामा सामान आउँछ
- (घ) मुख्य बृद्धि हुन्छ
- (ङ) सामाजिक सुरक्षा बढे आउँछ
- (च) अन्य:.....

१०.३ यस आयोजनाले महिलाहरूमा के कस्तो प्रभाव पाले ?

- (क) कामको भार बढे
- (ख) रोजगारी पाउने
- (ग) सामाजिक असुरक्षा
- (घ) अन्य:

११. क्षतिपूर्ति:

११.१ के तपाईं यो आयोजना आर्जस भन्ने चाहनुहुन्छ ? चाहन्छु चाहन्न

११.२ यदि यस आयोजनाले तपाईंको घर जग्गा अधिग्रहण गर्‍यो भने तपाईं त्यसको बदलमा कस्तो क्षतिपूर्ति चाहनुहुन्छ ?

- (क) नगद क्षतिपूर्ति
- (ख) जग्गाको बदलामा जग्गा
- (ग) अन्य कुनै:

११.३ यदि नगद चाहनुहुन्छ भने आशा गरिएको रकमको विवरण दिनुहोस् ?

- (क) छैन:..... (होसक्ने)
- (ख) बाँकी:
- (ग) घर:

११.४ यदि नगद क्षतिपूर्ति सन्तुष्ट भए त्यो नगद तपाईं के ना खर्च गर्ने चाहनुहुन्छ ?

- (क) जग्गा किन
- (ख) कृषि तिर्ने
- (ग) नयाँ घर बनाउन
- (घ) अन्य:.....

११.५ प्रभावित जग्गामा तपाईंको निजी रखरक् छु ? यदि छु भने तान र मंझा दिनुहोस् ?

- १. २. ३.
- ४. ५. ६.



१२. पुनर्वासि-सम्बन्धि धारणा:

१२.१ यदि कहि गरि यस आयोजनाले तपाईंको घर जग्गा अधिग्रहण गर्यो भने के तपाईं छोड्न तयार हुनुहुन्छ ?

तयार छु तयार छैन

१२.२ यदि घर वार छोड्न तयार हुनुहुन्छ भने यहाँबाट तपाईं कहाँ जान मन पराउनुहुन्छ?

- (क) यसै क्षेत्रमा तर अलि माथी
- (ख) तराई क्षेत्रमा
- (ग) पहाडी क्षेत्रमा
- (घ) अन्य:

१२.३ यदि तपाईंहरु अन्य कुनै ठाउँमा बस्न जानु पर्यो भने तपाईं समुहगत रुपमा जान नन पराउनुहुन्छ कि एकलै ?

- (क) समुहगत रुपमा छिनेको हर सँगै
- (ख) एकलै
- (ग) अन्य:

१२.४ यदि तपाईंहरु अन्य कुनै ठाउँमा बस्न जानु पर्यो भने तपाईंको परिवारले नयाँ ठाउँमा गएर कुन पेश अपनाउने छन् ?

- (क) कृषीमा आधारित
- (ख) व्यवसाय (पसल, व्यापार, उद्योग, होटल)
- (ग) नोकरी
- (घ) अन्य:

१३. आयोजना वाट आशा:

१३.१ तपाईंले यस आयोजनाबाट के आशा गर्नुभएको छ ?

- (क) राम्रो क्षतिपूर्ति
- (ख) गागोर पाउने अवसर
- (ग) विजुली बाल्न पाइन्छ
- (घ) आयोजनाले गर्दा गाउँमा अन्य विकासका कार्यहरु हुन्छन्
- (ङ) अन्य:

अपर सेती जलाशययुक्त ज.वि. आयोजना

सामाजिक, आर्थिक तथा वातावरणीय पक्ष

Village Profile Questionnaire

१. आयोजना अे को बारेमा सामान्य जानकारी:

- (क) अंचल: (ख) जिल्ला:
 (ग) गा.वि.स.: (घ) वार्ड नं.:
 (ङ) टोल :
 (च) जानकारी दिनेको नाम:
 (छ) कार्यालय:
 (ज) पद, सेवा:
 (झ) अन्तरवाता विनेको नाम:
 (ञ) मिति:

२. जनसंख्या तथा घर धुरी संख्या:

वार्ड नं.	घर संख्या	जनसंख्या		जम्मा
		पुरुष	महिला	
१				
२				
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७				
८				
९				
१०				
जम्मा:				



३. शिक्षा

क्र.सं.	स्कूलको तह	स्कूल संख्या	शिक्षक संख्या	विद्यार्थी संख्या		
				केटा	केटी	जम्मा
१	प्राथमिक					
२	निम्न माध्यमिक					
३	माध्यमिक					
४	व्यावसायिक					
	जम्मा:					

४. यत्न ठाउँमा स्थापित उद्योगधन्दा को संख्या:

क्र. सं.	प्रकार	जम्मा संख्या	स्थान	वार्ड नं.	उत्पादन	विक्री
१	पानी घट्टा					
२	धान मील					
३	पाउरोटी उद्योग					
४	फर्निचर उद्योग					
५	जुता, छाला उद्योग					
६	सुचिकार					
७	डोरी फर्न					
८	नदीरा भट्टी					
९	सुनार					
१०	कानी					
११	अन्य (खुलाउने)					

महिलाहरू वारे अध्ययन

आयोजना स्थल:
मिति:

जिल्ला:
वार्ड नं.:

१. अन्तर्-वार्ता दिनेको सामान्य जानकारी

१.१ अन्तर्-वार्ता दिनेको नाम:

जात:
उमेर:

धर्म:
घरमूली संगको नाता:

१.२ यदि तपाईंको घरमा अविवाहित, विवाहित, पारपाचुके गरेको, विधवा, छुट्टिएर
बसेको वा १५ वर्ष मुनीको बाल विधवा छन् भने निम्न जानकारी दिनुहोस्:

क्र.सं.	घरमूली संगको नाता	उमेर वर्ष/महिना	शिक्षा	व्यवसाय (तालिम)

१.३ के तपाईं विवाहित हुनुहुन्छ ? छु / छैन

१.४ यदि हुनुहुन्छ भने, तपाईंको विवाह कति उमेरमा भएको थियो : विवाह
हुदाको उमेर लेख्ने:

१.५ तपाईंको वच्चा छ ? छ / छैन
यदि छ भने कति छ लेख्ने:

२. स्वास्थ्य

२.१ तपाईंको पहिलो वच्चा जन्मदा तपाईंको उमेर कति थियो ?.....(वर्ष)

२.२ तपाईंको वच्चा जन्मदा कसले हेर चाह वा वच्चा जन्माउनमा सहयोग
गर्यो?

(क) पुरानै तरिकाले परिवार बाटै

(ख) प्राईभेट डा. द्वारा

(ग) हेल्य प्वाण्ट भएको

(घ) जिल्ला अस्पताल भएको

(ङ) अरु कुनै छ भने बताउने:



नेपाल सरकार
सामाजिक मामाला
विभाग, काठमाडौं

२.३ तपाईको घरबाट हेल्युपाष्ट वा अन्य कुनै औषधी गर्ने ठाउँ कति टाढा छ ?
(किलोमिटर वा हिंडा लाग्ने समय लेख्ने.....)

३. व्यवसाय/भुमिका

३.१ तपाईंको आफ्नो घरको काम बाहेक, अन्य आयनूलक काम गर्ने समय छः

छ / छैन

३.२ यदि छ भने तपाईं अन्य आयनूलक काम गर्ने तयार भएका मध्ये हुनुहुन्छः

छ / छैन

३.३ यदि हुनुहुन्छ भने यी मध्ये कुन अन्य आयनूलक काम गर्ने तयार हुनुहुन्छः

- | | |
|--------------------------------|------------------------------|
| (क) फार्ममा काम गर्ने | (ख) उद्योगमा काम गर्ने |
| (ग) घरेलु नोकरी | (घ) घरेलु उद्योग |
| (ङ) निर्माण सम्बन्धि काम गर्ने | (च) नोकरी |
| (छ) व्यापार/चिया/पत्तल | (ज) घरपालुवा जनावरहरु पाल्ने |
| (झ) भरिया भई काम गर्ने | (ञ) अन्य: |

३.४ यदि चाहनुहुन्न भने, किन ?

- | | |
|---|--------------------------------|
| (क) खराब स्वास्थ्यले गर्दा | (ख) घरको कामबाट फुर्सद नभएकोले |
| (ग) घरमा वच्चाहरुको रेखदेख गर्नुपरेकोले | (घ) परिवारको त्विकृती छैन |
| (ङ) अन्य: | |

३.५ तपाईंको घरमा घर खर्चको लागि कसले पैसा राख्ने गरेको छः

पुरुष / महिला

३.६ सामान्यतया घरायसी निर्णय कसबाट गर्ने गरिन्छः

क्र.सं.	कृयाकलाप	पुरुष/महिला
१	कृषी	
२	शिक्षा	
३	किनमेल	
४	वच्चाको हेरचाह	
५	सामुदायिक विकास कार्य	
६	आय आर्जन कृयाकलाप	
७	स्वास्थ्य, सर सफाई	
८	लेन देन	

२३. आयोजना क्षेत्रमा अवस्थित सामाजिक लक्ष्य को विवरण:

नाम

क्याम्पमा

२४. पिछडिएका जनजाती (Disadvantaged Group):

२५. गाउँको जनघनत्व:

बाक्लो वस्ती

पातलो वस्ती



--	--	--	--	--	--	--

५.

वाणिज्य:

उन क्षेत्रों में उत्पादित सामानों के बजारों के आँकड़ें:

क्र.सं.	औद्योगिक	कृषिजन्य उत्पादन	गाईं भैंसों का उत्पादन	अन्य
१				
२				
३				
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६				

६.

व्यावसायिक पसलें

क्र.सं.	प्रकार	जम्मा संख्या	स्थान	वार्ड नं.
१	खुदरा पसल			
२	भोजनालय			
३	होटल, लज			
४	फलामें सामग्री पसल			
५	निर्माण सामग्री पसल			
६	फोटो स्टुडियो			
७	हजान			
१०	औपधी पसल			
११	अन्य (खुलाउने)			

७.

सार्वजनिक कार्यालय, संस्थान:

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क्र.सं.	प्रकार	जम्मा संख्या	स्थान	वार्ड नं.
१	स्कूल			
४	अस्पताल, हेल्थ पोष्ट			
५	हुलाक			
६	प्रहरी कार्यालय			
७	टेलिफोन कार्यालय			
८	वन कार्यालय			
९	सिंचाई कार्यालय			
१०	कृषी सेवा केन्द्र			
११	पशु चिकित्सालय			
१२	खेलकुद मैदान			
१३	खानेपानी कार्यालय			
१४	बैंक			
१५	अन्य (खुलाउने)			

९. नोटः

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Appendix C





नेपाल विद्युत प्राधिकरण

(श्री ५ को सरकारको स्वामित्व)

इन्जिनियरिङ सेवा

माटो, ढुङ्गा तथा कंक्रीट प्रयोगशाला

प.स. २०२० ०२९ च.त. - २०२१

मिति : २०२० ०९ २३

श्री छान गा.वि.स.को कार्यालय, तनहुँ । च.नं. - ३६४

श्री माभकोट गा.वि.स.को कार्यालय, तनहुँ । च.नं. - ३६२

श्री रानीपोखरी गा.वि.स.को कार्यालय, तनहुँ । च.नं. - ३६६

श्री पोखरी भञ्ज्याङ्ग गा.वि.स.को कार्यालय, तनहुँ । च.नं. - ३६२

श्री काहुशिवपुर गा.वि.स.को कार्यालय, तनहुँ । च.नं. - ३६४

श्री भिमाद गा.वि.स.को कार्यालय, तनहुँ । च.नं. - ३६२

श्री जामुने गा.वि.स.को कार्यालय, तनहुँ । च.नं. - ३६६

श्री कोटदरबार गा.वि.स.को कार्यालय, तनहुँ । च.नं. - ३६६

श्री जिल्ला बन् कार्यालय, तनहुँ । च.नं. - ३६८

श्री व्यास नगरपालीकाको कार्यालय, तनहुँ । च.नं. - ३६९, ३६९, ४००४७

श्री जिल्ला प्रशासन कार्यालय, तनहुँ । च.नं. - ३८०

श्री जिल्ला मालपोत कार्यालय, तनहुँ । च.नं. - ३८१

श्री जिल्ला विकास समिति, तनहुँ । च.नं. - ३८२, ३८३

श्री जिल्ला प्रहरी कार्यालय, तनहुँ । च.नं. - ३८८

विषय : उपस्थित भइदिने संवन्धमा ।

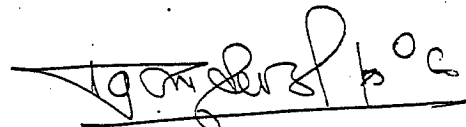
उपरोक्त विषयमा माथिल्लो सेती जलाशययुक्त जल विद्युत आयोजनाको वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धी सार्वजनिक सुनुवाई निम्न स्थान, मिति र समयमा हुनेभएकोले उक्त सुनुवाई कार्यक्रममा उपस्थित भई दिनुहुन अनुरोध गरिन्छ ।

अन्तिम जिल्ला बजार

स्थान : व्यास नगरपालीकाको भवन, दमौली, तनहुँ ।

मिति : २०२० साल माघ ११ गते आइतबार ।

समय : दिनको ११:०० बजे ।



(विष्णु बहादुर सिंह)

प्रयोगशाला प्रमुख



पो.ब.नं. १११३७, भगवान पाउ, स्वयम्भू, काठमाडौं, नेपाल ।

फोन नं. ४२७१३५१, ४२७१८८२, फ्याक्स नं. ४२७८३३६

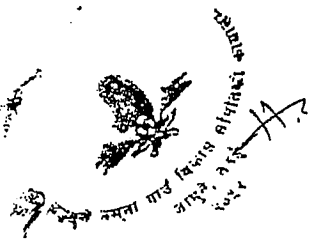
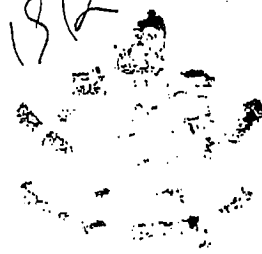
इमेल: srclnea@wlink.com.np

website: www.nea.org.np/srcl.html

नेपाल सरकार
वातावरण मन्त्रालय
तिरुवर, काठमाडौं



29/9/22
06018/22



29/9/22

सर्व विकास
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सर्व विकास

माथिल्लै सैती जलाशययुक्त जलविद्युत आयोजना
वातावरणीय प्रभाव मूल्याङ्कन सम्बन्धी
स्वातन्त्रिक सुनुवाई, माघ ११, २०६०

स्थान : जिल्ला सभामुख
दुमौली, लुम्बिनी

२

क्र.सं.	स्तर	हेतु	पद/संस्था	हस्ताक्षर
१	विश्वराज गैह्रे	राजौली-६, कृष्णपट्ट, सङ्खु	प्र.अ. श्री मेण्डा. वि. कृष्णपट्ट	श्री (प.गैह्रे)
२	भक्ति प्रसाद गैह्रे	" " " "	वि. वन प्रसाद गैह्रे	भक्ति प्रसाद
३	नन्द प्रसाद गैह्रे	जिम्मा वा वि. स. १५ नं. १	प्र.अ. प्रसाद	नन्द प्रसाद
४	पद्म प्रसाद गैह्रे	वि. स. १५ नं. १	वि. वन प्रसाद गैह्रे	पद्म प्रसाद
५	उद्योगिक	वि. स. १५ नं. १	वि. वन प्रसाद गैह्रे	उद्योगिक
६	टैक. बहादुर गजौली	काठमाडौं	काठमाडौं	टैक. बहादुर
७	जयप्रकाश गजौली	काठमाडौं	काठमाडौं	जयप्रकाश
८	रघुनाथ पौडेल	काठमाडौं	काठमाडौं	रघुनाथ
९	नारायण गजौली	काठमाडौं	काठमाडौं	नारायण
१०	सुन्दर गजौली	काठमाडौं	काठमाडौं	सुन्दर
११	पद्म गजौली	काठमाडौं	काठमाडौं	पद्म
१२	नारायण गजौली	काठमाडौं	काठमाडौं	नारायण
१३	वि. स. १५ नं. १	काठमाडौं	काठमाडौं	वि. स. १५ नं. १
१४	वि. स. १५ नं. १	काठमाडौं	काठमाडौं	वि. स. १५ नं. १
१५	वि. स. १५ नं. १	काठमाडौं	काठमाडौं	वि. स. १५ नं. १

क्र.सं.	नाम	ठेका ना	पद/संख्या	हस्ताक्षर
१६	विष्णु बहादुर झा	मो. दु. ग. म. के. उपप्रधान	उप.प.	19
१७	बहादुर नाथ झा	ने. वि. अ.	म. अ.प.	20
१८	शिव लाल झा	व्याव. - २, दमोली	२०० राखि जगद्विपरी	21
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२२	मुलक झा	मो. २००० वा. ६.	ने. म. ६. लोपारी	25
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१.	होम बहादुर थापा	काठु खिचपुर - १	समाजसेवी - १	होम बहादुर थापा
२.	रवि बहादुर थापा	" - १	" - १	रवि बहादुर थापा
३.	धन कुमारी थापा	" - १	" - १	धन कुमारी थापा
४.	विमल भाग्य थापा	" - १	" - १	विमल भाग्य थापा
५.	विमल कुमारी थापा	" - १	" - १	विमल कुमारी थापा
६.	विहसखा आले	" - १	" - १	विहसखा आले
७.	होम कुमारी साक	" - १	" - १	होम कुमारी साक
८.	जुन साक	" - १	" - १	जुन साक
९.	रवगी सरा थापा	" - १	" - १	रवगी सरा थापा
१०.	गत भाग्य थापा	" - १	" - १	गत भाग्य थापा
११.	कमलामोहन दाहाल	दाहाल - २	" - १	कमलामोहन दाहाल
१२.	मोहन हामाल	आइकोडी नेपाल कोशी	सि.उप.प्र. - १	मोहन हामाल
१३.	रमना थापा	काठु खिचपुर - १	समाजसेवी - १	रमना थापा
१४.	बैराव पडावुर नेमा	" - १	" - १	बैराव पडावुर नेमा

१५.	पुनःकार बेर	कोशी - २	" - १	पुनःकार बेर
१६.	हुम कं० थापा	काठु खिचपुर - १	" - १	हुम कं० थापा
१७.	नर कं० थापा	" - १	" - १	नर कं० थापा
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१९.	जुन थापा	काठु खिचपुर - १	" - १	जुन थापा
२०.	रामेश्वर थापा	" - १	" - १	रामेश्वर थापा
२१.	सावित्री थापा	" - १	" - १	सावित्री थापा
२२.	रामेश्वर थापा	" - १	" - १	रामेश्वर थापा
२३.	जोमान थापा	मोना - २	" - १	जोमान थापा
२४.	प्रियन्ता थापा	काठु खिचपुर - १	" - १	प्रियन्ता थापा
२५.	पुष्कर थापा	प्राणी कोशी - १	" - १	पुष्कर थापा
२६.	मोना थापा	काठु खिचपुर - १	" - १	मोना थापा
२७.	मिर्भदि थापा	" - १	" - १	मिर्भदि थापा
२८.	श्री लक्ष्मी आले	" - १	" - १	श्री लक्ष्मी आले
२९.	होम आले	" - १	" - १	होम आले
३०.	जुन कं० थापा	" - १	" - १	जुन कं० थापा
३१.	मोना कं० थापा	" - १	" - १	मोना कं० थापा

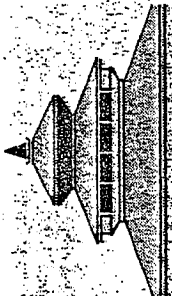
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नेपाली राष्ट्रिय दैनिक

कान्तिपुर



काठमाडौं र विराटनगरबाट प्रकाशित

गठसंज्ञा १५ माघ २०३० सोमबार सायं गृहदफ्ता नं. १२४

KANTIPUR, Nepal National Daily, Monday

माथिल्लो सेती आयोजना पूरा नभए मुलुकभर लोडसेडिङ हुने

■ धनश्याम खड्का

तनहुँ, ११ माघ- प्रस्तावित माथिल्लो सेती जलविद्युत आयोजना पूरा नभए विद्युत माग आपूर्तिमा आउने रोकवटका कारण आउँदा ५ वर्षपछि मुलुकभर लोडसेडिङ हुने विश्वहरूले बताएका छन् ।

आयोजनाले वातावरणमा पार्ने असरका सम्बन्धमा नेपाल विद्युत प्राधिकरणको केन्द्रीय कार्यालयमा आइतबार दमौलीमा आयोजना गरेको सार्वजनिक सुनुवाइमा जल विज्ञानियहरूले यो धारणा राखेका हुन् । आयोजनाको सम्भाव्यता अध्ययन पूरा भइसकेको छ । अर्को वर्ष दातु निकाय लगायतका लागि तयार भइसकेका छन् भन्ने हामी आशा छ- प्राधिकरणका

इन्जिनियर विष्णुबहादुर सिंहले भने । काम सुरु गरेको चार वर्षभित्र काम सम्प्त्त गर्ने योजना प्राधिकरणको छ ।

आयोजनाको कुल उत्पादन क्षमता १ सय २२ मेगावाट छ । यसका लागि २० करोड ३४ लाख अमेरिकी डलर खर्च लाग्ने सिंह बताउँछन् । यो १५ अबै नेपाली रूपैयाँ बराबर हुन आउँछ । विद्युत उत्पादन स्थल सदरमुकाम दमौलीबाट ३ किलोमिटर दक्षिण-पश्चिम दुलपट्टीमा छ । सम्भाव्यता अध्ययन २०४६ सालबाट सुरु भएको हो । यहाँबाट उत्पादित विद्युतलाई प्रतियुगित माग मूल्य २ रूपैयाँ पर्न आउँछ ।

आयोजनास्थलको मू-वनावटका कारण थोरै लगानीमा धेरै विद्युत उत्पादन गर्न सकिने प्राधिकरणले बताउँदै आएको छ । दुलपट्टीस्थित सेती नदीको किनारमा

दुवैतिर चार सय मिटरसम्मका आला पहाडी चट्टान छन् । सिंहका अनुसार यहाँ चट्टानका कारण यहाँ १ सय ४० मिटरसम्मको ग्राभो बाँध बनाउने लागिएको हो ।

वाघिवाट ७ दशमलव ६९ वर्ग मिटर क्षेत्रफलको ठूलो जलाशय तयार हुने छ । सिंहका अनुसार जलाशय बाँध क्षेत्रवाट २७ दशमलव ५ किलोमिटर माथिसम्म फैलने भएको छ ।

जलाशयका कारण जिल्लाको वनजंगल तथा बस्ती गरी ९ सय १७ हेक्टर जमिन डुवानमा पर्ने र यसवाट सात गाविसका तीन लाख चार हजार सय ३६ जनसंख्या तथा ३ सय २४ घरपरिवार विस्थापित हुने प्राधिकरणद्वारा गरिएको सम्भाव्यता अध्ययनमा उल्लेख छ ।



नेपाल सरकार
सिंहदरबार, काठमाडौं

गोरखापत्र

१० साल माघ १२ गते सोमवार ■ माघ शुक्ल पञ्चमी ■ नेपाल संवत् १९२४ सिल्लाख पञ्चमी ■ GORKHAPATRA DAILY January

माथिल्लो सेती जलविद्युत आयोजना निर्माण कार्य दुई वर्षभित्र शुरू हुने

काठमाडौं, माघ ११ गते । माथिल्लो सेती जलाशययुक्त विद्युत् आयोजनाको विस्तृत नमूना र निर्माण कार्य आगामी दुई वर्षभित्रमा शुरू हुने भएको छ ।

सो कार्यका लागि वैदेशिक आर्थिक स्रोत जुटाउन नेपाल विद्युत् प्राधिकरणले आवश्यक पहल गरिरहेको छ ।

कुल १२२ मेगावाट क्षमताको उक्त आयोजनाको मुख्य उद्देश्य नेपालमा दिन प्रतिदिन बढ्दैगएको विद्युत् शक्तिको माग र आपूर्तिको असन्तुलन हटाई राष्ट्रिय अर्थतन्त्रमा टेवा पुऱ्याउनु रहेको छ ।

श्री ५ को सरकार तथा नेपाल विद्युत् प्राधिकरणको संयुक्त लगानीमा प्राधिकरणअन्तर्गतको आयोजना विकास विभागले हाल सो आयोजनाको दोस्रो तथा अन्तिमचरणको संभाव्यता अध्ययन गरिरहेको छ । उक्त आयोजनाका सबै संरचना तनहुँ जिल्लाको सदरमुकाम दमौली र पृथ्वीराजमार्गबाट धेरै नजिक रहेनेछन् ।

आयोजनाको भूमिगत विद्युत् गृह ५५.५ मिटर लामो, १८ मिटर चौडाई र ३७ मिटर अग्लो दुईबटा ६५ मेगावाटका फ्रान्सिस टर्बाइनसहित उत्पादन उपकरणहरू जडान हुनेछन् ।

बाधको उचाई समुन्द्र सतहबाट ४२९ मिटर हुने र उत्पादित विद्युत् शक्तिलाई चार किलोमिटर लामो डवल सर्किट १३२ किलोभोल्ट क्षमता भएको प्रसारण लाइन

दमौली बजारस्थित सवस्टेशनसम्म लगी राष्ट्रिय प्रणालीमा आबद्ध गरिनेछ ।

निर्माण शुरू भएको मितिदेखि चार वर्षको अवधिमा सम्पन्न हुने उक्त आयोजनाको कुल लागत २० करोड तीन लाख ६० हजार अमेरिकी डलर लाग्ने नेपाल विद्युत् प्राधिकरणले जनाएको छ । प्रस्तावित उक्त आयोजना तनहुँ जिल्लाको हालसम्मको सबैभन्दा ठूलो हुने र आयोजनाका मुख्य संरचनामा बाध, जलाशय, सुरुङ्ग, विद्युत् गृह र प्रवेश मार्ग निर्माण गरिनेछ ।

आयोजनाले कुल ९१७ हेक्टर क्षेत्रफल प्रभाव पार्नेछ । उक्त आयोजनाले तनहुँ जिल्लाको व्यास नगरपालिका तथा माभकोट, छाड, रानीपोखरी, पोखरी भन्ज्याङ, काहुशिवपुर, भिमाद र जामुने र कोटदरवार गाविसका गरी ३२४ परिवारसहित तीन लाख चार हजार चारसय छयान्त्रे जनसङ्ख्यालाई प्रत्यक्ष तथा अप्रत्यक्षरूपमा प्रभाव पार्ने बताइएको छ ।

सोही सन्दर्भमा बातावरणीय प्रभाव तथा त्यसका न्यूनीकरण र निराकरणका उपाय, आयोजनाबाट प्रभावित परिवार र व्यक्तिहरूका सम्बन्धमा जानकारी दिने उद्देश्यले नेपाल विद्युत् प्राधिकरणले केही दिनमै दमौलीमा सार्वजनिक सुनुवाई कार्यक्रम गर्ने भएको छ ।

रासस

माथिल्लो सेती जलाशययुक्त आयोजना निर्माणको तयारी

● अमरराज नहर्की

तनहुँ
विगत लामो समयदेखि चर्चामा आइरहेको यहाँको प्रस्तावित माथिल्लो सेती जलाशययुक्त आयोजनाको निर्माणको तयारी थालनी गर्ने सरकारले उत्सुकता देखाएको छ ।

नेपाल विद्युत् प्राधिकरण आयोजना विकास विभाग काठमाडौँद्वारा आइतबार दमौलीमा गरिएको वातावरणीय प्रभाव, मूल्यांकनसम्बन्धी सार्वजनिक सुन्दाई कार्यक्रममा कार्यक्रमा टोली प्रमुख विष्णुबहादुर सिंहले चाडै नै आयोजनाको निर्माणकार्यको शालीनी गरिने जानकारी दिनुभयो । वातावरण संरक्षण ऐन २०५३ तथा वातावरण संरक्षण नियमावली २०५४ (पहिलो संशोधन

२०५५) अनुसार उक्त आयोजनाबाट यस क्षेत्रको भौतिक, जैविक, र आर्थिक-सामाजिक तथा सांस्कृतिक वातावरणमा पर्न सक्ने प्रभावहरूको बारेमा एकपटक भएको थियो ।

आयोजना क्षेत्रमा सार्वजनिक सुन्दाई कार्यक्रमको अन्तिम प्राथमिकता रहेकोमा आयोजना गरिएको हो ।
१२२ मेगावाट क्षमताको यस विद्युत् आयोजनाको मुख्य उद्देश्य नेपालमा दिन प्रतिदिन बढ्दै गएको विद्युत् शक्तिको माग र आपूर्तिको असन्तुलनलाई हटाई राष्ट्रिय अर्थतन्त्रमा टेवा पुर्‍याउनु रहेको छ । आयोजनाको सम्भाव्यता अध्ययनको दोस्रो चरणको कार्य सरकार तथा नेपाल विद्युत् प्राधिकरणअन्तर्गतको आयोजना विकास विभागले गरिरहेको छ । आयोजनाको विस्तृत अध्ययन र कार्ययोजनाको लागि वैदेशिक आर्थिक

स्रोत जुटाउने र वातावरणीय प्रभाव र त्यसको न्यूनीकरण तथा निराकरणका उपपक्षहरूको बारेमा कार्यक्रममा छलफल भएको थियो ।

यस सार्वजनिक सुन्दाईमा सम्पूर्ण आयोजना क्षेत्रमा सार्वजनिक सुन्दाई कार्यक्रमको अन्तिम प्राथमिकता रहेकोमा आयोजना गरिएको हो ।
१२२ मेगावाट क्षमताको यस विद्युत् आयोजनाको मुख्य उद्देश्य नेपालमा दिन प्रतिदिन बढ्दै गएको विद्युत् शक्तिको माग र आपूर्तिको असन्तुलनलाई हटाई राष्ट्रिय अर्थतन्त्रमा टेवा पुर्‍याउनु रहेको छ । आयोजनाको सम्भाव्यता अध्ययनको दोस्रो चरणको कार्य सरकार तथा नेपाल विद्युत् प्राधिकरणअन्तर्गतको आयोजना विकास विभागले गरिरहेको छ । आयोजनाको विस्तृत अध्ययन र कार्ययोजनाको लागि वैदेशिक आर्थिक

उत्पादन उपकरणहरू जडान हुनेछन् । उत्पादित विद्युत्लाई ४ किमि लामो डबल सर्किट १ सय ३६ किलोभोल्ट क्षमता भएको प्रसारण लाइनद्वारा दमौलीविजारीस्थित सबस्टेशनसम्म ल्याई त्यसबाट विद्युत् प्राधिकरणको छ १ रे सुपरग्रेडलेभ ११० किमि लामो लाइनद्वारा नेपाल विद्युत् प्राधिकरणको अनुसार यस आयोजनाले ९ सय १७ हेक्टर क्षेत्रफल प्रभाव पार्नेछ । यसै आयोजनाले तनहुँको व्यास नगरपालिकासहित माभकोट, छाङ्ग, रानीपोखरी, पोखरीभञ्ज्याङ, कर्तुशिवपुर, भिमाङ, जामुने तथा कोटरवार गाविसका ३ सय २५ परिवारसहित ३ लाख ४ हजार ४ सय ९६ जनसंख्यालाई प्रत्यक्ष अप्रत्यक्षरूपमा प्रभाव पार्नेछ । यसै गरी आयोजनाको निर्माणबाट १ सय ५५ हेक्टर वन क्षेत्र प्रभावित हुनेछ ।

आयोजनाको सबै संरचनाहरू पृथ्वीउपजर्मागको दमौलीबाट धेरै नजिक रहेकाले निर्माण चालू भएपछि चार वर्षभित्रमा सम्पन्न हुने अनुमान, नेपाल विद्युत् प्राधिकरणको छ । रे सुपरग्रेडलेभ ११० किमि लामो लाइनद्वारा नेपाल विद्युत् प्राधिकरणको अनुसार यस आयोजनाले ९ सय १७ हेक्टर क्षेत्रफल प्रभाव पार्नेछ । यसै आयोजनाले तनहुँको व्यास नगरपालिकासहित माभकोट, छाङ्ग, रानीपोखरी, पोखरीभञ्ज्याङ, कर्तुशिवपुर, भिमाङ, जामुने तथा कोटरवार गाविसका ३ सय २५ परिवारसहित ३ लाख ४ हजार ४ सय ९६ जनसंख्यालाई प्रत्यक्ष अप्रत्यक्षरूपमा प्रभाव पार्नेछ । यसै गरी आयोजनाको निर्माणबाट १ सय ५५ हेक्टर वन क्षेत्र प्रभावित हुनेछ ।



भञ्ज्याङ

राष्ट्रिय दैनिक

वर्ष २२ अङ्क १०६ २०६० पौष ३० गते बुधवार (Bhanjyang National Daily, 14 January

जलाशयले पोखरी भञ्ज्याङदेखि भिमाद सम्म प्रभाव पार्ने माथिल्लो सेती आयोजनाको वातावरणीय प्रभाव बारे सार्वजनिक सुनवाइ हुने

दमौली, पौष-२९

माथिल्लो सेती जलाशय भञ्ज्याङ, काहुँ शिवपुर, काटदरवार, युत्तः जलविद्युत आयोजनाको रानीपोखरी, माझकोट, भिमाद, झाडा र जामुने भञ्ज्याङ रहेका छन्। वातावरण संरक्षण ऐन २०५३, वातावरण संरक्षण नियामवली २०५४, प्रथम संसोधन २०५५ को आधारमा वातावरणीय प्रभाव मूल्याङ्कन प्रतिवेदन तयारी गर्ने मिलासिलांग हुन लागेको सार्वजनिक सुनवाइ आयोजना गरिनु लागिएको छ। यसको मुख्य उद्देश्यमा आयोजना कार्यन्वयबाट वातावरणमा पर्ने संकेत भौतिक, जैविक, आर्थिक तथा सामाजिक र सांस्कृतिक प्रभावहरूको बारेमा स्थानीय जनताहरूलाई जानकारी गराउनु भएको छ।

प्रस्तावित आयोजनाबाट प्रभावित हुने क्षेत्रहरूमा व्यास नगर पालिका, गाविसहरूमा पोखरी

माथिल्लो सेती

बुद्धिजीवीहरू, सरोकारवाला, संघ संस्था, विद्यालय, अस्पताल, मठ-मन्दिर का सञ्चालनका आदि क्षेत्रबाट राय सुझाव संकलन गर्ने उद्देश्य रहेको समाचार स्रोतमा जनाइएको छ। आयोजनाको तर्फबाट व्यापक सहभागिताको पनि अपेक्षा राखेको कुरा जनाइएको छ।

जलाशययुक्त विद्युत् योजनाको निर्माण सुरु हुने

काठमाडौं, ९ माघ : माथिल्लो सेती जलाशययुक्त विद्युत् आयोजनाको विस्तृत नमुना र निर्माणकार्य आगामी दुई वर्षभित्रमा सुरु हुने भएको छ।

त्यस कार्यका लागि देशिक आर्थिक स्रोत जुटाउन नेपाल विद्युत् प्राधिकरणले आवश्यक पहल गरिरहेको छ। कुल १२२ मेघावाट क्षमताको उक्त आयोजनाको मुख्य उद्देश्य नेपालमा दिनप्रतिदिन बढ्दै गएको विद्युत् शक्तिको माग र आपूर्तिको असन्तुलन हटाई राष्ट्रिय अर्थतन्त्रमा टेवा पुऱ्याउनु रहेको छ। सरकार तथा नेपाल विद्युत् प्राधिकरणको संयुक्त लगानीमा प्राधिकरणअन्तर्गतको आयोजना विकास विभागले हाल सो आयोजनाको दोस्रो तथा अन्तिम चरणको सम्भाव्यता अध्ययन गरिरहेको छ। उक्त आयोजनाका सबै संरचना तनहुँ जिल्लाको सदरमुकाम दमौली र

पृथ्वीगजमार्गबाट धेरै नजिक रहनेछन्।

आयोजनाको भूमिगत विद्युत्गृहमा ५५.५ मिटर लामो, १८ मिटर चौडाइ र ३७ मिटर अग्लो दुईवटा ६९

मेघावाटका ट्रान्सिस टर्बाइनसहित उत्पादन उपकरणहरू जडान हुनेछन्। बाँधको उचाइ समुन्द्र सतहबाट चार सय २९ मिटर हुने र उत्पादित विद्युत् शक्तिलाई चार किलोमिटर लामो डबल सर्किट १३२ किलोभोल्ट क्षमता भएको प्रसारण लाइनबाट दमौलीबजारस्थित सबस्टेसनसम्म लगी राष्ट्रिय प्रणालीमा आबद्ध गरिनेछ।

निर्माण सुरुभएको मितिदेखि चार वर्षको अवधिमा सम्पन्न हुने उक्त आयोजनाको कुल लागत २० करोड तीन लाख ६० हजार अमेरिकी डलर लाग्ने नेपाल विद्युत् प्राधिकरणले जनाएको छ। प्रस्तावित उक्त आयोजना तनहुँ जिल्लाको हालसम्मको सबैभन्दा ठूलो हुनेछ।

आयोजनाका मुख्य संरचनामा बाँध, जलाशय, सुरुङ्ग विद्युत्गृह र प्रवणमार्ग निर्माण गरिनेछ।

आयोजनाले कुल नौ सय १७ हेक्टर क्षेत्रफलमा प्रभाव पार्नेछ। आयोजनाले तनहुँ जिल्लाको व्यास नगरपालिका तथा मझकोट, छाङ, रानीपोखरी, पोखरीभन्स्याङ, काहुँशिवपुर, भिमाद, जामुने र कोटदरबार गाविसका गरी तीन सय २४ परिवारसहित तीन लाख चार हजार चार सय छ्यान्नब्बे जनसंख्यालाई प्रत्यक्ष तथा अप्रत्यक्ष रूपमा प्रभाव पार्ने बताइएको छ।

सोही सन्दर्भमा वातावरणीय प्रभाव तथा त्यसको न्यूनीकरण र निराकरणका उपाय, आयोजनाबाट प्रभावित परिवार र व्यक्तिहरूका सम्बन्धमा जानकारी दिने उद्देश्यले नेपाल विद्युत् प्राधिकरणले केही दिनमै दमौलीमा सार्वजनिक सुनुवाइ गरिने भएको छ। —एसस

माथिल्लो सेती जलविद्युत् आयोजनाका लागि लगानी जुटाउने प्रयास

मदन बाग्ले

तनहुँ, १५ माघ : प्रस्तावित एक सय २२ मेघावाट क्षमताको माथिल्लो सेती जलविद्युत् आयोजनाको विस्तृत अध्ययन र कार्यान्वयनका लागि वैदेशिक लगानी जुटाउने प्रयास जारी रहेको सो आयोजनाले जनाएको छ। नेपालमा बढ्दै गएको विद्युत् शक्तिको माग र आपूर्तिको असन्तुलनलाई हटाई राष्ट्रिय अर्थतन्त्रमा टेवा पुऱ्याउने उद्देश्यले यो आयोजनालाई कार्यान्वयन गर्न लागिएको सम्बद्ध अधिकारीहरूले जनाएका छन्।

उनीहरूका अनुसार श्री ५ को सरकार तथा नेपाल विद्युत् प्राधिकरणको संयुक्त लगानीमा नेपाल विद्युत् प्राधिकरणको आयोजना विकास विभागले माथिल्लो सेती जलाशययुक्त विद्युत् आयोजनाको सम्भाव्यता अध्ययन गर्ने दोस्रो चरणको कार्य गरिरहेको छ।

नेपाल विद्युत् प्राधिकरणले यसअगाडि नै प्रस्तावित सो आयोजनाको वातावरणीय प्रभाव र भूजलको प्रभाव बारेमा अध्ययन गरेर त्यस सम्बन्धी प्रतिवेदनसमेत सार्वजनिक गरिसकेको छ।

उक्त आयोजनाबाट यस क्षेत्रको भौतिक, जैविक र आर्थिक, सामाजिक तथा सांस्कृतिक वातावरणमा पर्नेसक्ने प्रभावबारे विभिन्न सुझावहरू संकलन गर्नका लागि सार्वजनिक सुनुवाइ गर्ने कार्य सम्पन्न भइसकेको अध्ययन टोलीले जानकारी दिएको छ।

अनुमानित १५ अर्ब रुपैयाँ लागत रहने उक्त आयोजनाको निर्माणकार्य सुरु भएपछि चार वर्षमा सम्पन्न हुने र त्यसले आयोजनास्थल वरपरका नौ सय १७ हेक्टर क्षेत्रफल जमिनमा प्रभाव पार्ने त्यस सम्बन्धी एक प्रतिवेदनमा उल्लेख गरिएको छ। प्रतिवेदनका

माथिल्लो सेतीले दमौलीको मुहार फेरिदिने दाबी

तनहुँ जिल्ला विकास समिति तनहुँका पूर्वसभापति रामचन्द्र पोखरेलले बिहीबार यहाँ एक पत्रकार सम्मेलनको आयोजना गर्दै माथिल्लो सेती जलविद्युत् आयोजनाले आर्थिक क्षेत्रमा विकास ल्याई जिल्ला सदरमुकाम दमौलीको मुहार नै परिवर्तन गरिदिने बताउनुभएको छ। उहाँले वरपरका मस्याङ्दी, मध्यमस्याङ्दी, कालीगण्डकी र पोखरा

सेती परियोजनाको अनुभवबाट पाठ सिक्नु नुहने दोहोरिनु नदिनु नगरिक समालोचना गर्नु हुनुपर्ने भन्दै दिनुभयो। पूर्वसभापति पोखरेलले जिल्लाको उत्तर दक्षिणी क्षेत्रमा योजनाले बढी प्रभाव पार्ने सम्भव भएकोले यसको बीच भागमा मोटर चलाउने पुलको आवश्यकता रहेको पत्रकार सम्मेलनमा जानकारी गराउनुभयो।

अनुसार आयोजनाले तनहुँ जिल्लाको व्यास नगरपालिका, मझकोट, छाङ, ऋषिङ रानीपोखरी, पोखरीभन्स्याङ, काहुँशिवपुर, भिमाद, जामुने र कोटदरबार गाविसका तीनसय २४ घर परिवारलाई

यसैगरी, आयोजना अन्तर्गत निर्माण गरिने जलाशयले त्यस क्षेत्रका चारवटा झोलुंगेपुल, एउटा मन्दिर, तीनवटा घाटहरू समेतलाई प्रभाव पार्ने तथा करिब एक सय ५५ हेक्टर वनक्षेत्र प्रभावित हुने आयोजनाको वातावरणीय प्रभाव मूल्यांकनसम्बन्धी संक्षिप्त विवरण पुस्तिकामा जनाइएको छ।

सो पुस्तिकाका अनुसार हालसम्मको अध्ययनबाट आयोजनाको फाइदा तथा लागतको अनुपात एक दशमलव २६ रहेको छ भने आन्तरिक प्रतिफल दर १२.५ प्रतिशत रहेको छ। आयोजनाको प्रतिकिलोवाट लागत एक हजार छ सय १५ अमेरिकी डलर र प्रतियुनिट मूल्य दुई दशमलव ८१ सेन्ट प्रतिकिलोवाट

रहेको बताइएको छ। श्री ५ को सरकार तथा नेपाल विद्युत् प्राधिकरणले उक्त आयोजनाका लागि लगानी गर्ने दातृ संस्थाको खोजी गरिरहेको आयोजनाका प्रमुख गिरिजानन्द मिश्रले अन्नपूर्ण, प्रोष्टलाई बताउनुभयो। यसको लागि विषय बैंक, ब्रिच, फिनिक्स बैंक विकास बैंकजस्ता अन्तराष्ट्रिय दातृ निकायहरूसँग कुरा भइरहेको पनि उहाँले बताउनुभयो।

उक्त आयोजना तनहुँकै सबैभन्दा ठूलो जलविद्युत् आयोजना हुने भएकाले त्यसबाट स्थानीयस्तरको विकासका लागि आवश्यक पूर्वाधार निर्माण हुनुका साथै अल्पकालीन तथा दीर्घकालीन रोजगारीका अवसर पनि बढ्ने टोली प्रमुख विष्णुबहादुर सिंहले बताउनुभयो।

यसैबीच, तनहुँ जिल्लाकै गाईघाटस्थित मादी र सेती नदीबाट तल्लो सेती जलविद्युत् आयोजनाका लागि पनि सम्भाव्य अध्ययन भइरहेको जानकारी पनि आयोजना प्रमुख मिश्रले दिनुभयो।

फेवाको जलकम्भी नियन्त्रणार्थ खानेपानी



१२२ मेघावाट क्षमताको माथिल्लो सेती जलविद्युत आयोजनाको बातावरणीय प्रभावबारे छलफल

शुक्रबार जलेश्वर/समाधान
तुम्ही ११ माघ ।

तनहुँ जिल्लाको उदरमुकाम इमौली नजिक रहेको सेती नदीमा माथिल्लो सेती जलविद्युत आयोजनाको दोस्रो चरणको कार्य सम्पन्न भएको छ । यसै विषयलाई लिएर आइतबार दमौलीमा यस प्रस्ताविक आयोजनाले बातावरणमा पार्ने प्रभावका बारेमा छलफल कार्यक्रम सम्पन्न भएको छ ।

१ जसको १ हजार ६ सय १५ यूएस डलर प्रति किलोमिटरबाट लागत रहने अनुमान नेपाल सरकारले गरेको छ । तनहुँ जिल्लाको सबैभन्दा ठूलो आयोजना भएको इमौली यस क्षेत्रका जनताको विकासको निम्ति आवश्यक पूर्वाधारहरूको स्थापना तथा अल्पाको र दीर्घकालीन रोजगारीको अवसरहरू बढ्ने, तथा उद्योगधन्दाहरूको सुलभता, जलको विकास, ठूलो जलाशय क्षेत्रमा पपेटक आगमनमा बृद्धि, सांस्कृतिक, तत्त्व पालन तथा समग्रमा राष्ट्रिय अर्थतन्त्रमा समेत टेवा पुग्ने देखिन्छ ।

नेपालको राष्ट्रिय विद्युत प्रणालीमा

मूल्यमा समेत फेर बढ्न हुन सक्ने तथा वन जंगलमा अतिरिक्त चाप बढ्ने, झुन्डो, आमादहबाट, सुमाझुङ, विकलि, आमा नैसकेको प्रविधेक्षमा आयोजनाको कुनैटको दुईफेकले पनि माथिल्लो सेती जलविद्युत आयोजनाको आवश्यकता सहभागीले बताए ।

मरिजातको नरामा पक्ष एकतिर भएता पनि करिब चार वर्षमा सम्पन्न हुने उक्त आयोजनाबाट विद्युत उत्पादन भएको खण्डमा नेपालमा विज्ञाति बढ्ने किसिमको आयोजनाको निर्माण कार्य अति आवश्यक भएको छ । तनहुँ जिल्लाको सबैभन्दा ठूलो आयोजना भएको इमौली यस क्षेत्रका जनताको विकासको निम्ति आवश्यक पूर्वाधारहरूको स्थापना तथा अल्पाको र दीर्घकालीन रोजगारीको अवसरहरू बढ्ने, तथा उद्योगधन्दाहरूको सुलभता, जलको विकास, ठूलो जलाशय क्षेत्रमा पपेटक आगमनमा बृद्धि, सांस्कृतिक, तत्त्व पालन तथा समग्रमा राष्ट्रिय अर्थतन्त्रमा समेत टेवा पुग्ने देखिन्छ ।

नेपालको राष्ट्रिय विद्युत प्रणालीमा

वातावरणीय व्यवस्थापन योजनाहरू बनाई सञ्चालन गर्ने बाग्यतका रहेका छन् । सेती नदीमा मरम्भगत रुपमा भइरहेको विभिन्न जातका माछाहरू पनि आयोजना सञ्चालन पछि हराउने भएकाले कालीगण्डकी ए जलविद्युत आयोजनामा भस्ताव गरिएको माछाको भुटा उत्पादन केन्द्रको सहयोगमा यस आयोजनाको जलाशयमा सामुदायिक मत्स्य पालन कार्यक्रमको विकास गरिने योजना रहेको छ ।

आयोजनाबाट इमौली नजिकै रहेकाले उत्पन्न विजुली ४ किलोमिटर लामो डबल सर्किट १३२ किलो भोल्ट क्षमता भएको प्रसारण लाइन दमौली बजारस्थित स्विचगृहसम्म लगेर राष्ट्रिय प्रणालीमा आबद्ध गरिने योजना रहेको आयोजना प्रमुख मरिजानन्द मिश्रले बताए ।

समरणीय छ उक्त प्रस्ताविक आयोजनाको तात्कालिन जलश्रोतभन्दी दीपक जवालीले निरीक्षण गरी सम्भाव्यताको अध्ययन समेत एक टोलीले गत वर्ष गरेको थियो तनहुँ नजीकै उक्त आयोजना शुरू हुने पर्ने पक्षमा रहेका छन् ।

थ

माथिल्लो सेती जलविद्युत आयोजना निर्माण कार्य दुई वर्षभित्र शुरु हुने

काठमाडौं, माघ ११ गते। माथिल्लो सेती जलाशययुक्त विद्युत् आयोजनाको विद्युत् तन्मूला र निर्माण कार्य आगामी दुई वर्षभित्रमा शुरु हुने भएको छ।

सो कार्यका लागि वैदेशिक आर्थिक स्रोत जुटाउन नेपाल विद्युत् प्राधिकरणले आवश्यक पत्रले गरिरहेको छ।

कुल १२२ मेगावाट क्षमताको उक्त आयोजनाको मुख्य उद्देश्य नेपालमा दिन प्रतिदिन बढ्दैगएको विद्युत् शक्तिको माग र आपूर्तिको असन्तुलन हटाई राष्ट्रिय अर्थतन्त्रमा टेवा पुऱ्याउनु रहेको छ।

श्री ५ को सरकार तथा नेपाल विद्युत् प्राधिकरणको संयुक्त लगानीमा प्राधिकरणअन्तर्गतको आयोजना विकास विभागले हाल सो आयोजनाको दौम्रो तथा अन्तिमचरणको संभाव्यता अध्ययन गरिरहेको छ। उक्त आयोजनाका सबै संरचना तनहुँ जिल्लाको सदरमुकाम दमौली र पृथ्वीराजमार्गबाट धेरै नजिकै रहनेछन्।

आयोजनाको भूमिगत विद्युत् गृह ५५.५ मिटर लामो, १८ मिटर चौडाइ र ३७ मिटर अग्लो दुईवटा ६१ मेगावाटका फ्रान्सिस टर्बाइनसहित उत्पादन उपकरणहरू जडान हुनेछन्।

वाघको उचाइ समुन्द्र सतहबाट ४२९ मिटर हुने र उत्पादित विद्युत् शक्तिलाई चार किलोमिटर लामो डवल सर्किट १३२ किलोभोल्ट क्षमता भएको प्रसारण लाइन

दमौली बजारस्थित सबस्टेसनसम्म लगेर राष्ट्रिय प्रणालीमा आबद्ध गरिनेछ।

निर्माण शुरु भएको मितिदेखि चार वर्षको अवधिमा सम्पन्न हुने उक्त आयोजनाको कुल लागत २० करोड तीन लाख ६० हजार अमेरिकी डलर लाग्ने नेपाल विद्युत् प्राधिकरणले जनाएको छ। प्रस्तावित उक्त आयोजना तनहुँ जिल्लाको हालसम्मको सबैभन्दा ठुलो हुने र आयोजनाका मुख्य संरचनामा बाँध, जलाशय, सुरङ्ग, विद्युत् गृह र प्रवेश मार्ग निर्माण गरिनेछ।

आयोजनाले कुल ९१७ हेक्टर क्षेत्रफल प्रभाव पार्नेछ। उक्त आयोजनाले तनहुँ जिल्लाको व्यास नगरपालिका तथा माभुकोट, छाड, रानीपोखरी, पोखरी भन्ज्याङ, काहुशिवपुर, भिमाद र जामुने र कोटदरवार गाविसका गरी ३२४ परिवारसहित तीन लाख चार हजार चारसय छयान्नव जनसङ्ख्यालाई प्रत्यक्ष तथा अप्रत्यक्षरूपमा प्रभाव पार्ने बताइएको छ।

साँघो सन्दर्भमा बातावरणीय प्रभाव तथा त्यसका न्यूनीकरण र निराकरणका उपाय, आयोजनाबाट प्रभावित परिवार र व्यक्तिहरूका सम्बन्धमा जानकारी दिने उद्देश्यले नेपाल विद्युत् प्राधिकरणले केही दिनमै दमौलीमा नावजानिक नुनुवाई कार्यक्रम गर्ने भएको छ।

रासल



नेपाली राष्ट्रिय दैनिक

कान्तिपुर

वर्ष १२ अंक १० काठमाडौं १२ फागुन २०६० शनिवार फाल्गुन शुक्लपक्ष अष्टमी

साथिल्लो सेतीमा दोस्रो ठूलो जलाशय बन्ने

६४ घनशयाम खड्का

तनहुँ १५ फागुन- साथिल्लो सेती परियोजनामा मुलुककै दोस्रो ठूलो मानव निर्मित जलाशय बन्ने भएको छ । यसबाट जैविक विविधता र हावापानीमा सकारात्मक परिवर्तन आउने वातावरणविदहरूको दावी छ ।

परियोजनाको सम्भाव्यता अध्ययन प्रतिवेदन अनुसार बाँधदेखि दक्षिण पश्चिमको २७ दशमलव ५ किलोमिटर क्षेत्रफल जलाशयले ओगट्ने छ । जलाशयको सरदर गहिराइ ७ दशमलव ६९ वर्गमिटर हुने प्रतिवेदनमा उल्लेख छ । प्राधिकरणका जल इन्जिनियर विष्णुवहादुर सिंह सेतीमा बन्ने उक्त जलाशय कुल्लेखानीपछिको सर्वाधिक ठूलो कृत्रिम जलाशय भएको बताउँछन् ।

उनका अनुसार जलाशयको

आर्थिक महत्त्व अझ धेरै छ । 'नेपालका ठूलाठूला परियोजनामा पनि सुख्खा मौसममा साविक बिजुली उत्पादन हुन सकेको छैन । हिउँदमा नदी सुक्ने गरेकाले यो समस्या देखिएको हो ।' उनी भन्छन्, 'साविक बिजुली उत्पादन नहुँदा देशले धेरै घाटा सहनु परेको छ । तर यो जलाशयका कारण हिउँदमा पनि पानीको समस्या नहुने भएकाले विद्युत् उत्पादन कम हुँदैन ।' परियोजनाको कुल उत्पादन क्षमता १ सय २२ मेगावाट छ ।

यहाँका सात गाविस भने बाँध बनेपछि डुवानमा पर्ने सम्भाव्यता अध्ययनले देखाएको छ । प्राधिकरणअन्तर्गतको माटो, ढुङ्गा तथा कंक्रीट प्रयोगशालाका अधिकृत देवीप्रसाद अधिकारीका अनुसार रानी पाखरी, छाड, जामुने, माझकोट, कोटवरवार, पाखरी भन्ज्याङ र भिमाद गाविस डुवानमा

पर्नेछन् । यी ठाउँका वासिन्दालाई उचित क्षतिपूर्तिको व्यवस्था गरी अन्यत्र सारिने उनले बताए ।

यहाँको जैविक विविधतामा अब बन्ने तालले सकारात्मक र नकारात्मक दुवै प्रभाव पार्ने वातावरणविदको दावी छ । 'तालका कारण स्थानीय जीवजन्तु डुवानमा परी नासिने खतरा छ ।' भानुमती शान्ति निकुञ्जका सभापति रामचन्द्र पौडेलले भने, 'काम सुरु गर्नुअघि यसतर्फ आवश्यक सतर्कता नअपनाए वातावरणमा धेरै नोक्सान पुग्न सक्छ ।' वातावरणवादीको स्वतन्त्र समूह गठन गरी तालले पार्ने असरको सूक्ष्म अध्ययन हुनुपर्ने उनी बताउँछन् ।

उनका अनुसार जलाशयका कारण हिउँदमा साइबेरियादेखिका चरा यहाँ आउने सम्भावना छ । यो परियोजनाको सकारात्मक पक्ष भएको उनले बताए ।

स्थित भन्त नारायण मनाउन लागिएका

प्रीतिशतले बढी रहेको जनाएको छ ।

तावत्पुन उचाहरूक मुभभव भयो ।

बढेकोछ योजना अन्तर्गत

उत्पादन उपकरणहरू जडान हुनेछ ।

उत्पादन उपकरणहरू जडान हुनेछ ।

माथिल्लो सेती जलाशययुक्त आयोजना निर्माणको तयारी

● असारराज न्हर्की

विगत लामो समयदेखि चर्चामा

आइरहेको यहाँको प्रस्तावित माथिल्लो

सेती जलाशययुक्त जलविद्युत

आयोजनाको डिसेम्बरमा निर्माणको

शालनी गर्न सरकारले उत्सुकता

देखाएको छ ।

नेपाल विद्युत् प्राधिकरण आयोजना

विकास विभाग काठमाडौँबाट आइतबार

दमौलीमा गएको वातावरणीय प्रभाव,

मूल्यांकनसम्बन्धी सार्वजनिक सुनाई

कार्यक्रममा टोली प्रमुख

विष्णुहराज सिंहले चाँडै नै आयोजनाको

निर्माणकार्यको शालनी गरिने जानकारी

दिनुभयो । वातावरण संरक्षण ऐन

२०५३ तथा वातावरण संरक्षण

नियमावली २०५४ (पहिलो संशोधन

२०५४) अनुसार उक्त आयोजनाबाट

यस क्षेत्रको भौतिक, जैविक र आर्थिक-

सामाजिक तथा सांस्कृतिक वातावरणमा

पर्न सक्ने प्रभावहरूको बारेमा एकपटक

आयोजनाको डिसेम्बरमा निर्माणको

शालनी गर्न सरकारले उत्सुकता

देखाएको छ ।

नेपाल विद्युत् प्राधिकरण आयोजना

विकास विभाग काठमाडौँबाट आइतबार

दमौलीमा गएको वातावरणीय प्रभाव,

मूल्यांकनसम्बन्धी सार्वजनिक सुनाई

कार्यक्रममा टोली प्रमुख

विष्णुहराज सिंहले चाँडै नै आयोजनाको

निर्माणकार्यको शालनी गरिने जानकारी

दिनुभयो । वातावरण संरक्षण ऐन

२०५३ तथा वातावरण संरक्षण

नियमावली २०५४ (पहिलो संशोधन

स्रोत जुटाउने र वातावरणीय प्रभाव र

त्यसको न्यूनीकरण तथा निराकरणको

उपायहरूको बारेमा कार्यक्रमा छलफल

भएको थियो ।

नेपाल विद्युत् प्राधिकरण आयोजना

विकास विभाग काठमाडौँबाट आइतबार

दमौलीमा गएको वातावरणीय प्रभाव,

मूल्यांकनसम्बन्धी सार्वजनिक सुनाई

कार्यक्रममा टोली प्रमुख

विष्णुहराज सिंहले चाँडै नै आयोजनाको

निर्माणकार्यको शालनी गरिने जानकारी

दिनुभयो । वातावरण संरक्षण ऐन

२०५३ तथा वातावरण संरक्षण

नियमावली २०५४ (पहिलो संशोधन

धारणा ओल्याएको थिए ।

आयोजनाको सधै संरचनाहरू

पूर्वीराजमार्गको दमौलीबाट धेरै नजिक

रहेकाले निर्माण चालू भएपछि आर

वर्षभित्रमा सम्पन्न हुने अनुमान नेपाल

विद्युत् प्राधिकरण आयोजना

विकास विभाग काठमाडौँबाट आइतबार

दमौलीमा गएको वातावरणीय प्रभाव,

मूल्यांकनसम्बन्धी सार्वजनिक सुनाई

कार्यक्रममा टोली प्रमुख

विष्णुहराज सिंहले चाँडै नै आयोजनाको

निर्माणकार्यको शालनी गरिने जानकारी

दिनुभयो । वातावरण संरक्षण ऐन

२०५३ तथा वातावरण संरक्षण

नियमावली २०५४ (पहिलो संशोधन

उत्पादन उपकरणहरू जडान हुनेछ ।

उत्पादन उपकरणहरू जडान हुनेछ ।

उत्पादन उपकरणहरू जडान हुनेछ ।

उत्पादन उपकरणहरू जडान हुनेछ ।

उत्पादन उपकरणहरू जडान हुनेछ ।

उत्पादन उपकरणहरू जडान हुनेछ ।

उत्पादन उपकरणहरू जडान हुनेछ ।

उत्पादन उपकरणहरू जडान हुनेछ ।

उत्पादन उपकरणहरू जडान हुनेछ ।

उत्पादन उपकरणहरू जडान हुनेछ ।

उत्पादन उपकरणहरू जडान हुनेछ ।

उत्पादन उपकरणहरू जडान हुनेछ ।

उत्पादन उपकरणहरू जडान हुनेछ ।

उत्पादन उपकरणहरू जडान हुनेछ ।

उत्पादन उपकरणहरू जडान हुनेछ ।

Appendix D



Appendix D

Wild Flowering Plants Recorded from the Project Area

SN	Botanical Name	Local Name	Family
1	<i>Acacia catechu</i> (L.f.) Willd.	Khayar	Leguminosae
2	<i>Acacia pennata</i> (L.) Willd.	Arphu Lahara	Leguminosae
3	<i>Achyranthes aspera</i> L.	Datiwan	Amaranthaceae
4	<i>Acorus calamus</i> L.	Bojho	Araceae
5	<i>Adina cordifolia</i> (Willd. Ex Roxb.) Benth. & Hook.f. ex Brandis	Karma	Rubiaceae
6	<i>Aegle marmelos</i> (L.) Corr.	Bel	Rutaceae
7	<i>Agave americana</i> L.		Agavaceae
8	<i>Ageratum conyzoides</i> L.	Gandhe	Compositae
9	<i>Albizia chinensis</i> (Osbeck) Merr.	Seto siris	Leguminosae
10	<i>Albizia lebbeck</i> (L.) Benth	Kalo siris	Leguminosae
11	<i>Albizia lucidior</i> (Steudel) I. Nielson ex Hara	Padke	Leguminosae
12	<i>Alstonia scholaris</i> (L.) R. Br.	Chhatiwan	Apocynaceae
13	<i>Amaranthus spinosus</i> L.		Amaranthaceae
14	<i>Ardisia solanacea</i> Roxb.	Seti kath	Myrsinaceae
15	<i>Arisaema</i> sp.	Sarpako makai	Araceae
16	<i>Arisaema tortuosum</i> (Wall.) Schott	Sarpako makai	Araceae
17	<i>Artemisia indica</i> Willd.	Pati	Compositae
18	<i>Arundinella nepalensis</i> Trin.	Nigalo	Gramineae
19	<i>Asparagus racemosus</i> Willd.	Kurilo	Liliaceae
20	<i>Atrocarpus lakoocha</i> Wall.	Badahar	Moraceae
21	<i>Azadirachta indica</i> A. Juss.	Neem	Meliaceae
22	<i>Bambusa nepalensis</i> Stapleton	Choya bans	Gramineae
23	<i>Bauhinia purpurea</i> L.	Tanki	Leguminosae
24	<i>Bauhinia vahlii</i> Wight & Am.	Bhorla	Leguminosae
25	<i>Bauhinia variegata</i> L.	Koiralo	Leguminosae
26	<i>Begonia tribenensis</i> C.R. Rao.		Begoniaceae
27	<i>Bidens pilosa</i> L.	Kuro	Compositae
28	<i>Boehmeria rugulosa</i> Wall.		Urticaceae
29	<i>Bombax ceiba</i> L.	Simal	Bombacaceae
30	<i>Brassaiopsis hainla</i> (Buch.-Ham. ex D. Don) Seem	Chunetro	Araliaceae
31	<i>Butea minor</i> Buch.-Ham. Ex Baker		Leguminosae
32	<i>Caesalpinia decapitata</i> (Foth.) Alston	Arilae kanda	Leguminosae
33	<i>Callicarpa arborea</i> Roxb.	Guyela	Verbenaceae
34	<i>Callicarpa macrophylla</i> Vah.		Verbenaceae
35	<i>Cannabis sativa</i> L.	Ganja	Cannabaceae
36	<i>Capillipedium assimile</i> (Stut.) A. Camus.	Muse Khari	Gramineae
37	<i>Cassia tora</i> L.		Leguminosae
38	<i>Castanopsis indica</i> (Roxb.) Miq.	Katus	Fagaceae
39	<i>Celtis australis</i> L.	Khari	Ulmaceae
40	<i>Centella asiatica</i> (L.) Urban.	Ghodtapre	Umbelliferae
41	<i>Chonemorpha fragrans</i> (Moon) Alston		Apocynaceae
42	<i>Chrysopogon aciculatus</i> (Retz.) Trin.	Kuro	Gramineae
43	<i>Cissampelos pareira</i> L.	Batulpate	Menispermaceae
44	<i>Cleome viscosa</i> L.	Ban tori	Capparaceae
45	<i>Clerodendrum chinense</i> (Osbeck) Mabberty		Verbenaceae
46	<i>Clerodendrum indicum</i> (L.) Kuntze.		Verbenaceae
47	<i>Clerodendrum japonicum</i> (Thunb.) Sweet		Verbenaceae
48	<i>Coccinia grandis</i> (L.) Viogt.	Goal kankri	Cucurbitaceae
49	<i>Coelogyne</i> sp.		Orchidaceae
50	<i>Colebrookea oppositifolia</i> Sm.	Dhurseli	Labiatae
51	<i>Costus speciosus</i> (Koenig) Sm.		Zingiberaceae

SN	Botanical Name	Local Name	Family
52	<i>Crateva unilocularis</i> Buch.-Ham.	Sipligan	Capparaceae
53	<i>Crotalaria</i> sp.		Leguminosae
54	<i>Cuphea</i> sp.		Lythraceae
55	<i>Curculigo orchioides</i> Gaertn.		Hypoxidaceae
56	<i>Cuscuta reflexa</i> Roxb.	Akasbeli	Convolvulaceae
57	<i>Cyanotis cristata</i> (L.) D. Don		Commelinaceae
58	<i>Cynoglossum zeylanicum</i> (Vahl) Thunb. Ex Lehm.	Kuro	Boraginaceae
59	<i>Cyperus rotundus</i> L.	Mothe	Cyperaceae
60	<i>Dalbergia sisoo</i> Roxb.	Sisoo	Leguminosae
61	<i>Datura stramonium</i> L.	Dhaturo	Solanaceae
62	<i>Daturo metel</i> L.	Dhaturo	Solanaceae
63	<i>Dendrobium</i> sp.		Orchidaceae
64	<i>Dendrocalamus strictus</i> (Roxb.) Nees	Bans	Gramineae
65	<i>Dendrocalamus strictus</i> (Roxb.) Nees		Gramineae
66	<i>Desmodium confertum</i> DC		Leguminosae
67	<i>Desmodium gangeticum</i> (L.) DC		Leguminosae
68	<i>Desmodium laxiflorum</i> DC		Leguminosae
69	<i>Desmodium oojeinense</i> (Roxb.) Ohashi	Sadan	Leguminosae
70	<i>Desmostachys bipinnat</i> (L.) Stapf.	Kush	Gramineae
71	<i>Dioscorea bulbifera</i> L.	Githa	Dioscoreaceae
72	<i>Dioscorea deltoidea</i> Wall. Ex Griseb	Tarul	Dioscoreaceae
73	<i>Diospyros malabarica</i> (Desr.) Kostel.	Tendu	Ebenaceae
74	<i>Drepanostachyum falcatum</i> (Munro) Keng f.	Phurke ghans	Gramineae
75	<i>Drepanostachyum intermedium</i> (Munro) Keng. f.	Nigalo	Gramineae
76	<i>Drymaria diandra</i> Blume	Abijalo	Caryophyllaceae
77	<i>Duabanga grandiflora</i> (Roxb. ex DC) Walp	Odal	Lythraceae
78	<i>Elephantopus scaber</i> L.		Compositae
79	<i>Engelhardia spicata</i> Lsch. ex Blume	Mauwa	Juglandaceae
80	<i>Ensete glaucum</i> (Roxb.) Cheesman	Ban Kera	Moraceae
81	<i>Ergrostris tenella</i> (L.) Beauvois ex Roem. & Sch.		Gramineae
82	<i>Erythrina stricta</i> Roxb.	Phaledo	Leguminosae
83	<i>Eulaliopsis binata</i> (Retz.) C.E. Hubbard	Babiyo	Gramineae
84	<i>Eupatorium adenophorum</i> Spreng.	Banmasa	Compositae
85	<i>Euphorbia hirta</i> L.	Dudhe jhar	Euphorbiaceae
86	<i>Euphorbia pulcherrima</i> Wild. ex Klotsch.	Lalupate	Euphorbiaceae
87	<i>Euphorbia royleana</i> Boiss	Siudi	Euphorbiaceae
88	<i>Ficus benghalensis</i> L.	Bar	Moraceae
89	<i>Ficus benjamina</i> L.	Sami	Moraceae
90	<i>Ficus racemosa</i> L.	Dumbre	Moraceae
91	<i>Ficus religiosa</i> L.	Pipal	Moraceae
92	<i>Ficus sarmentosa</i> Buch.-Ham. ex Sm.	Bedulo	Moraceae
93	<i>Ficus semicordata</i> Buch.-Ham ex Sm.	Khaniyo	Moraceae
94	<i>Garuga pinnata</i> Roxb.	Dabdabe	Burseraceae
95	<i>Glabosa racemosa</i> Sm.		Zingiberaceae
96	<i>Habenaria</i> sp.		Orchidaceae
97	<i>Hedera nepalensis</i> K. Koch		Araliaceae
98	<i>Hedychium ellipticum</i> Buch.-Ham. ex Sm.		Zingiberaceae
99	<i>Holarrhena pubescens</i> (Buch.-Ham.) Wall. Ex G. Don	Khirro	Apocynaceae
100	<i>Hydrocotyle nepalensis</i> Hook.		Umbelliferae
101	<i>Ichnocarpus frutescens</i> (L.) R. Br.		Apocynaceae
102	<i>Imperata cylindrica</i> (L.) P. Beauv	Siru	Gramineae
103	<i>Jasmine caudatum</i> Wall ex Lindl.	Jasmine	Oleaceae
104	<i>Jatropha curcas</i> L.	Sajiwan	Euphorbiaceae
105	<i>Justicia adharoda</i> L.	Asuro	Acanthaceae
106	<i>Lagerstroemia indica</i> L.	Asarac	Lythraceae
107	<i>Lagerstroemia parviflora</i> Roxb.	Botdhaero	Lythraceae

SN	Botanical Name	Local Name	Family
108	<i>Lantana camara</i> L.		Verbenaceae
109	<i>Leea macrophylla</i> Roxb. Ex Homen.	Galen	Leeaceae
110	<i>Leucas cephalotes</i> (Roth) Spreng		Labiatae
111	<i>Leucas lanata</i> Benth.		Labiatae
112	<i>Leucosceptrum canum</i> Sm.		Labiatae
113	<i>Ligustrum confusum</i> Decne.		Oleaceae
114	<i>Litsea monopetala</i> (Roxb.) Pers.	Kutmero	Lauraceae
115	<i>Macaranga denticulata</i> (Blume) Mull. Agr.		Euphorbiaceae
116	<i>Maesa chisia</i> Buch.-Ham. ex D.Don	Bilauni	Myrsinaceae
117	<i>Maesa macrophylla</i> (Wall.) A. DC.		Myrsinaceae
118	<i>Mallotus philippensis</i> (Lam.) Muell.-Arg.	Sindure	Euphorbiaceae
119	<i>Mangifera indica</i> L.	Aamp	Anacardiaceae
120	<i>Melastoma malabathricum</i> L.		Melastomataceae
121	<i>Melia azederach</i> L.		Meliaceae
122	<i>Melothria heterophylla</i> (Lour.) Cogn		Cucurbitaceae
123	<i>Michelia champaca</i> L.	Chanp	Magnoliaceae
124	<i>Mimosa pudica</i> L.		Leguminosae
125	<i>Momordica dioca</i> Roxb. ex Willd.	Ban Karela	Cucurbitaceae
126	<i>Morus nigra</i> L.	Kimbu kafal	Moraceae
127	<i>Murraya koenigii</i> (L.) Spreng.		Rutaceae
128	<i>Mussaenda macrophylla</i> Wall.	Dhobini	Rubiaceae
129	<i>Myrica esculenta</i> Buch.-Ham. ex D.Don	Kafal	Myricaceae
130	<i>Nicandra physaloides</i> (L.) Gaertn.		Solanaceae
131	<i>Nyctanthes arbor-tristis</i> L.	Parijat	Oleaceae
132	<i>Oroxylum indicum</i> (L.) Kurz.	Tatelo	Bignoniaceae
133	<i>Osbeckia chinensis</i> L.		Melastomataceae
134	<i>Oxalis corniculata</i> L.	Chariamilo	Oxalidaceae
135	<i>Pandanus nepalensis</i> St. John		Pandanaceae
136	<i>Parthenium hysterophorus</i> L.		Compositae
137	<i>Pennisetum purpureum</i> Schum & Thom.	Nepiar ghans	Gramineae
138	<i>Phyllanthus amarus</i> Schumac. & Thonn.		Euphorbiaceae
139	<i>Phyllanthus emblica</i> L.	Amala	Euphorbiaceae
140	<i>Physalis divaricata</i> D.Don		Solanaceae
141	<i>Physalis peruviana</i> L.		Solanaceae
142	<i>Pilea glaberrima</i> (Blume.) Blume.		Urticaceae
143	<i>Piper longum</i> L.	Pipla	Piperaceae
144	<i>Plumeria rubra</i> L.		Apocynaceae
145	<i>Premna barbata</i> Wall. ex Schauer	Ginari	Verbenaceae
146	<i>Pterospermum lanceaefolium</i> Roxb.	Singane	Sterculiaceae
147	<i>Pyracantha crenulata</i> (D.Don) Roem.		Rosaceae
148	<i>Quamoclit pennata</i> Bojer		Convolvulaceae
149	<i>Quisqualis indica</i> L.		Combretaceae
150	<i>Rauvolfia serpentina</i> (L.) Benth.	Sarpagandha	Apocynaceae
151	<i>Remusatia pumila</i> (D.Don) H.L. Li & A. Hay	Jaluko	Araceae
152	<i>Remusatia vivipara</i> (Roxb.) Schott.	Jaluko	Araceae
153	<i>Rhus javanica</i> L.	Bhakimlo	Anacardiaceae
154	<i>Ricinus communis</i> L.		Euphorbiaceae
155	<i>Rock exaduate</i>	Silajit	
156	<i>Rubus ellipticus</i> Smith	Aiselu	Rosaceae
157	<i>Saccharum spontaneum</i> L.	Kans	Gramineae
158	<i>Salvia plebia</i> R.Br.		Labiatae
159	<i>Salvia sp.</i>		Labiatae
160	<i>Sapindus mukorossi</i> Gaertn.	Ritha	Sapindaceae
161	<i>Sapium baccatum</i> Roxb.	Ban pipal	Euphorbiaceae
162	<i>Sapium insigne</i> (Royle) Benth. ex Hook.f.	Khirro	Euphorbiaceae
163	<i>Sapondias pinnata</i> (L.f.) Kurz	Amaro	Anacardiaceae



SN	Botanical Name	Local Name	Family
164	<i>Sarcococca coriacea</i> (Hook.) Sweet		Buxaceae
165	<i>Schima wallichii</i> (DC.) Korth	Chilaune	Theaceae
166	<i>Scutellaria discolor</i> Colebr.		Labiatae
167	<i>Shorea robusta</i> Gaertn.	Sal	Dipterocarpaceae
168	<i>Sida rhombifolia</i> L.		Malvaceae
169	<i>Sida cordata</i> (Burm.f.) Borss.		Malvaceae
170	<i>Sigesbeckia orientalis</i> L.		Compositae
171	<i>Smilax ovalifolia</i> Roxb. ex D. Don.		Liliaceae
172	<i>Smilax perfoliata</i> Lour		Liliaceae
173	<i>Smilax wightii</i> A. DC.		Liliaceae
174	<i>Solanum nigrum</i> L.		Solanaceae
175	<i>Solanum torvum</i> Swartz		Solanaceae
176	<i>Solena heterophylla</i> Lour.	Bankankri	Cucurbitaceae
177	<i>Sonchus wightianus</i> DC.	Mulapate	Compositae
178	<i>Stephania japonica</i> var <i>discolor</i> (Miq.) Forman		Menispermaceae
179	<i>Strobilanthes angustifrons</i> C.B. Clarke		Acanthaceae
180	<i>Symplocos pyrifolia</i> Wallich ex G. Don.	Kali Kath	Symplocaceae
181	<i>Syzygium cumini</i> (L.) Skeels	Jamun	Myrtaceae
182	<i>Tamarindus indica</i> L.	Amili	Leguminosae
183	<i>Terminalia alata</i> Heyne ex Roth	Saj	Combretaceae
184	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Barro	Combretaceae
185	<i>Terminalia chebula</i> Retz.	Harro	Combretaceae
186	<i>Tetrastigma serrulatum</i> (Roxb.) Planch.		Vitaceae
187	<i>Themeda arundinacea</i> (Roxb.) Ridley	Dhadi ghans	Gramineae
188	<i>Thespesia lampas</i> (Cav.) Dalzell & Gibson	Ban Kapas	Malvaceae
189	<i>Thysanolaena maxima</i> (Roxb.) O. Kuntze	Amriso	Gramineae
190	<i>Tinospora cordifolia</i> (Willd.) Miers.	Gurjo	Menispermaceae
191	<i>Trewia nudiflora</i> L.	Ramritha	Euphorbiaceae
192	<i>Urena lobata</i> L.	Kuro	Malvaceae
193	<i>Urtica dioica</i> L.	Sisnu	Urticaceae
194	<i>Vanda teres</i> Lindl.		Orchidaceae
195	<i>Viscum album</i> L.	Hadchur	Loranthaceae
196	<i>Vitis lanata</i> Roxb.		Vitaceae
197	<i>Woodfordia fruticosa</i> (L.) Kurz.		Lythraceae
198	<i>Zizyphus rugosa</i> Lam	Bayar	Rhamnaceae
199		Sutim lahara	
200		Pahare lahara	
201		Madan lahara	
202		Kharighans	Gramineae
203		Sankha sur	Gramineae
204		Kholesag	
205		Gurbo	
206		Dambarekanda	
207		Phaner kanda	
208		Bafal	
209		Gai Simal	
210		Siudo	Euphorbiaceae

List of Plants used for Making Local Wine (Fermentation)

SN	Local Name	Botanical name
1	Bhui Katahar	<i>Ananas comosus</i> (L.) Merr.
2	Rukha Katahar	<i>Atrocarpus integra</i> (Thunb.) Merr.
3	Rudilo	<i>Clerodendrum indicum</i> (L.) Kuntze.
4	Pipla	<i>Piper longum</i> L.
5	Ukhu	<i>Saccharum officinarum</i> L.
6	Mula pate	<i>Sonchus wightianus</i> DC.
7	Bheduwa	

Plants of Fiber Use Value

SN	Local Name	Botanical name
1	Bhorla	<i>Bauhinia vahlii</i> Wight & Am.
2	Kubhindo	<i>Cucurbita pepo</i> L.
3	Odal	<i>Duabanga grandiflora</i> (Roxb. ex DC) Walp
4	Babiyo	<i>Eulaliopsis binata</i> (Retz.) C.E. Hubbard

Plants Used in Fish Poisoning

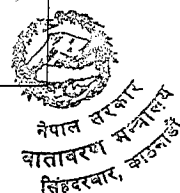
SN	Local Name	Botanical name	Parts used
1	Bhogate	<i>Maesa macrophylla</i> (Wall.) A. DC.	Leaf
2	Khirro	<i>Sapium baccatum</i> Roxb.	Leaf
3	Chilaune	<i>Schima wallichii</i> (DC.) Korth	Bark

Plants Used as Fodder

SN	Local Name	Botanical name
1	Bhorla	<i>Bauhinia vahlii</i> Wight & Am.
2	Sadan	<i>Desmodium oojeinense</i> (Roxb.) Ohashi
3	Dumbre	<i>Ficus racemosa</i> L.
4	Bedulo	<i>Ficus sarmentosa</i> Buch.-Ham. ex Sm.
5	Khaniyo	<i>Ficus semicordata</i> Buch.-Ham ex Sm.
6	Dabdabe	<i>Garuga pinnata</i> Roxb.
7	Ginari	<i>Premna barbata</i> Wall. ex Schauer
8	Sal	<i>Shorea robusta</i> Gaertn.
9	Saj	<i>Terminalia alata</i> Heyne ex Roth

Medicinal Plants used in Different Disease/Disorder

SN	Local Name	Botanical name	Parts uses	Mode of use	Disease/disorder
1	Khayar	<i>Acacia catechu</i> (L.f.) Willd.	Wood	Decoction	Body ache; Stomachache; as tea
2	Bojho	<i>Acorus calamus</i> L.	Root		Cough
3	Bel	<i>Aegle marmelos</i> (L.) Corr.	Fruit/bark	Pulp; Juice;Decoction	Diarrhoea/ Stomachache
4	Gande	<i>Ageratum conyzoides</i> L.	Leaf	Juice	Cut
5	Chhatiwan	<i>Alstonia scholaris</i> (L.) R. Br.	Stem	Latex	Sprain
6	Amba	<i>Psidium guajava</i> L.	Young shoots	Juice	Stomachache
7	Titepati	<i>Artemisia indica</i> Willd.	Leaf	- Juice - Juice+ Justicia sp.	Cut and wound; Boils; Worms - Worms on young buffalo



List of Plants Recorded in the Project Area with Various Ethnobotanical Uses

List of Plant used to make Agriculture Implements

SN	Local Name	Botanical name	Implements
1	Sadan	<i>Desmodium oojeinense</i> (Roxb.) Ohashi	Plough
2	Chilaune	<i>Schima wallichii</i> (DC.) Korth	Axe/Sickle handle
3	Sal	<i>Shorea robusta</i> Gaertn.	Plough
4	Kali kath	<i>Symplocos pyrifolia</i> Wallich ex G. Don.	Axe/Sickle handle
5	Ban khirro		Sickle case

List of Edible Plant of Project Area

SN	Local Name	Botanical name	Parts uses	Use value
1	Bel	<i>Aegle marmelos</i> (L.) Corr.	Fruit	Fruit
2	Kurilo	<i>Asparagus racemosus</i> Willd.	Young shoot	Vegetable
3	Choya bans	<i>Bambusa nepalensis</i> Stapleton	Young shoot	Vegetable
4	Koiralo	<i>Bauhinia variegata</i> L.	Flower	Pickle
5	Katus	<i>Castanopsis indica</i> (Roxb.) Miq.	Fruit	Fruit
6	Ban tori	<i>Cleome viscosa</i> L.	Seed	Spice
7	Gol kankri	<i>Coccinia grandis</i> (L.) Viogt.	Fruit	Fruit
8	Sipligan	<i>Crateva unilocularis</i> Buch.-Ham.	Young shoots	Vegetable
9	Githa	<i>Dioscorea bulbifera</i> L.	Fruit	Vegetable
10	Tarul	<i>Dioscorea deltoidea</i> Wall. Ex Griseb	Tuberous root	Vegetable
11	Ban kera	<i>Ensete glaucum</i> (Roxb.) Cheesman	Fruit	Fruit
12	Dumbre	<i>Ficus racemosa</i> L.	Fruit	Fruit
13	Bedulo	<i>Ficus sarmentosa</i> Buch.-Ham. ex Sm.	Fruit	Fruit
14	Khaniyo	<i>Ficus semicordata</i> Buch.-Ham ex Sm.	Fruit	Fruit
15	Ban karela	<i>Momordica dioca</i> Roxb. ex Willd.	Fruit	Vegetable
16	Kimbu kafal	<i>Morus nigra</i> L.	Fruit	Fruit
17	Kafal	<i>Myrica esculenta</i> Buch.-Ham. ex D. Don	Fruit	Fruit
18	Paniamala	<i>Nephrolepis cordifolia</i> (L.) Presl.	Tuberous root	Fruit
19	Jaluko	<i>Remusatia vivipara</i> (Roxb.) Schott.	Tender shoots	Vegetable
20	Bhakimlo	<i>Rhus javanica</i> L.	Fruit	Fruit
21	Aiselu	<i>Rubus ellipticus</i> Smith	Fruit	Fruit
22	Amaro	<i>Sapondias pinnata</i> (L.f.) Kurz	Fruit	Fruit
23		<i>Smilax ovalifolia</i> Roxb. ex D. Don.	Young shoots	Vegetable
24	Jamun	<i>Syzygium cumini</i> (L.) Skeels	Fruit	Fruit
25	Kali Niuro	<i>Tectaria macrodonta</i> (Fee) C. Christensen	Young shoots	Vegetable
26	Sisnu	<i>Urtica dioca</i> L.	Young shoots	Vegetable
27	Bayar	<i>Zizyphus rugosa</i> Lam	Fruit	Fruit/Pickle
28	Gurbo (Mag.)		Young shoots	Vegetable
29	Bochesing (Mag.)		Fruit	Fruit

List of Plants Commonly used in Fencing

SN	Local Name	Botanical name
1	Siudi	<i>Euphorbia royleana</i> Boiss
2	Sajiban	<i>Jatropha curcas</i> L.

SN	Local Name	Botanical name	Parts uses	Mode of use	Disease/disorder
				Rani sinka+ gujargano	
43	Amaro	<i>Sapondias pinnata</i> (L.f.) Kurz	Bark	Paste	Rheumatism
44	Sal dhup	<i>Shorea robusta</i> Gaertn.	Latex		Blood dysentery
45		Silajit			Diarrhoea /boils
46	Kantakari	<i>Solanum surattense</i> Burm. f.	Fruit	Smoke	Toothache
47	Jamun	<i>Syzygium cumini</i> (L.) Skeels	Bark	Juice	Cough, Headache, Sinusites
48	Kali Neuro	<i>Tectaria macrodonta</i> (Fee) C. Christensen	Rhizome	Juice	Blood dysentery
49	Barro	<i>Terminalia bellirica</i> (Gaertn.) Roxb.	Fruit	Pulp	Cough
50	Harro	<i>Terminalia chebula</i> Retz.	Fruit	Pulp	Cough
51	Ban kapas	<i>Thespesia lampas</i> (Cav.) Dalzell & Gibson	Whole plant	Paste; Juice	Cut for cattle; wound of human; sprain; Bone fracture of man and cattle
52	Gurjo	<i>Tinospora cordifolia</i> (Willd.) Miers.	Stem	Juice	Sprain; Refrigerant
53	Goya	<i>Vanda teres</i> Lindl.	Fruit	Pulp	Bone fracture
54	Hadchur	<i>Viscum album</i> L.	Leaf	Paste	Fracture
55	Dhairo	<i>Woodfordia fruticosa</i> (L.) Kurz.	Flower	Juice	Stomachache
56	Bayar	<i>Zizyphus rugosa</i> Lam	Seed/root	Juice	Stomachache; Refrigerant ;Smallpox
57	Bheduwa		Leaf	Paste	Boils
58	Ghutuk		Fruit		Refrigerant

Plants of Religious Value

SN	Local Name	Botanical name
1	Bojho	<i>Acorus calamus</i> L.
2	Titepati	<i>Artemisia indica</i> Willd.
3	Katus	<i>Castanopsis indica</i> (Roxb.) Miq.
4	Kush	<i>Desmostachys bipinnat</i> (L.) Stapf.



SN	Local Name	Botanical name	Parts uses	Mode of use	Disease/disorder
8	Kurilo	<i>Asparagus racemosus</i> Willd.	Root	Paste; Juice	Lactative; Refreezerant
9	Badahar	<i>Atrocarpus lakoocha</i> Wall.	Bark	Juice	Stomachache
10	Neem	<i>Azadirachta indica</i> A. Juss.	Leaf	Juice	Cooling; Toothache, Malarian fever; Diarrhoea
11	Koiralo	<i>Bauhinia variegata</i> L.	Bark	- Juice - Mangifera and Aegle juice	Diarrhoea; Refrigerant
12		<i>Begonia</i> sp.	Whole plant	Juice	Stomachache
13		<i>Boehmeria rugulosa</i> Wall.	Leaf	Paste	Wound
14	Aank	<i>Calotropis gigantea</i> (L.) Dryand.	Stem	Latex	Sprain
15	Ganja	<i>Cannabis sativa</i> L.	Leaf	Paste	Diarrhoea of cattle
16	Godtapre	<i>Centella asiatica</i> (L.) Urban.	Whole plant	Juice	Fever; Refreezerant ;Urine infection
17	Ranisinka	<i>Cheilanthes dalhousiae</i> Hooker	Whole plant	Juice	Stomachache
18	Batulpate	<i>Cissampelos pareira</i> L.	Root	Juice	Stomachache ; Problem due to oily food
19	Rudilo	<i>Clerodendrum indicum</i> (L.) Kuntze.	Leaf	Juice	Fever; Headache; Cold and Cough
20	Akasbeli	<i>Cuscuta reflexa</i> Roxb.	Whole plant	Juice	Jaundice
21	Abijalo	<i>Drymaria diandra</i> Blume	Leaf	Juice	Fever
22	Sahasbuti	<i>Elephantopus scaber</i> L.	Root	Juice	Refrigerant
23	Bankera	<i>Ensete glaucum</i> (Roxb.) Cheesman	Root	Juice	Urine infection; Refrigerant
24	Phadelo	<i>Erythrina stricta</i> Roxb.	Bark	Juice	Refrigerant
25	Babiyo	<i>Eulaliopsis binata</i> (Retz.) C.E. Hubbard	Young leaves	Paste	Bone fracture
26	Banmasa	<i>Eupatorium adenophorum</i> Spreng.	Leaf	Juice	Cut
27	Dude	<i>Euphorbia hirta</i> L.	Leaf	Juice	Cut
28	Khniyo	<i>Ficus semicordata</i> Buch.-Ham ex Sm.	Root	Juice	Urine infection; Refrigerant
29	Sajiban	<i>Jatropha curcas</i> L.	Stem	Juice; Latex	Cuts and Wounds
30	Rohini	<i>Mallotus philippensis</i> (Lam.) Muell.-Arg.	Bark	Decoction	Stomachache ; Refrigerant
31	Aanp	<i>Mangifera indica</i> L.	Bark	Decoction; Juice	Stomachache; Rheumatism
32	Champ	<i>Michelia champaca</i> L.	Leaf	Paste	Leg fracture of cattle
33	Lajjawati	<i>Mimosa pudica</i> L.	Root	Juice	Refrigerant
34	Kimbu kafal	<i>Morus nigra</i> L.	Root	Juice	Worms
35	Dhobini	<i>Mussaenda macrophylla</i> Wall.	Root	Juice	Fever
36	Kafal	<i>Myrica esculenta</i> Buch.-Ham. ex D.Don	Bark	Decoction	Blood dysentery; Bleeding from tooth
37	Chariamilo	<i>Oxalis corniculata</i> L.	Whole plant	Juice	Fever
38	Amala	<i>Phyllanthus emblica</i> L.	Fruit and bark	Juice; Decoction	Cough and cold
39	Pipla	<i>Piper longum</i> L.	Fruits	Freshry	Cough
40	Gineri	<i>Premna barbata</i> Wall. ex Schauer	Leaf	Juice with fitkiri	Headache
41	Aiselu	<i>Rubus ellipticus</i> Smith	Root	Juice	Urine infection
42	Kans	<i>Saccharum spontaneum</i> L.	Root	+ rohini +Pipla +	Stomachache

Plants Used for Roofing

SN	Local Name	Botanical name
1	Babiyo	<i>Eulaliopsis binata</i> (Retz.) C.E. Hubbard
2	Khar	<i>Themeda triandra</i> Forssk

Plants of Timber Value

SN	Local Name	Botanical name
1	Karma	<i>Adina cordifolia</i> (Willd. Ex Roxb.) Benth. & Hook.f. ex Brandis
2	Seto siris	<i>Albizia chinensis</i> (Osbeck) Merr.
3	Kalo siris	<i>Albizia lebbeck</i> (L.) Benth
4	Padke	<i>Albizia lucidior</i> (Steudel) I. Nielson ex Hara
5	Katus	<i>Castanopsis indica</i> (Roxb.) Miq.
6	Sisoo	<i>Dalbergia sisoo</i> Roxb.
7	Sadan	<i>Desmodium oojeinense</i> (Roxb.) Ohashi
8	Mauwa	<i>Engelhardia spicata</i> Lsch. ex Blume
9	Rohini	<i>Mallotus philippensis</i> (Lam.) Muell.-Arg.
10	Aamp	<i>Mangifera indica</i> L.
11	Sigane	<i>Pterospermum lanceaefolium</i> Roxb.
12	Ban papal	<i>Sapium baccatum</i> Roxb.
13	Khirro	<i>Sapium insigne</i> (Royle) Benth. ex Hook.f.
14	Chilaune	<i>Schima wallichii</i> (DC.) Korth
15	Sal	<i>Shorea robusta</i> Gaertn.
16	Kali kath	<i>Symplocos pyrifolia</i> Wallich ex G. Don.
17	Saj	<i>Terminalia alata</i> Heyne ex Roth



Mammals of the Project Area

SN.	Common Names	Scientific Names	Local Name	Conservation Status		
				CITES Annex	IUCN	GON
1	Rhesus monkey	<i>Macaca mulatta</i>	Bandar	2	LR/nt	
2	Assamese monkey	<i>Macaca assamensis</i>	Asami Bandar	2	VU	P
3	Jungle cat	<i>Felis chaus</i>	Ban Biralo	2	LR/lc	
4	Common leopard	<i>Panthera pardus</i>	Chituwa	1	LR/lc	
5	Golden Jackal	<i>Canis aureus</i>	Syal	3		
6	Clouded leopard	<i>Neofelis nebulosa</i>	Dhwanse Chituwa	1	VU	P
7	Rabbit	<i>Lepus nigricollis</i>	Kharayo			
8	Porcupine	<i>Hystrix indica</i>	Dumsi			
9	Barking deer	<i>Muntiacus muntjak</i>	Ratuwa Mirga			
10	Sloth bear	<i>Melursus ursinus</i>	Kathe Bhalu	1	VU	
11	Royal Bengal tiger	<i>Panthera tigris</i>	Bagh	1	EN	P
12	Mongoose	<i>Herpestes edwardsi</i>	Nyauri Musa			
13	Yellow throated martin	<i>Martes flavigula</i>	Malsapro	3		
14	Common rat	<i>Rattus rattus</i>	Musa			
15	Squirrel	<i>Funambulus sp.</i>	Lokharke			
16	Bats	NA	Chamera			
17	Common Otter	<i>Lutra lutra</i>	Ontt	1	VU	
18	Langur Monkey	<i>Semnopithecus entellus</i> Syn. <i>Presbytis entellus</i>	Langur (Kalo bander)	1	LR/nt	
19	Bengal Fox	<i>Vulpes bengalensis</i>	Fauro	3	DD	
20	Wild boar	<i>Sus scrofa</i>	Bandel			
21	Himalayan black bear	<i>Selenarctos thibetanus</i>	Kalo bhalu	1	VU	
22	Wolf	<i>Canis lupus</i> *	Byanso	1	Lr/ic	
23	Palm civet cat	<i>Pagume larvata</i>	Bharse			
25	Red fox*	<i>Vulpes vulpes</i>	Rato Fyauo	3	LR/ic	
26	Flying squirrel*	<i>Petaurista sp.</i>	Udne lokharke			
27	Leopard cat*	<i>Felis bengalensis</i>	Chari bagh	1	LR/ic	P

Note: EN = Endangered, VU = Vulnerable, LR/lc = Lower Risk/ least concern, LR/nt= Lower Risk/near threatened.

P = Protected by law

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

NA = Name not available

Birds Recorded from the Project Area

S N	Order	Family	Name of bird	Scientific Name	Habitat	Conservation Status	Migratory Status
1.	Passeriformes	Sturnidae	Jungle Myna	<i>Acridotheres fuscus</i>	-	-	-
2.	Passeriformes	Sturnidae	Common Myna	<i>Acridotheres tristis</i>	R, Sv, AG	-	R
3.	Passeriformes	Nectariniidae	Crimson Sunbird	<i>Aethopyga sipraja</i>	R, AG, Sv	-	R
4.	Gruiformes	Rallidae	White-breasted Waterhen	<i>Anaouornis phoenicurus</i>	F, Sv	-	R
5.	Anseriformes	Anatidae	Mallard*	<i>Anas platyrhynchos</i>	Wa, F, Sv	-	R
6.	Anseriformes	Anatidae	Spot-billed Duck*	<i>Anas poecilorhyncha</i>	Wa	CITES I	M (Wv)
7.	Ciconiiformes	Ardeidae	Indian Pond Heron	<i>Ardeola grayii</i>	Wa	-	R, M (Wv)
8.	Strigiformes	Strigidae	Spotted Owlet	<i>Athene brama</i>	Wa, Sv	-	R
9.	Ciconiiformes	Ardeidae	Cattle Egret	<i>Bubulcus ibis</i>	AG, R	-	R
10	Passeriformes	Turdidae	White-capped Redstart	<i>Chaimarrornis leucocephalus</i>	Wa, AG, Sv	-	R
11.	Ciconiiformes	Ciconidae	Woolly necked Stork	<i>Ciconia episcopus</i>	Wa	-	R
12.	Apodiformes	Apodidae	Himalayan Swiftlet	<i>Collocalia brevirostris</i>	AG, Wa	-	R
13.	Columbiformes	Columbidae	Rock Pigeon	<i>Columba livia</i>	F, Sv	-	R
14.	Passeriformes	Turdidae	Oriental Magpie Robin	<i>Copsychus saularis</i>	R	-	R
15.	Passeriformes	Corvidae	Large-billed Crow	<i>Corvus macrorhynchos</i>	F, Sv, AG	-	R
16.	Passeriformes	Corvidae	House Crow	<i>Corvus splendens</i>	F, R, Sv	-	R
17.	Cuculiformes	Cuculidae	Eurasian Cuckoo	<i>Cuculus canorus</i>	R, Sv	-	R
18.	Cuculiformes	Cuculidae	Indian Cuckoo *	<i>Cuculus micropterus</i>	F, Sv	-	M (Sv)
19.	Passeriformes	Corvidae	Rufous Treepie	<i>Dendrocitta vagabunda</i>	F, Sv	-	M (Sv)
20.	Piciformes	Picidae	Fulvous-breasted Woodpecker	<i>Dendrocopos macei</i>	F, Sv	-	R
21.	Passeriformes	Dicaeidae	Fire-breasted Flowerpecker	<i>Dicaeum ignipectus</i>	F, Sv	-	R
22.	Passeriformes	Dicruridae	Black Drongo	<i>Dicrurus macrocerus</i>	F, Sv	-	R
23.	Ciconiiformes	Ardeidae	Little Egret	<i>Egretta garzetta</i>	R, Sv, AG	-	R
24.	Cuculiformes	Cuculidae	Asian Koel	<i>Eudynamis scolopacea</i>	Wa, Sv	-	R
25.	Galliformes	Phasianidae	Black Francolin	<i>Francolinus francolinus</i>	F, Sv, AG	-	R
26.	Galliformes	Phasianidae	Red Junglefowl*	<i>Gallus gallus</i>	F, AG, Sv	-	R
27.	Charadriiformes	Accipitridae	Vulture*	<i>Gyps sp.</i>	F, AG, Sv	CT	R
28.	Coraciiformes	Alcedinidae	White-throated	<i>Halcyon smyrnensis</i>	F	-	R

S N	Order	Family	Name of bird	Scientific Name	Habitat	Conservation Status	Migratory Status
			Kingfisher				
29.	Cuculiformes	Cuculidae	Common Cuckoo*	<i>Hierococcyx varius</i>	Sv	-	R
30.	Passeriformes	Hirudinidae	Barn Swallow	<i>Hirundo rustica</i>	Wa, AG, Sv	-	R
31.	Passeriformes	Laniidae	Long-tailed Shrike*	<i>Lanius schach</i>	F	-	R
32.	Galliformes	Phasianidae	Kalij Pheasant*	<i>Lophura leucomelana</i>	R, AG, Wa	-	R, M (Sv)
33.	Piciformes	Capitonidae	Blue-throated Barbet	<i>Megalaima asiatica</i>	Sv, Ag, F	-	R
34.	Order	Family	Name of bird	Scientific Name	F	-	R
35.	Piciformes	Capitonidae	Great Barbet	<i>Megalaima virens</i>	F, Sv	-	R
36.	Coraciiformes	Meropidae	Chestnut-headed Bee-eater	<i>Merops leschenaultia</i>	F	-	R
37.	Charadriiformes	Accipitridae	Black Kite	<i>Milvus migrans</i>	F, Wa	-	R, M (Sv)
38.	Passeriformes	Motacillidae	White Wagtail	<i>Motacilla alba</i>	R	-	R, M (Wv)
39.	Passeriformes	Motacillidae	Yellow wagtail	<i>Motacilla flava</i>	Wa	-	R, M (Wv)
40.	Passeriformes	Motacillidae	White browed wagtail	<i>Motacilla maderaspatensis</i>	Wa	-	M (Wv)
41.	Passeriformes	Turdidae	Blue Whistling Thrush	<i>Myophonus caeruleus</i>	Wa	-	R
42.	Charadriiformes	Accipitridae	Egyptian Vulture	<i>Neophron percnopterus</i>	F, Wa	-	R
43.	Passeriformes	Oriolidae	Eurasian Golden Oriole	<i>Oriolus oriolus</i>	Sv, R	CITES II	R
44.	Passeriformes	Paridae	Great Tit	<i>Parus major</i>	F, Sv	-	M (Sv)
45.	Passeriformes	Paridae	Black-lored Tit	<i>Parus xanthogenys</i>	F	-	R
46.	Passeriformes	Ploceidae	House Sparrow	<i>Passer domesticus</i>	F	-	R
47.	Passeriformes	Ploceidae	Eurasian Tree Sparrow	<i>Passer montanus</i>	R, Sv, AG	-	R
48.	Passeriformes	Ploceidae	Russet Sparrow	<i>Passer rutilans</i>	R, AG, Sv	-	R
49.	Galliformes	Phasianidae	Indian Peafowl*	<i>Pavo cristatus</i>	F, AG, Sv	-	R
50.	Gruiformes	Phalacrocoracidae	Little Cormorant*	<i>Phalacrocorax niger</i>	F	-	R
51.	Psittaciformes	Psittacidae	Rose-ringed Parakeet	<i>Psittacula krameri</i>	Wa	-	R, M (Wv)
52.	Passeriformes	Pycnonotidae	Red-vented Bulbul	<i>Pycnonotus cafer</i>	F, Sv, AG	-	R
53.	Passeriformes	Turdidae	Pied Bushchat	<i>Saxicola caprata</i>	R, Sv, AG	-	R
54.	Passeriformes	Turdidae	Common Stonechat	<i>Saxicola torquata</i>	Sv, AG	-	R
55.	Passeriformes	Sylviidae	Black-browed Warbler	<i>Seiurus burkii</i>	Sv, AG	-	R, M (Wv)
56.	Charadriiformes	Accipitridae	Hodgson's Hawk Eagle	<i>Spizaetus nipalensis</i>	F	-	R
57.	Passeriformes	Timaliidae	Black-chinned Babbler	<i>Stachyris pyrrhops</i>	AG, R, F	-	R
58.	Columbiformes	Columbidae	Spotted Dove	<i>Streptopelia chinensis</i>	F, Sv	-	R
59.	Passeriformes	Sturnidae	Chestnut-tailed starling	<i>Sturnus malabaricus</i>	Sv	-	M (Wv)
60.	Passeriformes	Sylviidae	Lesser Whitethroat	<i>Sylvia curruca</i>	AG, R, Sv	-	R

SN	Order	Family	Name of bird	Scientific Name	Habitat	Conservation Status	Migratory Status
61.	Upupiformes	Upupidae	Common Hoopoe*	<i>Upupa epops</i>	F	-	R
62.	Passeriformes	Corvidae	Red billed Magpie*	<i>Urocissa flavirostris</i>	Wa	-	R
	Charadriiformes	Charadriidae	River Lapwing	<i>Vanellus duvaucelii</i>			

Note: * Species recorded from questionnaire survey

CITES I – Listed in CITES Appendix I, CITES II – Listed in CITES Appendix II and GT – Globally Threatened

R= Residential, M= Migratory, Sv= Summer visitor, Wv= Winter visitor (Categorization based on Inskipp *et al.* 1991) Wa = Water, AG = Agricultural Land and Grassland,

Sv = Scrubby Vegetation, R = House, F = Forest

Source: Supplemental EIA Survey, JICA Study Team, 2006



Appendix E



नेपाल सरकार
वातावरण मन्त्रालय
सिंहदरबार, काठमाडौं

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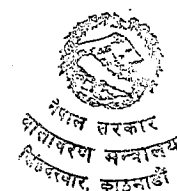
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Executive Summary

1.0 Background

Nepal Electricity Authority has been promoting the Upper Seti Storage Project to fulfill the country peak load demand. The proposed Upper Seti Project is a storage type of development with installed capacity of 122 MW. The project is located on the Seti river near the Damauli bazar of Tanahu district and close to Pokhara Mugling road. The fish and aquatic life study was undertaken as a part of feasibility level Environmental Impact Assessment Study of the proposed project. The study includes collection of baseline information of fish and aquatic life sector, identify potential impacts, and suggest cost effective mitigation measures and develop mitigation management and monitoring plan.

2.0 Study Area Description

The study area covers the project area that will be directly or indirectly affected due to construction and operation of the project. Direct impact zone consist of two locations: 1.5-Km river stretch from dam to Seti Madi confluence and reservoir area. In addition the construction site and immediate vicinity (camp area and other project facilities) are also considered as part of Direct Impact Zone. Indirect impact zone includes the river upstream of reservoir, reduced flow section from Seti Madi confluence to approximately 4 km downstream area.

3.0 Approach and Methodology

Literature review, field visit by the expert, collection of fish, aquatic life and water quality sample and laboratory analysis were the prime methodology applied for the EIA study. The sample was collected from 8 different sampling stations of Seti river and catch per unit effort & catch per hour effort were also calculated. Questionnaire survey, group discussion and impact assessment matrix are the other methodology used to assess the likely impact of proposed project on fish and aquatic life resources.

4.0 Baseline Condition of the Project Area

The result obtained from water quality analysis of Seti river reveals that parameters are suitable for the growth of fish and aquatic life. Dissolved oxygen and total hardness were recorded 9- 11 mg/l and 153.9 to 188mg/l respectively. pH ranges 6- 9 is considered suitable for fish growth. Thirty-five species of phytoplanktons, 13 species of zooplanktons and 23 species of insects were recorded at different sampling station along the Seti river. Among the phytoplankton Cyanophyceae, Chlorophyceae and Basidiomycota are the major group. Similarly Rotifers, Cladocerans and Copepods represent the zooplankton. *Ephemeroptera sp.*, *Canis sp.*, *Hydropsyche*, *Nemoura sp.* and *Tanytus* are the major species recorded from the project area. Nine species of blue green algae were recorded from the downstream part of Seti river (Station 6 to 8). *Chaetophora inclassata*, *Cladophora glomerata* *Oedogonium sp.* and *Ulothrix sp.* are the dominant species of algae recorded from Seti river.

Seti river is both snow fed and rain fed. The gradient of the river varies considerably from section to section and differences in river morphology affects fish habitat, distribution pattern and diversity. As a consequence a series of run, riffle and pools have been developed along the Seti course. Pools are dominant habitat in the project area. Fish sampling at 8 different locations along the Seti river, previous studies and local information collected in the field reveal the presence of 32 species of fish. A total of 471 fish of 19 different species were collected during the present survey (April 2003). Torrent minnows contribute about 35% of the total catch. The composition of Copper Mahseer and Mahseer throughout Seti river are 25.26% and 13.8 % respectively. Stoneroller and Baghi contributes 12.31 % and 5.73 % of the total catch.

The study showed that diversity of fish progressively increases towards downstream. Nine species of fish were recorded at upstream section (Bhimad area) where as 12 species was recorded at downstream (Damauli area). The sampling result in Seti river shows that fish composition is low in downstream and high in upstream, which show slight deviation in normal fish diversity. This is probably because of high fishing pressure, presence of more pool areas and high human disturbances in downstream area.

In average >7 fish was caught per hour through out the Seti river by cast net. The average catch per unit effort of Seti river is 0.22 fish with highest catch at station 1 & 2 and lowest at Station 3. Out of 32 species recorded or reported from Seti river 5 were long distance migrant 6, were midrange migrant and 21 were residents in habit. Among the total species found in Seti river 7 species are vulnerable, 1 is endangered and 2 species are categorized as rare. Two species are grouped under occasional category. All the fishes collected during the field survey are edible and have considerable food value. Fish species like copper mahseer, mahseer, snow trout and minor carps have high food value.

Seti river itself is a common ground for fishing but some people have been observed fishing in the tributaries like Madi. Approximately 36-part time and 250 occasional fishermen are reported from project area. The total annual estimated catch by the part time and occasional fishermen in the project area is 11440 kg (5940 kg part time and 5500 kg occasional) of worth Rs. 11,44,400 equivalent. Out of the total catch the part time fisherman consumes about 15 % and 85% is sold to local market and or villages. The average annual catch per household is 165 kg.

5.0 Evaluation of Value

The valuation of fish was made on the basis of two important criterion viz. status of species and habitat. The value of Direct Impact Zone is considered medium because of moderate species diversity (9 species) and moderate spawning and rearing areas. The value of Indirect Impact Zone is considered higher because of high species diversity (12 species), presence of long distance migrant species (mahseer, eel, gounch etc) and the presence of a number of spawning and rearing ground and species of economically importance & of conservation value.

6.0 Possible Impacts on the Aquatic Ecosystem

Habitat destruction, loss of spawning ground, possible increase in water pollution due to spoil disposal and other direct and indirect impacts associated with construction activities and

increase in fishing pressure are the possible impacts likely to be occur in construction phase of the project.

The operation phase impacts includes changes of riverine habitat in to reservoir in 7.69 km² area, blockage of fish migration, de-watering of 1.5 Km river section, reduced flow, changes in water quality and fish entrainment etc. The likely changes in fish diversity and density of indigenous species in reservoir area and adaptation of other species is also considered significant adverse impact. The impact on local fishermen due to possible reduction in fish catch is also considered to be a significant impact. The exploitation of reservoir potential for aquaculture development is considered positive impact of the project.

7.0 Mitigation Measures

The mitigation measures recommended to minimize the adverse impacts are muck disposal plan, riparian release of 2.4m³/s, construction and operation of fish hatchery, fish trapping and hauling program and water quality protection measures. The other programs are open water stocking of exotic and indigenous carps and cage fish culture to enhance the potential of reservoir and minimize the negative impacts. The enhancement program such as training and loan assistance to fishermen and environmental awareness programs are also suggested. The strengthening of Begnas Fisheries Research Center, NARC is suggested as an alternate to fish hatchery.

8.0 Monitoring Plan

Baseline, impact and compliance monitoring is suggested during construction and operation phases of the project. The construction phase monitoring will be responsibility of the Upper Seti Storage Project where as operation phase monitoring will be conducted by Nepal Electricity Authority, Ministry of Water Resources and Ministry of Population and Environment will also be responsible for compliance and impact monitoring. The estimated cost for monitoring and mitigation for fish and aquatic life resources is NRs.1, 34,16000/- and annual operation cost 800000/-

9.0 Conclusion and Recommendations

The study indicates that proposed project would have moderate to low impacts on fish and aquatic life if the recommended mitigation measures will be applied. The study shall be updated prior to implementation of project and due consideration shall be given on the recommendations of chapter-9.



1. Background

Nepal Electricity Authority has been promoting the Upper Seti Storage Project. According to Environment Protection Rule 97 (EPR) and its Amendment 1998, hydropower project above 5 Mw generating capacity require Environmental Impact Assessment Study and the report should be submitted to the Ministry of Population and Environment (MoPE) for public disclosure and approval. The preparation of EIA for Upper Seti storage project is required as per EPR 97 and will result in a better planned and designed project by identifying means of minimizing impact, compensating for unavoidable environmental impacts. The fish and aquatic life study was undertaken as a part of feasibility level Environmental Impact Assessment Study of the proposed project. The study includes collection of baseline information of fish and aquatic life sector, identify potential impacts, and suggest cost effective mitigation measures and develop mitigation management and monitoring plan.

1.1 Project Description

The proposed Upper Seti Project is a storage type of development with installed capacity of 122 MW. The project is located on the Seti river near the Damauli bazar of Tanahu district and close to Pokhara Mugling road. The project component includes a 136-meter high dam, 7.69-km reservoir, tunnel, and surface powerhouse.

1.2 Objectives of the Study

Objectives of this study are to:

- Identify fisheries baseline condition of the project area
- Identify the type and extent of potential environmental impact on fish and other Aquatic life
- Recommend mitigation measures and strategies to minimize adverse environmental impacts.
- Assist decision makers in evaluating the project feasibility based on its potential environmental impact on fish and aquatic life.
- Develop Mitigation Management and Monitoring Plan
- Prepare Environmental Impact Assessment Report as per EPR 1997.

1.3. Literature Review

The published literature on fish and fisheries of Nepal reveals a total of 186 indigenous fish species belonging to 79 genera, 31 families and 11 orders which are distributed in different rivers and other water bodies of Nepal (Shrestha 1981, 1992, 1994 1995; Terashima 1984, Subba and Ghosh 1996). The fishes of Nepal have wide distribution according to the climatic conditions and altitudinal variations. On the basis of published literature, out of 186 species, 127 species are reported from Koshi, 157 from Gandaki, 119 from Karnali and 71 species from Mahakali (Shrestha 1992).

Studies on fish and aquatic life of Seti river are limited. Jhon 1986 studied morphological adaptations of fishes of Seti river and adjoining areas Nepal. This study reported the presence of 14 species of fish from Seti river. This study is important and informative for baseline data. Swar (1990) studied effects of impoundment on the indigenous fish population in Indrasarobar reservoir, Nepal. This study is helpful to predict the Upper Seti reservoir



condition and fish species likely to be adapted and or affected in changed environmental condition.

Among these species thirty-four threatened species (vulnerable, endangered and rare species) are recorded (18% of the total number of species). Ninety species (49% of the total species) have a status of commonly / occasionally recorded. Sixty-two species (33%) have a status of insufficiently known that also includes the ten species for which no account is given. None of these fish are listed in the IUCN or CITES lists.

Despite a long history of hydropower development in Nepal, there are very few past project assessment of the ecological impacts of hydropower development focussing on the flows essential to maintain natural ecological process. The amendment of Aquatic Animal Protection Act. (2055), however, has recognized river regulation and/ or consumptive use as potentially impacting on ecological values. Section 3 of the AAPA confirms the punishment to any party introducing poisonous, noxious or explosive materials into water sources, or destroying any weir, bridges or water system, with the intent of catching or killing aquatic life. Article -5 Kha emphasized that fish ladder must be constructed while constructing dam for Hydropower generation, irrigation or other purposes. The act also mentioned that other alternative provision such as Fish Hatchery etc should also be considered.

2. Study Area Description

2.1 General Description

The study area for the fish and aquatic life includes Seti river and its major tributaries. For the sake of study 8 sampling stations were established throughout Seti river starting from upstream of Bhimad Bazar to down stream of powerhouse. The study area covers the project area that will be directly or indirectly affected due to construction and operation of the project. The study area is divided into two parts on the basis of magnitude of possible impacts.

2.2 Direct Impact Zone (DIZ)

Direct Impact Zone consist of two locations: 1.5-Km river stretch from dam to Seti Madi confluence and reservoir area. In addition the construction site and immediate vicinity (camp area and other project facilities) are also considered as part of Direct Impact Zone. To all these locations DIZ includes the river stretches and riverine habitats.

2.3 Indirect Impact Zone (INDIZ)

Indirect Impact Zone includes the river upstream of reservoir and area approximately 4 km below the Seti Madi confluence. The major downstream tributary such as Madi is also included in INDIZ. The reason behind selecting the Madi Khola under INDIZ is that this Khola is major spawning and rearing ground of Mahseer, Copper Mahseer and River Rohu.

3. General Approach and Methodology

A survey of fish and aquatic life was conducted as a part of an Environmental Impact Assessment (EIA) study of Upper Seti Storage Project. The field investigation lasted for 12 days in April 2003. Field survey was conducted in the Seti river and its major tributaries. The field survey included collection of fish specimens from different sampling locations, identification and characterization of fish habitat and collection of information about fish migration and spawning pattern. The collection of aquatic insects and planktons were also

completed during the fieldwork. The following methodology was applied to conduct the survey of fish and aquatic life of the proposed project.

3.1 Habitat Characterization

The river habitat was studied by using visual method (observation). Topographical map available for the area was used for river habitat characterization. Possible spawning habitat conditions such as type, cover and shelter were recorded by walking along the bank of river.

3.2 Sampling Locations

Fish, aquatic life and water quality samples were collected from Seti river (Fig-1). Madi Khola was also sampled for fish and water quality. The Seti river was divided in to 8 different sampling stations/locations to collect detail information about fish distribution, composition and food availability of the river (Murphy and Wills 1996). The sampling stations were set along the stretch of Seti river from Bhimad Bazar to below powerhouse locally known as Pratap. Approximately 1km area in length (500 meter upstream and downstream) was covered at each sampling site. To provide specific information on status, distribution and abundance of fish and aquatic life the following locations were sampled (Table-3.1).

Table- 3.1 Fish/Aquatic life/Water Quality Sampling Location/Station

Sampling Station	Location
1	Seti river at Changthadi (upstream of Bhimad Bazar)
2	Seti river near Chan Patan (Downstream of Bhimad Bazar)
3	Seti river at Bandarkuna (Rising Patan area)
4	Seti river at dam site (Dule)
5	Seti river at powerhouse site and dewatered section (Area from powerhouse to Seti Madi confluence)
6	Seti river at Madi Seti confluence area
7	Seti river at Pratap approximately 4 km downstream of powerhouse
8	Seti river approximately 5 km downstream of powerhouse site

3.3 Sampling Methods

3.3.1 Aquatic life/Water Quality

Sample of aquatic insects and other invertebrates were collected from station 1-8 (Fig-1) along the Seti river and preserved in formalin (10%). The insects and zooplanktons were collected by D net and plankton net respectively. The phytoplanktons were collected by collecting the residue of water samples using lugol solution. The aquatic insects and planktons were identified in the Fisheries Development Division Laboratory at Balaju, Kathmandu. Water quality was analyzed at spot for each sampling site with water analysis kit (heck kit).



3.3.2 Fish

Cast net was used for fish sampling & eight hours was spent at each sampling site. Local fishermen were hired to collect fish specimens from the river and its tributaries. Fish species caught at each site/station were identified, 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 (Appendix-16). Fish species caught during the field visit at each sampling site were identified using standard method of taxonomy (Jayaram 1981 and Shrestha 1994, Talwar & Jhingran 1991). Some fishes were dissected and stomach contents and gonads were taken out and preserved in formalin solution for microscopic study. The collected fish were preserved in formaldehyde solution for further study. A map was prepared showing aquatic habitats and spawning areas.

Survey in Market centers like Bhimad and Damauli were conducted to collect information about fish diversity of Seti river. Fish species available at local market and fish caught by local fishermen were also purchased to document information regarding local fisheries resources.

Interview and focused group discussion with local fishermen

Local fishermen of Chanpatan, Malebagar, Bhimad Bazar, and Patan were interviewed using structured questionnaire to document their knowledge on distribution status, availability, spawning sites and migratory behavior (Fig-2). The information about catches, sell and consumption and population trend of fishes was also collected.

Colored photographs of different fishes were shown to fishermen/local people to confirm their presence. The information about economical value of different species, local use pattern and other relevant areas were collected during the field visit.

Focused group discussions were conducted at Chanpatan (reservoir area) and Patan villages to obtain information on local fisheries resources, fishing practices catch and consumption pattern among different ethnic groups. Approximately 10-15 people participated in group discussion at each site.

3.4 Impact Assessment Method

Matrix method was used to identify the possible positive and negative impacts due to implementation of the proposed project. The impacts were predicted in terms of magnitude, extend and duration. The impacts were further rated as high medium and low in terms of magnitude, site specific, local and regional in terms of extend and short term, medium term and long-term in terms of duration.

3.5 Limitation of the Study

The total study was carried out in a limited time span of 45 (12 days field work & 33 days office work) days so the primary information on fish migration, spawning and seasonal sampling of fish to identify fish diversity and population density of Seti river was not covered. The fish sampling results shows only limited catch of long distance migrants. The fish migration information was collected locally but for detail information effort shall be made to conduct fish tagging or telemetry study. The fish migration information was also supplemented by available literature. The total population of fish likely to be affected by the project could not be calculated because for such calculation long term data is required.

The feasibility study of the proposed project is in process and technical data required for the impact assessment is not available which pose further limitation for EIA study.

The sampling gears and study methods are selective. So some of the major migratory species such as Eel and Jalkapur could not be collected although the local fisherman reports their presence. Cast net was used for sampling and this gear was locally used throughout the year. The catch per hour effort and unit effort was calculated based on dry season sampling at selected places and it was expected that the information fairly represent the dry season fish catch of the Seti river in general.

4 Results and Baseline condition of the Project Area

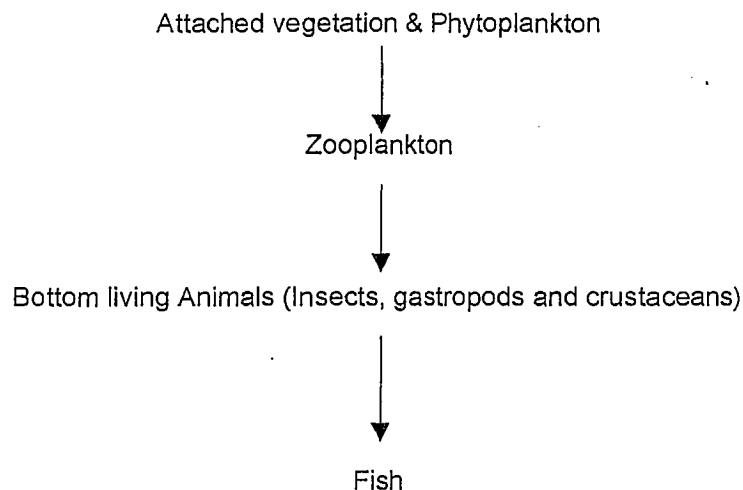
Seti river is one of the major tributaries of the Gandaki River System. It originates from Annapurna and Machhapuchrey peak and passes through Kaski & Tanahu districts and meets with Marsyangdi at downstream of Mugling and then joins with Kali Gandaki at Deoghat. Its catchment basin is about 1502km². The detail of the fish and aquatic life baseline situation of the project area is given below.

4.1 Water Quality

The result obtained from water quality analysis of Seti river reveals that parameters are suitable for the growth of fish and aquatic life. The dissolved oxygen content, which is an important parameter for assessing the quality of water in relation to flora and fauna, is in a very good range (9 to 11 mg/l). Dissolved oxygen below 5mg/l is not suitable for fish and aquatic life. The pH of water throughout the project area is found to be alkaline in nature (7.9 to 8.7) suitable for fish growth. pH 6.5 to 9.0 is considered most suitable for fish growth. Variation in temperature has an important influence on all the organisms including fishes. Feeding, breeding, respiration and all other physiological activities are influenced by temperature. Water temperature was recorded at the moment of sampling to be varying between 21 to 22°C which is considered suitable for growth of carps especially Mahseer, Copper Mahseer & minor carps. The catch of snow trout in project area is fairly low and high water temperature might be one of the important reasons. Total hardness & alkalinity were measured as 188 mg/l and 153.9 mg/l respectively (Appendix-1).

4.2 Aquatic Plants, Invertebrates and Food Links

Aquatic invertebrates are the most important resources which are the link in the production process in aquatic ecosystem because they include both primary consumers and carnivorous. They form the matured food source of several fishes. The overall aquatic production in moderate or fast flowing water takes place in the river bottom. The simplified food chain is as follows;



Food chain

Phytoplankton

Thirty- five species of phytoplanktons of three different orders were collected in the project area (Appendix-2). The major groups of phytoplanktons recorded in the project area are Cyanophyceae, Cholorophyceae and Bacillariophyceae. The species diversity is high at station 1, 4, 6 and 7 where more than 17 species were recorded. Station 2, 5 and 8 contributes 12, 14 and 15 species respectively in total species diversity. The details of species recorded in each group are:

Cyanophyceae	:	<i>Oscillatoria, Spirulina, Merismopedia and Lymgbya</i>
Cholorophyceae	:	<i>Closterium, Spirogyra and Actinastrum</i>
Bascillariophyceae	:	<i>Nevicula, Melosira, Fragilaria, Synedra and Cymbella</i>

The population of Bascilorphyceae seems high and ranges from 10600 to 13800 N/L at station 2 and 8 respectively in April 2003 sample (Appendix-3). *Melosira, Fragilaria*, and *Synedra* are the dominant species of phytoplankton. The presence of Cyanophyceae was noted at all eight sampling station of Seti river with lowest number at station 3 and highest at station 8. Similarly the Cholorophyceae was noted at all sampling stations with highest number at station 7 and lowest at 2.

Zooplankton

Thirteen species of zooplanktons of three different groups are found in Seti river (Appendix-4). The major groups of zooplankton recorded from the project area are consisted of Rotifers, Cladocera and Copepoda. The details of species recorded in each group are:

Rotifers	:	<i>Chromogaster, Trichocer & Epiphanies</i>
Cladocerans	:	<i>Bosmia & Alona</i>
Copepods	:	<i>Cyclops & Cyanthocamplus</i>

Rotifers are found at all eight sampling sites with highest at station 2 (160 N/L) and lowest at station 7 (60 N/L). The number of Cladocerans recorded is 40,20 and 60 N/L respectively at station 2, 5 and 6 (Appendix-5). The presence of Copepods is noted at 3 sampling stations 2,4 & 8 and density is 20 N/L at each station.

Blue Green Algae

Nine species of blue green algae were recorded from the downstream part of Seti river (Station 6 to 8). *Chaetophora inclassata*, *Cladophora glomerata*, *Oedogonium sp.* and *Ulethris sp.* are the dominant species of algae recorded from Seti river. The other species are *Spirogyra*, *Stigeoclonium*, *Compsopogon*, *Audounilla* and *Genicularia elegans*.

Aquatic Insects

Twenty-three species of aquatic insects are recorded from the project area (Appendix-6). Station 7 contributes 14 species whereas only 7 species are recorded from station 8. The contribution of station 1 & 4 each is 11 whereas station 3 & 5 contribute 10 species each. Among the recorded species *Ephemeroptera sp.*, *Canis sp.*, *Hydropsyche*, *Nemoura sp.* *Tanytus* is common.

4.3 Fish Fauna

4.3.1 Description of Aquatic Habitat

Seti river is both snow fed and rain fed. The gradient of the river varies considerably from section to section and differences in river morphology affects fish habitat, distribution pattern and diversity (Table-4.1). As a consequence a series of run, riffle and pools have been developed along the Seti course.

Seti river at Upstream of Bhimad Bazar (Changthandi Confluence to 2km upstream)

The river in this section receives Changthandi Khola, which is steep and dry. Seti river in this stretch is wide and bifurcated. This stretch of river consists about 800-meter run and 1200 meter deep to shallow pool areas. Shallow pool areas occupy major stretch of river and provide suitable rearing site for fry and fingerlings. Three small pool areas were noted at left bank a side the main river channel where a number of fry and fingerlings were observed in their natural condition (Fig-3). Boulders are found at upper section of river and pebbles and gravels are found in downstream stretch. . Man made disturbances such as removal of boulders, vehicle movement and construction of suspension bridge were observed. This part of river is identified as suitable spawning and rearing ground for migratory and resident fish species.

Bhimad Bazar to Badarkuna

Seti river at this stretch has deep pool followed by run and riffle habitat. The river is narrow particularly in Bhimad area and has deep pool. The river below Chanpatan shows mixed habitat. Seti river receives Wantey Khola, Jidi Khola and Phendi Khola in this stretch of river. Spawning and rearing sites were noted in 1km stretch of Jidi Khola and 500 meter stretch of Phendi Khola. The confluence points and tributaries are suitable for torrent minnows, stone roller and other resident species.

The other spawning and rearing area was noted in 1-km river stretch of Seti Khola (Jhakas to Geruwatar stretch) on both the banks (Fig-3). Fry and fingerlings were seen in their natural habitat. This stretch of river is identified suitable spawning areas for copper mahseer, mahseer and minor carps.

Tituwa to Dam site at Dule (Lokma)

Seti river in this stretch is narrow and broken in to runs, and riffles dominated by pools offering varieties of micro and macro habitats for fishes. Seti river receives Karasati Khola, Limna Khola and Likindi Kholas. The river section supports copper mahseer, mahseer and other large size fish due to presence of pool habitat. Limna and Linkidi Seti confluence areas and approximately 600meter section of the Limna Khola are the major spawning grounds noted in this section (Fig-3).

The dam site at Dule is located in narrow gorge and shallow pool is found at both up and downstream of proposed dam axis (500 meter). Although this location is difficult for netting but fishing by using explosive was observed.

Dam to Powerhouse and Madi Seti Confluence Area

This stretch of river is relatively wide and consists of pool habitat (75%) followed by run and riffle (25%). The river section consists 3 spawning and 4 rearing sites located at both the banks (Fig -4). Seti Madi confluence area and Madi Khola are identified as suitable spawning and rearing grounds for most of the species. Migratory species found in Seti Khola use Madi for spawning and rearing. River substrata consist of gravels and pebbles and sands in this stretch of river. This section of river supports copper mahseer, mahseer, spiny eel, snow trout, catfishes and a number of resident species.

Madi Seti confluence to downstream area

The pools, runs and riffles found in this stretch provide suitable habitat for different fish species in different life stages. The river section consists approximately 60% pool and 40% run and riffle habitat. The river channel is composed of cobbles, sands and pebbles. Rearing areas with fry and fingerlings of torrent minnows and stone roller were noted on the left bank of river in 1 meter width and about 400 meters length just below the Seti Madi confluence area. Rearing sites were also noted at right bank of river. This stretch of river consists of 6 spawning sites at both the banks of river. This stretch of river provides suitable habitat for copper mahseer, mahseer, spiny eel, snow trout, catfishes and a number of resident species.

Table-4.1 Summary of the Aquatic Habitat

River Section	Impact Zonation	Habitat Type	Major Spawning Areas	Species Occurrence	Remarks
Seti river app 2 km upstream of Bhimad bazar	INDIZ	Run, riffle and deep to shallow pool areas	Seti river at left bank	Snow trout, copper mahseer, mahseer and rewa species. Fry and fingerlings of Buduna was observed at both the banks	Major habitat in upper reaches
Bhimad to Bandarkuna	DIZ	Run and riffle habitat	1 km stretch of Seti Khola from	Copper mahseer, mahseer and minor	Major habitat and spawning area in

(Reservoir area)		dominated by Pool	Jhakas to Geruwatar, Jidi and Phendi Khola	carps species. Fry and fingerlings of torrent minnows was observed at right bank	reservoir stretch
Bandarkuna to Dam site(Dule)	DIZ	Run and riffle habitat dominated by Pool	Pocket of spawning area in Seti near Likindi confluence area, Likindi and Limna Kholas	Torrent minnows and copper mahseer	Low to moderate habitat for spawning and rearing
Dule to Madi Seti Confluence	DIZ	75% pool habitat and 25 % run and riffle	3 spawning and 4 rearing sites in Seti river.	Copper mahseer, mahseer, minor carps and catfishes are the major species. Fry and fingerlings of Buduna and torrent minnows were observed about 400 meter downstream of dam	Moderate habitat
Pratap approximately 4 km downstream of the powerhouse	INDIZ	Riffle and runs (40%) dominated by pools (60%)	Rearing site is found at left bank in 1x400 m just below the Seti Madi confluence. 6 spawning sites are noted.	High species diversity (12 sp.) Mahseer, Copper mahseer, minor carps, torrent minnows and Stonerollers are the commercially important species noted in this stretch of river.	Madi Khola is major spawning and rearing ground for migratory species. This stretch of river has high potential in terms of species diversity, spawning area and great importance for the income generation (fishing).
Approximately 5 km downstream of powerhouse	INDIZ	Riffle, runs and pools	River section is wide and covers with gravels sand and pebbles. Rearing site is noted approximately 3 km downstream of Seti Madi confluence	Moderate species diversity. Fry of torrent minnows and stone roller was noted	This section of river is moderate potential in terms of species diversity, spawning area and importance for the income generation (fishing)

Source: Field Survey, 2001

4.3.2 Species Occurrence/Distribution Pattern and Diversity

Fish of Himalayan waters are biologically diverse. The published literatures of fish and fisheries of Nepal reveals a total of 186 indigenous species distributed in different river systems and other water bodies of Nepal (Shrestha 1995).

Seti river in project area provides suitable habitat for copper mahseer, mahseer minor carps, and torrent minnows and stone roller. Fish sampling at 8 different locations along the Seti river, previous studies and local information collected in the field reveal the presence of 32 species of fish (Fig-5).

A total of 471 fish of 19 different species were collected during the present survey (April 2001). Torrent minnows contribute about 35% of the total catch. The composition of Copper

Mahseer and Mahseer throughout Seti river are 25.26% and 13.8 % respectively. Stoneroller and Baghi contributes 12.31 % and 5.73 % of the total catch (Table-4.2).

Table-4.2 Species Composition

S.No.	Scientific Name	English Name	Local Name	No. Fish Caught	%
1	<i>Amblyceps mangois</i>	Torrent catfish	Bidur	1	0.21
2	<i>Barilius bendelisis</i>	Torrent minnows	Faketa	21	4.45
3	<i>Barilius barila</i>	Torrent minnows	Jhuli	117	24.84
4	<i>Barilius barna</i>	Torrent minnows	Pate Faketa	25	5.30
5	<i>Botia almorhae</i>	Loach	Baghi	27	5.73
6	<i>Channa gachua</i>	Murrels	Bhoti	6	1.27
7	<i>Chagunius chagunio</i>	Minor carps	Rewa	1	0.21
8	<i>Garra gotyla</i>	Stone Roller	Nakatuwa	56	11.89
9	<i>Garra annandalei</i>	"	Buduna	2	0.42
10	<i>Labeo dero</i>	Minor carps	Gardi	2	0.42
11	<i>Mastacembelus armatus</i>	Spiny eel	Bam	18	3.82
12	<i>Neolisochilus hexagonolepis</i>	Copper Mahseer	Katle	119	25.26
13	<i>Nemacheilus botia</i>	Stone loach	Gadela	1	0.21
14	<i>Puntius conchoniis</i>	Barbs		2	0.42
15	<i>Schizothorax plagiostomus</i>	Snow Trout	Asala	3	0.64
16	<i>Schizothoracichthys progastus</i>	Point Nosed Snow Trout	Chuche Asala	2	0.42
17	<i>Cyprinus semplotum</i>		Khurpe	3	0.64
18	<i>Tor putitora</i>	Mahseer	Sahar	56	11.89
19	<i>Tor tor</i>	Mahseer	Sahar	9	1.91
	Total			471	100

Source: Field Survey, 2004

The principal groups of fish of Seti river are:

Carps- Snow trout (*Schizothorax plagiostomus*), long nose trout (*Schizothoracichthys progastus*) Copper Mahseer (*Neolisochilus hexagonolepis*) and Mahseer (*Tor putitora* and *Tor tor*), minor carps (*Labeo dero* & *Labeo angara*) and Sucker head (*Garra gotyla* & *Garra annandali*)

Fresh water Eel - (*Anguilla bengalensis*)

Loaches - Stone loach (*Nemacheilus botia* & *Nemacheilus beavani*)

Torrent Minnows - (*Barilius barila*, *B. bendelisis* & *B. barna*)

Catfishes - Torrent catfish (*Glyptothorax sp.*) river catfish (*Bagarius bagarius*)

Barbs - (*Puntius conchoniis*)

It is found that diversity of fish progressively increases towards downstream. Nine species were recorded at upstream section whereas 12 species were recorded in downstream (Table 4.3). Torrent minnow is the dominant species of Seti river in dry season sample in terms of number. Copper mahseer, mahseer, spiny eel and stone rollers are the other dominant species of Seti river. The species diversity is high in wet season compare to dry season. Local people reported the presence of 32 species of fish in wet season. Gouch, Sahar, Katie, Jalkapoor, Raja bam, Thed, Gardi, Titae and Kabre are the common species (Appendix-7).

Table- 4.3 Species Diversity and Distribution Pattern

S.No.	Scientific Name	Sampling Station/ River Stretch							
		1	2	3	4	5	6	7	8
1	<i>Amblyceps mangois</i> (Ham)	♦							
2	<i>Barilius barila</i> (Ham)	♦	♦	♦	♦	♦	♦		♦
3	<i>Barilius bendalasis</i> (Ham)	♦	♦	♦			♦		
4	<i>Barilius barna</i> (Ham)		♦						
5	<i>Botia almorhae</i> (Gray)				♦	♦		♦	♦
6	<i>Chagunius chagunio</i> (Ham)	♦							
7	<i>Channa gachua</i> (Orientalis Bl.)					♦	♦		♦
8	<i>Garra annandalei</i> (Ham)						♦		
9	<i>Garra gotyla</i> (Gray)		♦		♦		♦	♦	♦
10	<i>Labeo dero</i> (Ham)						♦		♦
11	<i>Mastacembelus armatus</i> (Lacepede)		♦			♦	♦	♦	♦
12	<i>Neolissocheilus hexagonolepis</i> (Mc Cle)	♦	♦	♦		♦	♦	♦	♦
13	<i>Nemacheliu botia</i> (Ham)				♦				
14	<i>Puntius conchoni</i> (Ham)							♦	♦
15	<i>Schizothorax plagiostomus</i> (Ham)	♦	♦						
16	<i>Schizothoraichthys progastus</i> (Mc Cle)	♦							
17	<i>Cyprinon semplotum</i> (Mc. Cle)	♦					♦		
18	<i>Tor putitora</i> (Ham)	♦	♦		♦		♦	♦	
19	<i>Tor tor</i> (Ham)						♦		
	Total	9sp.	8sp.	3sp.	5sp.	5sp.	12sp.	6sp.	9sp.

Source: Field Survey, 2001

4.3.3 Species Abundance and Fish Composition

Four hundred and seventy one fishes of 19 different species were caught during the field visit. The station 1 contributes approximately 21 percent of the total catch whereas station 8 contributes 10.61 percent. Station 2 and 5 contributes 25.26 and 7.64 % of the total catch respectively (Table-4.4).

Table-4.4 Percentage Abundance at each Sampling Station

Station Number	Number of Fish Caught	Number of species	%
1	99	9	21.01
2	119	8	25.26
3	47	3	9.97
4	33	5	7.0
5	36	5	7.64
6	46	12	9.76
7	41	6	8.70
8	50	9	10.61
Total	471	19	100

Source: Field Survey, 2001

The sampling results show that per hour catch of fish is > 12 fish at upstream of Bhimad (Station 1), and well above 14 fish at Bhimad area and immediate downstream (Station 2). The average per hour catch is >4 fish in dam and dewater section and well above 5 fish at downstream of Seti Madi confluence. The average per hour catch in dry period is > 7 fish throughout Seti river by cast net. This figure fairly represents fish densities of dry period especially April by using the local gears (Table-4.5).

In general trend fish diversity and density is low in upstream and gradually increase towards downstream. The sampling result in Seti river shows that fish composition is low in downstream and high in upstream, which show slight deviation in normal fish diversity. This is probably because of high fishing pressure, presence of more pool areas and high human disturbances in downstream. Selective methods of fish sampling especially the fishing gears, water pollution (fishing by explosive and other river uses) and habitat destruction might be the other causes of differences.

Table-4.5 Catch per hour effort at different Sampling Station

Sampling Station	Sampling Hour	No. of fish caught	Catch per hour effort (CPH)	Catch per hour (Kg)
1	8	99	12.37	0.61
2	8	119	14.87	0.17
3	8	47	5.87	0.18
4	8	33	4.12	0.04
5	8	36	4.5	0.03
6	8	46	5.75	0.13
7	8	41	5.12	0.06
8	8	50	6.25	0.15
Total	64		7.35	0.17

Source: Field Survey, 2001

The average catch per unit effort of Seti river is 0.22 fish with highest catch at station 1 & 2 and lowest at Station 3 (Table -4.6). In general 1 fish was caught at 4 effort. One fish was

caught at 3 effort at station 1 & 2 and 6 effort at station 5 & 7. The details of the fish fauna of Seti river at each sampling stations/locations are described below.

Table-4.6 Catch per unit effort at different Sampling Station

Sampling Station	Level of Effort	No. of Fish Caught	Catch Per Unit Effort (CPU)	Attempt Catch Ratio
1	341	99	0.29	3:1
2	334	119	0.35	3:1
3	304	47	0.15	6:1
4	192	33	0.24	4:1
5	208	36	0.17	6:1
6	232	46	0.19	5:1
7	228	41	0.17	6:1
8	256	50	0.19	5:1
Total	2095	471	0.22	4:1

Source: Field Survey, 2003

Fish Composition at Dam and Reservoir Area

Sampling station 1,2, 3 and 4 represents fish composition and diversity above intake and at intake site respectively.

Sampling station 1 (Upstream of Changthandi/Bhimad).

Ninety-nine fish of ten different species were collected in this stretch of river during the sampling work. The total level of effort at this station was 341 in 8 hours (Table-4.6). The catch per unit effort was 0.29 fish and 1 fish was caught at 3 attempts. The average weight of the total catch was approximately 5 kg (Appendix-8). Torrent minnows (39%) followed by copper mahseer (22%) and sucker head (29%) dominates this section of river. The maximum size of fish (*Neoleoscheilus hexagonolepis*) caught at this station was 22 cm long and weights 175gm.

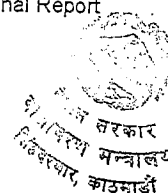
Sampling station 2 (Bhimad Bazar and downstream area)

A total of 119 fishes of eight different species were collected in this stretch of river. The total level of effort at this station was 334 in 8 hours (Table-4.6). The catch per unit effort and attempts catch ratio was 0.35 fish. The average weight of the total catch was 1.39 kg. The maximum size of fish (*Garra gotyla*) caught at this station was 17 cm long and weights 60gm (Appendix-8).

Copper Mahseer (57) and Mahseer (29) dominate this section of river in terms of number. Torrent minnows contribute 14% of the total catch (Appendix-8).

Sampling Station 3 (Reservoir area at Bandarkuna)

Forty-seven fish of three different species were collected in this stretch of river during the sampling work (April 2003). The total level of effort at this station was 304 in 8 hours (Table-4.6). The catch per unit effort was 0.15 fish and 1 fish was caught at 6 attempts. The average



weight of the total catch was approximately 1.45 kg. The maximum size of fish (*Neollessoscheilus hexagonolepis*) caught at this station was 23 cm long and weights 115-gm (Appendix-8). Torrent minnows are the again dominant species by number.

Sampling Station 4 (Dam site)

A total of 33 fishes of five different species were collected in this stretch of river. The total level of effort at this station was 192 in 8 hours (Table-4.6). The catch per unit effort and attempts catch ratio was 0.24 fish and 4: 1fish respectively. The average weight of the total catch was 0.34 kg. The maximum size of fish (*Botia almorhae*) caught at this station was 16 cm long and weights 50gm (Appendix-8).

This section of river is dominated by Minnows (21) followed by Mahseer (7) in terms of number.

Fish Composition in powerhouse and Dewater Zone

Sampling Station 5 (De-watered Zone)

This station represents fish fauna of powerhouse and dewatered zone. A total of 36 fishes of 5 different species were collected in this station in April 2001. *Barilius spp.* is well represented group by number (83%) *Botia almorhae* and *Mastacembelus armatus* contributes about 5.5% each respectively (Appendix-8).

The total level of effort at this station was 208 in 8 hours (Table-4.6). The catch per unit effort was 0.17 fish and 1 fish was caught at 6 attempts. The per hour catch at station 5 is > 4 fish in dry season (Table-4.5).

Sampling Station 6 (Seti Madi confluence and downstream area)

Forty-six fish of 12 different species were collected in this stretch of river during the sampling work (April 2001). The total level of effort at this station was 232 in 8 hours (Table-4.6). The catch per unit effort was 0.19 fish and 1 fish was caught at 5 attempts. The average weight of the total catch was 1.10 kg (Appendix-8). The maximum size of fish (*Labeo dero*) caught at this station was 22.5 cm long and weight 105 gm. Mahseer is the dominant species by number. The other species recorded in this stretch of river is spiny eel.

The fish diversity seems high in this area because Madi Khola provides suitable spawning and rearing area for most of the migratory and resident species. As mention in habitat. section the river stretch in Madi Seti confluence and further downstream area is wide and suitable for netting therefore high fishing pressure was observed in this stretch of river. The catch per unit effort was low and over fishing might be one of the main reasons.

Sampling Station 7 (Pratap approximately 4 km downstream of powerhouse)

Altogether 41 individuals of 6 different species were noted during the field survey. Copper Mahseer is again a dominated species by number (44%). A 28-cm long spiny eel (*Mastacembelus armatus*) with 35 gm wt was collected at this station during April 2003 sampling (Appendix-8).

The total level of effort at this station was 228 in 8 hours (Table-4.6). The catch per unit effort was 0.17 fish and 1 fish was caught at 6 attempts. The per hour catch at this station is > 5 fish.

Sampling Station 8 (Approximately 5 km below Powerhouse area)

A total of 50 fishes of 9 different species were collected in this station in April 2003 sample. Torrent minnow is still a well-represented species by number (42%). *Botia almorhae* (22%) and *Mastacembelus armatus* (10%) are the next dominant species by number. *Garra gotyla* and *Channa gachua* each contributes about 8% of the total catch (Appendix-8).

The total level of effort at this station was 256 in 8 hours (Table-4.6). The catch per unit effort was 0.19 fish and 1 fish was caught at 5 attempts. The per hour catch at station 8 is > 6 fish. The average weight of the total catch was 0.15 kg. The maximum size of fish (*Mastacembelus armatus*) caught at this station was 45 cm and weights 215 gm.

4.3. 4 Fish Migration and Ecology

Many Cyprinidae and Siluridae fishes undertake upstream migrations from feeding areas to spawning habitat where well oxygenated water and swift current clean the eggs. During the monsoon season most of the fishes migrate upstream for spawning. The bank of Seti river and its tributaries especially the Madi Khola, Likindi Khola, Phendi Khola and Jidi Khola seem to offer favorable habitat conditions to the fishes in project area. Out of 32 species recorded or reported from Seti river 5 are long distance migrant, 6 are midrange migrant and 21 resident in habit (Appendix-9).

4.3. 5 Food Feeding and Spawning Ecology

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

Food feeding and spawning ecology of long distance migrant

Mahseer (*Tor sp*) is the most spectacular long distance migratory fish distributed throughout the project area. This species was caught at Station 1, 2, 4 in upstream area and 6 & 7 in downstream area. *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 (Appendix-11). They migrate to upstream area of Seti for spawning. This species prefers pools and rapids for rearing and spawning (Appendix-10). The migration range of this species was reported up to the Pokhara in upstream area and Tribani in downstream. According to local information the upstream migration of Mahseers starts from April when the water temperature in downstream part of river rises. However their mass migration start in May/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.

According to available information this species migrate 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 they stay for rearing or migrate with adult. However, on the basis of 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 Seti river and its major tributaries such as Madi Khola. 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 1-2 meter. Seti river at Sisneri, Bandarkuna, Madi Seti confluence area and further downstream are the major spawning sites in project area for mahseer.

The Mahseer caught during the field visit was of 13 cm (Appendix-8). Fishermen reported the incidents of catching the fish up to 6-10 kg at Bhimad and Damauli area last year during upward migration. The artificial propagation of this species is available.

Fresh water Eel (*Anguila bengalensis*) is commonly known as Rajabm in the project area and is an excellent game fish. Eels live in deep crevices of stone and among dead twig. This fish could not be collected during the field visit but the local fishermen have reported their presence. Fresh water eel is carnivorous fish feeds on mollusca crabs, shrimps, tadpoles frogs and large insects. Eel is long distance (catadromous) migrant fish and reaches to the ocean (Bay of Bengal) for breeding purpose. Its migratory routes in Nepalese river system are not clearly known.

An eel measuring up to 1.5-2 meter in length and weight up to 5-6 Kg. was reported to be caught in Madi Khola by "Duwali Thunne" a trapping method reported by local fishermen. This species was also reported to be caught from Bhimad area by baited rod and line. This species can not be breed in artificial condition, as fish requires special condition for spawning in seawater.

Food feeding and spawning ecology of midrange migrant species

Asala (*Schizothorax plagiostomus* and *Schizothoraichthys progastus*) is rarely seen in project area and contributes 1% of the total catch. It is omnivorous fish and feeds on algae, pieces of aquatic plants and mud (Appendix-12). 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 Seti river and its feeder streams. 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 (Appendix 10). The snow trout spawn in slight gravel depressions on shallow banks vegetated with the water moss. Sisneri areas and further upstream are the spawning areas of this fish. The artificial breeding technology of this species is available in Nepal.

Copper Mahseer (*Neolissocheilus hexagonolepis*) is commonly known as Katle in the project area. This species is distributed throughout the project area and contributes 25% of the total catch. Copper Mahseer feeds on euophagus animal, plant and detritus (Appendix-12). Katles are short distance migrants. The migration of this species was reported to start from late May to end of June from downstream of Seti as the discharge of river begins to increase. Katle migrate up to Pokhara during the breeding season.

This fish spawns in banks of Seti river and its major tributaries such as Madi Khola. Seti river at Sisneri, Bandarkuna, Madi Seti confluence area and further downstream are the major spawning sites in project area for mahseer. Adult Katles remain in the spawning grounds for a short period and then migrate downstream. *Neolissocheilus hexagonolepis* prefers rapids and pools.

The female attains maturity in the month 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). On the basis of 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.

Rewa (*Chagunius chagunio*) is known as Rewa in project area. This species prefers gravel and pebble beds for spawning and rearing. Rewa is herbivorous fish and feeds on plant, aquatic vegetation, filamentous algae and detritus material. This species shows the jumping behavior and migrate in a group of 6 - 8 fish.

Food feeding and spawning ecology of resident species

Faketa (*Barilius spp*) 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 Jidi, Wantey, Phendi, Karasati and Limna Kholas.

Suckerhead (*Garra spp.*) is locally known as Buduna. This fish has a slender body with a C-shaped mouth. 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 Seti river and its feeder streams (Appendix-13). This species prefers backwater pool and rocky areas. *Garra* also prefers to remain at confluence point where tributary with warm water mixes in the Seti river.

Stone Loach (*Nemacheilus sp.*) locally known, as Gadela is a fairly 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 Seti river. This fish is known to occur between 300 m to 3000 m and breeds in April and May on the feeder streams. *Garra* prefers to hide under stones (Appendix-10).

4.3. 6 Fish Population Trend

The population status of different fish species on the Seti river throughout the year is not clearly known. However on the basis of field observation and sampling torrent minnows and copper mahseer are the most common species of fish in Seti river. A total of 471 fishes of 19 different species were collected during the study period. Minnows contribute about 35% of the total catch whereas the composition of copper mahseer is 25 % of the total catch. The compositions of mahseer and sucker head throughout Seti river are 13.8 % and 12.31% respectively (4.2).

According to local fishermen fish population has declined during past few years. The consequences for the depletion of fish population in Seti river are:



- The fishing pressure, both legal and illegal has increased in Seti river and elsewhere in Nepal. The use of explosive and herbicides in pools is normal for the villagers. These types of illegal fishing not only kill the brood fish but also kill the fry and fingerlings and destroy the habitat. The use of Lahare paso and electric fishing is common in the project area
- Habitat degradation due to unusual erosion, removal of river boulders and other direct and indirect causes also contribute to fish degradation.
- Increase in human population along the Seti river and increase in river uses such as washing ,bathing rafting etc.
- The construction of Tribeni dam at Gandak.

4.3.7 Spawning Grounds

Seti river and its tributaries provide suitable habitats for both resident and migratory species. The major spawning sites identified in the project area are as follows:

Table-4.7 Major Spawning sites in the Project Area

S.No.	Khola Stretch	Spawning and Rearing Ground	Suitable for the Species	Remarks
1	Bhimad to app.2 km upstream area	Seti river at left bank	Snow trout, copper mahseer, mahseer & stone roller	Tributaries are not productive
2	Bhimad to dam site	1 km stretch of Seti Khola from Jhakas to Geruwatar. Jidi and Phendi Khola . Seti near Likindi confluence area, Likindi and Limna Kholas	Copper mahseer, mahseer and minor carps & torrent minnows	Ref Fig-3
3	Dam to Seti Madi Confluence	3 spawning and 4 rearing sites in Seti river.	Copper mahseer, mahseer, minor carps and catfishes are the major species.	Ref Fig-4
4	Madi Seti confluence to approximately 2 km downstream	Rearing site is found at left bank in 1x400 m just below the Seti Madi confluence. 6 spawning sites are noted.	High species diversity (12 sp.) Mahseer, Copper mahseer, minor carps, torrent minnows and Stonerollers are the commercially important species noted in this stretch of river.	Ref Fig-4
5	Madi Seti confluence to approximately 3 km downstream	100m down of proposed powerhouse	Torrent minnows, loach, spiny eel and stone roller	Ref Fig-4

Source: Field Survey, 2003

4.3.8 Endangered Status of the Fish Species

Non of the fish species listed for the project area belongs to the category of IUCN and CITES lists of endangered fish species. Shrestha (1995) has enumerated a list of indigenous fish species from Nepal. Biodiversity profile project studied all scattered accounts of fish species recorded from Nepal including their conservation and distribution status and prepared a status account of fish species of Nepal. The report indicate that out of 186 listed species 90 are commonly/occasional recorded, 62 insufficiently known and 34 are categorized as threatened species (Vulnerable 9, endangered 1 and rare 24).

Out of 32 species recorded from the project area 7 species are vulnerable (*Neolissocheilus hexagonolepis*, *Anguilla bengalensis*, *Tor putitora*, *Schizothoracichthys progastus*, *Schizothorax plagiosomus*, *Chagunius chagunio* & *Psilorhynchus pseudoecheinus*), 1 is endangered (*Tor tor*) and 2 species (*Amblyceps mangois* & *Glyptosternum blythi*) are categorized as rare. Two species such as *Pseudecheinus sulcatus* and *Chana striatus* are considered as occasional. No account has been given for *Botia almorhae* (Appendix-9).

4.3.9 Economic Importance of Fish

Most of the fish species of the Seti river and its tributaries are of high economic value, which is summarized in Appendix-9. 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 flavor 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*, spp. This species is also used as bait to lure the fish predators. Although the hill stream fishes like *Garra* spp, *Glyptothorax* spp are known to be very tasty but due to their small size are grouped under medium value.

Fishes like *Neolissocheilus hexagonolepis*, *Schizothorax* sp. and *Tor putitora*, have high sportive value. Very little is known about the medicinal value of the fishes of Nepal as well as the Seti river. The gall bladder and brain of Sahar (*Tor putitora*) are used for fever and burn respectively. Small fish species like *Barilius* spp. can be used as a biological controller to control water born diseases. Titae (*Psilorhynchus pseudoecheineis*) is taken to increase the appetite especially in summer months. Similarly Gadela (*Nemacheilus* sp.) is used as a medicine of tooth pain. It is also used as medicine to grow the teeth of young babies by rubbing the smoked Gadela on the jaws.

4.3.10 Fishing Activity and Fish Catch

Fishermen of the Seti catchment come from different ethnic groups. People living at Patan area visit up to dam site to powerhouse site and Madi Khola area for fishing whereas those living at Bhimad go up to upstream of Sisneri. Although Seti river itself is a common ground for fishing some people have been observed fishing in the tributaries like Madi. Estimation of fishermen population in the Seti project area is difficult mainly because people found fishing did not claim themselves as professional fishermen.

Approximately 35 part time fishermen are reported from project area (Appendix-14). The survey indicates that occasional fishing is common practice for the villagers living aside the river. Besides part time fishermen approximately 250 occasional fisherman are found in the project area.

Based on interviews with the fishermen, fishing takes place throughout the year, but the peak fishing was reported to be practiced mainly from March to June and September to November. Fishing was also reported during high water phase of July to October. The gears most commonly used are cast net, gill net, dip net, bamboo traps, sneering loops and hook lines. Manual methods like poisoning by using various plants leaves, stems and barks are used. The common plants used in Seti Project area, as fish poison are *Sapium insigne* (Khirro), *Avage americana* (Pirro), *Polygonum*, spp. (Ketukee), *Acacia pennata* (Arkhu), *Schima wallachi* (Khanio), and *Camella kissi* (Hanwa). The leaves fruits and barks of these plants after crushing are mixed with sand and mud and released into fish shelter in crevices

and pools of diverted stream channels. Fishing with electric current and explosive in pools is also common practiced in project area by some households. Such harmful practices, not only kill adult fish but also developing egg and larval fish.

The total annual estimated catch by 35 part time and 250 occasional families in project area is 11440 kg/year (5940 kg part time and 5500 kg occasional) of Rs. 11,44,000 equivalency. Out of the total catch the part time fishermen consumes about 15 % and 85% is sold to local market and or villages where as occasional fishermen consumes 80% and sold only 20% of the total catch (Table -4.8). The average annual catch per household is 180-kg upstream area (Bhimad) where as 162 kg was caught between dam to powerhouse including Madi Khola.

Table 4.8 Fish Catch and Consumption at Different Section of River

Fishing Stretch	No of fishermen	Fishing Gear	Fishing Days	Estimated monthly catch (Kg)	Total Annual catch	Rate NRs. (Kg)	Amount NRs.
Bhimad area							
Part time fishermen	6	Cast net, dip net rod line etc	270	20	1080	100	108000
Occasional fishermen	150		LS		3000	100	300000
Sub Total					4080		408000
Dam to Madi Seti confluence and further downstream							
Part time fishermen	30	Cast net, dip net rod line etc	270	18	4860	100	486000
Occasional fisherman	100		LS		2500	100	250000
Sub Total					7360		736000
Grand Total					11440		11,44,000

Source: Field Survey, 2003

In average part time fisherman earn NRs. 14025/- per year by fishing which is considered second major source of income after agriculture. Similarly the occasional fishermen also earn some money per year (500/-) by selling their catch. Besides this the local fish catch is the major source of protein consumption for the people involved in fishing practices as well as the riverside villagers. The estimated fish consumption is 25kg/year/family in part time fishermen where as occasional fishermen consumes 18 kg/year/family.

5. Evaluation of Value

5.1 Definition of valuation Criteria

The valuation of fish was made on the basis of two important criterion viz. status of species and habitat. The valuation criteria are as follows.

5.1.1 Species

- Conservation Status (Rare, endangered, protected etc)
- Sportive Value
- Economic Importance (High, medium and low food value)
- Migration Value (Long distance, midrange and resident)

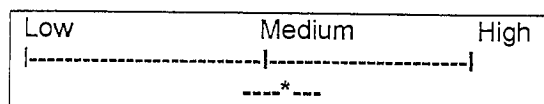
5.1.2 Habitat

- Major Spawning and Rearing Area
- Biodiversity Value (High, low and medium species diversity)

Socioeconomic value can also be listed as a criterion. But the productivity of fish yield and protein diet of local communities is not known. For valuation the listed criteria have been prioritized. High value is assigned to conservation status. Similarly high value is also given when four-sub points (two from each main criteria) of main criteria are made. In the presence of two sub points medium value is assigned. If non-of these criteria are met low value is given.

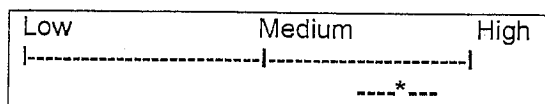
5.2 Value of Direct Impact Zone (DIZ)

The value of Direct Impact Zone is considered medium because of moderate species diversity (9 species) and moderate spawning and rearing areas. The river stretch identified in Direct Impact Zone meet only three criteria such as conservation, economic importance and migration value.



5.3 Value of Indirect Impact Zone (INDIZ)

The value of Indirect Impact Zone is in general considered higher than the value of the DIZ because of high species diversity (12 species), presence of long distance migrant species (Mahseer, eel, gounch etc) and the presence of a number of spawning and rearing ground, species of economically importance and of conservation value. Madi Khola is the major tributary for rearing and spawning ground in INDIZ. The river stretch identified in Direct Impact Zone meet four sub criteria such as conservation, economic importance, migration and high biodiversity value. This section of river also has high value of spawning area and sportive value.



6. Possible Impacts on the Aquatic Ecosystem

The construction and operation of Seti Storage Project is likely to have some impacts on local fish resources. Submergence of 7.69 km² riverine habitat, loss of habitat, blockage of fish migration and dewatering of approximately 1.5 Km river section are the impacts likely to be appear due to implementation of the project. The other possible impacts are reduced flow from Madi Seti confluence to further downstream, changes in water quality, and possible increase in river sedimentation etc. (Appednix-15).

The magnitude of impact of these parameters mentioned above are assessed on the basis of the following criteria:

- Spatial extent of Impact
- Duration of Impact
- Reversibility
- Intensity of Impact

Positive Impacts

The likely reduction of fishing pressure due to employment opportunity in the project during construction and operation & maintenance phases is likely to have medium positive impacts.

Negative Impacts

The negative impacts of the proposed project are classified as follows:

High negative Impacts

- Loss or elimination of species from certain stretch of the river
- Loss of riverine habitat
- Blockage of fish migration

Medium negative Impacts

- Reduction of riverine habitat
- Modification of habitat
- Likely reduction in species diversity and density
- Loss or reduction in the livelihood of the local fishermen
- Likely reduction in water quality due to project activities

6.1 Impacts during Construction Period

6.1.1 Habitat Destruction and loss of Spawning Ground

The construction disturbances such as removal of river boulder for quarry, temporary diversion of the river for construction of dam, water pollution and possible increase in fishing activities are considered adverse impact of the project during construction phase. Seti river contains large number of boulders, pebbles and gravels especially in downstream of dam.

The boulders occupy large pool area acting as fish shelter where as pebbles and gravels deposited in the river provide potential spawning habitat. The excess removal of boulders from a particular place will affect the fish habitat, upstream migration (migration with the help of adhesive disc as in *Schizothorax sp*) and provide easy place for exploitation of fishes.

6.1.2 Hydrology and Sedimentation

The run off soil from the unmanaged sites degrades water quality by increasing turbidity and suspended solids. Excavation of soil, cutting slopes and filling operations are required for the construction of dam, powerhouse and other accessories. The possible increase in sediment during dry period may affect spawning areas, survival of fertilized egg and fish. The fry and fingerlings are supposed to be highly affected by choking the gill. In contrast to "naturally" occurring particles, particles from newly crushed rocks might be very sharp, depending on the geology in the area. The sharp edges of these particles are known for cutting small

wounds on the gills, skin/eye of fish, and fish kills have been reported from both wild and farm fish.

However based on the available information the anticipated impact is considered to be moderate. The minor increase (2000-5000PPM) in sediment load during the monsoon may not severely affect fish and aquatic life. Because fish and aquatic life found in Himalayan water evolved physiological and behavioral ways to cope high sediment load occur annually. Overall the magnitude of this impact is expected to be moderate because erosion of spoil would mostly takes place in the wet season when sediment loads in the Seti river is already high and water quality during the high flow months (June to September) would probably not seriously impaired for fish and aquatic life.

6.1.3 Water Quality/Water Pollution

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. Cement slurry used for the construction of diversion dam, washing of sand, aggregates and concrete batching plants are the main sources of construction wastewater in project area. This wastewater may discharge into the river without treatment and it will effect the quality of water. These wastewaters have high pollution potential and contain cement as well as suspended and colloidal particles.

Furthermore, quarrying and disposal of sanitary waste are likely to happen during the construction period. The construction equipments used in the project area for various activities require frequent lubrication and changing of oil. Used oil at the maintenance yard, leaks from the equipments, accidental spills and leakages at fuelling points are the main source of oil and grease that may go into the river and create adverse impact on aquatic habitat and organism and ultimately fish. The labor camp located at the headworks and powerhouse area may also effect water quality if not properly manage.

6.1.4 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. Fishing may probably increase in the river sections downstream of the project area, (dam to Seti Madi confluence and further downstream) where fishing is already common. Harvesting by using simple ordinary techniques may probably not affect the fish population significantly. However, destructive technique such as the use of dynamites, herbicides and electric rod will have an adverse impact on the local fish population. Because the use of dynamite, poison and electric rod will not only kills the fry and fingerlings including adults but also distrust the habitat.

The prevailing market price of fish at present in project area is NRs. 100 per Kg. The construction crew will provide ready market for harvested fish and demand may increase. Local Fishermen may get benefited due to possible increase in fish price during project construction, which leads to more fishing.

6.2 Impacts during Operation Period

6.2.1 Impact of Reservoir

Thermal Stratification Impact

Seti reservoir will be formed by damming the Seti river for hydropower generation. The proposed reservoir will extend from Dule of Damali to Bhimad Bazar and covers an area of 769 ha (Fig-6). Qualitative and quantitative changes in limnological condition of Seti river are expected due to impoundment. The valley in which reservoir is located has steep sides and are subjected to large changes in depth.

It is known that the stratification, which occurs in reservoir due to temperature and other factors at various seasons of the year, is mainly responsible for the movements and the quality changes of the impoundment water. The transfer of heat from the atmosphere to the body of water leads to an unequal distribution of temperature, with high temperature in the layers near the surface and decreasing temperatures with depth. The warm water is accumulated at the surface and heavier cooler water in the layers below. This leads to a remarkable stable placement of water particles with the lighter ones on the top of the heavier and is known as temperature stratification. The principle factors involved in the heating of lake waters are (Hutchison 1957, Yoshimura 1936).

- Absorption of solar energy
- Molecular thermal conduction
- Turbulent thermal conduction
- Thermal advection in to and out of the reservoir by inflows and discharge

Considering the nature of reservoir, drawdown pattern, water temperature of Seti Khola it is assumed that the approximate thermal condition of the Upper Seti reservoir will be as following.

As the surface temperature declines with year progressing into late fall and winter the body of water will gradually become homogenous in temperature downward from the water surface. Connecting cooling is assumed to mix the reservoir homogeneously between the surface temperature and the corresponding isotherm. Hence the fall and winter isotherms are assumed to be vertical lines extending from the surface to the temperature level equal to the surface temperature. Finally the reservoir will thermally be homogeneous during winter and the dissolved oxygen content in the water will also be homogeneous.

The gradual increase in air temperature during spring will increase the absorption of solar energy by the surface water. The intake water with lower temperature will slowly sink down and the warmer water with less diversity will remain on the top layer. Thus three distinct layer epilimnion, metalimnion and hypolimnion will be formed. This condition will start from late spring and remain until early fall. Some mixing might occur during heavy floods during monsoon rain but the stratification will remain throughout that period.

Dissolved oxygen concentration in the top few meters (3- 4m) will be high throughout the year and slightly lowered in June & July. The oxygen concentration may decline below 5 -6 meter depth and gradually decrease as depth increases. Similarly the total bicarbonate alkalinity will increase in winter months and then dropped in rainy season. The existing parameter of pH will be change due to continuous leaching of limestone and calcareous layers along the reservoir margin. The dissolved solids will be dominated by calcium magnesium

carbonates and bicarbonates. The reservoir will have moderate level of suspended material made up of clay and fine silt particles.

Impact on Aquatic life

The aquatic environment provided by the semi static water of the reservoir differs markedly from that which prevailed prior to inundation. As the land is flooded the submerged vegetation is infested by fungi & bacteria, which caused decomposition. The fungal and bacterial action release inorganic nutrients (largely phosphorus and nitrogen) causing an initial raising of the trophic level of the reservoir. The leaching of nutrients from soils is also an important source of enrichment in a new water body. The result is an increase in primary production and better food production thus providing suitable condition for the growth of herbivorous fishes.

Typically riverine organisms that are adapted to fast flowing water and a sandy bottom will perish and drift away. However organism adapted to muddy bottom will be little affected. One of the most profound effects of such impoundment is upon food supplies available to the fish population. Immediately after formation, the reservoir receives inorganic and organic fertilizers from the catchment area. The development of an abundant population of phyto and zooplankton in the newly formed reservoir will provide a rich food supply for a variety of omnivorous and planktivores species. The formation of reservoir will also destroy many food sources notably benthic organisms and aquatic insects belonging to the orders: Ephemeroptera, Odonata, Plecoptera, Megaloptera, Trichoptera, Lepidoptera, Coleoptera and Diptera, which are usually abundant in a stream. This is partly due to siltation, the anoxic bottom of the reservoir and the pronounced annual drawdown, which greatly affect the littoral production.

Impact on Fish

The transition from riverine to lacustrine conditions would probably have profound effects on the aquatic conditions and fauna of the area. Due to the formation of reservoir the river flow velocity in reservoir stretch will be substantially reduced. All rapids and stretches of broken water (run and riffle) and spawning and rearing areas will be submerged accordingly. Rapid colonization of fish species preferring standing water environment often takes place soon after a reservoir has been created.

Fish species such as Copper mahseer, mahseer, minor carps (*Labeo sp.*) and *Puntius sp* will grow well in reservoir area. There will be abundant growth of aquatic vegetation which, contribute direct food to most of fish species such as *Labeo sp.* and *Chagunius chagunio*. Carnivorous fish species will breed fast and dominate the ecosystem due to prolific growth of aquatic and terrestrial insects stranded on the slow moving water surface of the reservoir. The other species likely to be adapted in reservoir type habitat are *Channa sp* and *Barilius sp*. Snow trout species which occupy very low distributional range and composition in project area will be further lowered or eliminated by formation of reservoir. This species will be adapted to live in cool precipitous upper section of Seti reservoir. The population of migratory catfish such as (*Bagarius bagarius*) and Jalkapoor (*Clupisoma garua*) will probably be eliminated from the reservoir area.

6.2.2 Fish Migration

Barrier effect is expected on long distance and midrange migrant species due to construction of dam about 119m high above the riverbed. The presence of long distance migrant species

such as Sahar, Gounch, Jalkapoor and Eel are reported from Seti river especially in high water phase. Seti river near Bandarkuna and Sisneri are the likely spawning sites in upstream area. The construction of dam in Seti 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 Seti river will be significantly affected by the construction of dam. The construction of dam will pose significant impact with regard to migration of collected/ reported migratory species of Seti river. Mahseer, Eel, Gounch and Jalkapoor are the prime concern.

The midrange migrant migratory species, which occupies distribution range both up and downstream of dam, will be isolated by construction of dam in Seti river. The isolation impact is considered for 9 months in a year. However it depends on the reservoir operation and storage capacity. The fish species utilizing the upstream and downstream tributaries for feeding, spawning and rearing will be significantly affected. Copper mahseer, minor carps, and snow trout are the species of major concern.

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, torrent catfish, stone roller and stone loaches are the species likely to be affected by the construction of dam.

The over all magnitude of impact is considered high, long term and localized because as mentioned in Chapter 3 fish diversity and density is high in Bhimad area the construction of dam will pose significant impact to up and down river migration of fish.

6.2.3 Water Diversion

The proposed Seti Hydroelectric project is designed for peak operation of 6 hours a day. The down stream flow is regulated in non peak time or during non operating hours and the river section between dam to Seti Madi confluence will be dry during November to June. 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 fishermen can easily exploit more fish in this area .The main parameters affecting the fish are;

- Reduced water flow
- Change of water quality
- Water fluctuation Impact

Reduced Water Flow and Dewater Zone

The river flow will be regulated during non-operating hours and there will be no downstream release in the Seti river during dry season. The impact will be significant in a stretch of river of 1.5 km from dam to down stream before joining the Madi Khola. This section of the river will be dewatered for about 8.5 months between January to mid June and November to December. Furthermore water released from reservoir to downstream area will also have some impact on fish and other aquatic life. The water drawn from hypolimnion layer of reservoir will have lowered dissolved oxygen concentration and low temperature. The epilimnetic release can result in temperature that is high for downstream cold water species.

Loss of Micro Organism

Dewatering below the powerhouse for approximately 18 hours a day for a stretch of 1.5 km will have the serious impact on micro flora and aquatic invertebrate. A total of 5 species of fish, 14 species of phytoplanktons, 4 species of zooplanktons and 10 species of aquatic insects may be lost in this section.

Fish food in Seti river is plentiful. The reduced flow would result in lower flow velocities, increased water temperature and shifts in zooplankton, aquatic vegetation and riparian vegetation. There could be shortage of fish food for 8.5 months in dewatered bed. The overall aquatic production in a moderate or fast flowing river takes place on the river bottom. In addition input from the terrestrial surrounding along the river like leaves, insects, grass, and other organic particles, often play an important part to increase the productivity of the river. Generally speaking, a permanent reduction of water flow in a river will reduce the area of river bottom for aquatic production.

Impact on Fish Population

The hill stream fish species, which has ecologically adapted to a fast flow condition, will be adversely effected by water diversion. The impact will be more serious to resident and mid range migratory fish species.

Impact on Resident Species

It is expected that the resident fish species in the affected parts of the river will be influenced at all life stages. All fish populations will decrease according to the reduction of water discharge and change of water quality. Species and populations living in the dewatered section will be most affected. This include the following species *Garra gotyla*, *Noemacheilus bevari*, *N. rupicola*, *Glyptothorax sp.*, *Barilius bendelisis*, and *B. barana*. The pool areas will provide a suitable rearing ground for the resident and midrange migrant species. Some small size fish like *Barilius* may survive in pool areas.

Impact on Mid range Migrants Species

Mid range migratory fish, living their adult life in central or lower parts of Seti and spawn in upper parts, will be affected mainly by reduced area for spawning and growth of fry. The impact will be considered particularly high in March -April when the popular snow trout breed. However, the adult stages will also be affected in 1.5-km stretch according to the reduction of discharge. Any change in water quality will also affect the spawning and nursery ground more severe than the adult residence area. This includes the snow trout species *Schitothorax plagiostomus*, *S. progastus*, *Neolissocheilus hexagononepis* and *Labeo dero*. The adult fish requires more water as a result of low flows they could move out of the area (1.5-Km) into the deeper water. In the worse case scenario there could be a species change to catfish, rock carp and loaches which are adaptable to low flow conditions.

Impact on Long distance Migrant Species

Long distance migratory fish can be defined as fish living in downstream part of Seti and or Narayani river and move into upper reaches for spawning. Most upstream spawning migrations take place between May to July the likely reduction in flow during spawning

migration will have significant impact on long distance migratory fishes. The young fry living in spawning area or nearby downstream will experience lower discharge and different water quality compared to pre diversion years. Production of fry of these fish species will be reduced according to reduction of discharge in addition to affects caused by modified water quality. This will concern fish species like *Tor putitora*, *T. tor*, *Anguilla bengalensis*, *Bagarius bagarius* and *Clupisoma garua*.

Water Quality Changes

During the non-operating hours in dry period there will be no flow in Seti river between Dam to Madi Seti confluence. As this section consist a number of pool areas some stagnant water will be found in these pools. There will be possibilities of rising in water temperature and likely increase in temperature above 25°C will be fatal for snow trout and many other species.

In river section downstream of powerhouse after joining the Madi Khola the quality of water remaining in the Seti river in dry period will be more influences by the qualities of Madi Khola. As shown in Appendix-1 the physico chemical parameter of water of Seti river is similar to Madi Khola the likely impact due to differences in water quality will be minimum.

Water Fluctuation Impact

The reservoir will be operated at different operating level during different time of the year and month as required for generation. The reservoir operation level will also fluctuate on daily and even hourly basis. As proposed project is design for peak operation there will be substantial flow in downstream for 6 hours a day and river flow will be drastically reduced for the remaining period.

It was noted in major power plants of Nepal that fish would accumulate at powerhouse tailrace and immediate downstream. Fish especially fry and fingerling and small size resident species feeding and rearing at natural condition in the river will not adjust themselves immediately as river water level change and remain at the bank of river. The local fishermen took this opportunity and pickup the fish with hand. Some fish may accumulate in pool areas and there will be possibilities of exploiting these fish by using herbicides and blasting. The water fluctuation impact is also expected in reservoir area but in lesser degree because this area will not easily accessible for the fishermen.

6.2.4 Fish Entrainment

The Upper Seti Storage Project will divert the reservoir water for power generation. The diversion of the river (reservoir) water in to the turbine is expected even to divert the fishes (migrant and resident) through the intake structure. Given the amount of head and pressure in the penstock tunnel (Bell 1990), hardly any of these fish passing through turbine will survive. However, 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.

6.2.5 Loss of Livelihood of Fishermen

The construction and operation of Upper Seti storage project will affect the fisheries resources of the Seti river in the project area and may influence the livelihood and income of

farmers/fishermen families living around the riverside villages. Approximately 36-part time and 250 occasional fishermen are reported from project area. The total annual estimated catch by 286 families in project area is 11440 kg of Rs. 11,44,000 equivalent.

Considering 100 % loss in dewatered section and 25%(of total annual catch) in reduced flow section approximately 4600-kg fish worth Rs.4, 60,00 will loss annually by river diversion. Similarly in upstream area the fish catch will also be reduced in reservoir section and fisherman have to move further upstream to compensate this loss. The estimated loss will be approximately 50 % of the current catch in this section i.e. 2040 kg. The total annual estimated direct loss would be 6640 kg, worth Rs 6,64,000 by the construction of the project. The likely reduction in fish catch may effect the fish consumption of local people.

7. Mitigation Measures

The following mitigation measures and enhancement programs are recommended to minimize the adverse impact on fish and aquatic life that may arise during construction and operation phases of Upper Seti Storage Project.

7.1 Muck Disposal Plan

Spoil material should be disposed in barm at proposed spoil disposal site. Larger materials would be placed near the out side edge of the barm while finer phyllite materials would be placed in the inner portion of the barm. During the dry season when baseline turbidity is also low the river must be protected from increase in suspended sediment. It is advised that project should prepare a detail muck disposal plan through out construction period and the spoil disposal at proposed sites should be modified based on the monitoring results. The other possible spoil disposal sites as well as use of muck for other purpose should be explored.

7.2 Riparian Release

7.2.1 General Background

The proposed Upper Seti Storage Project will divert water from the Seti river. Flow is a key feature in determining the complexity of aquatic habitats within the river's riffle, run and pools environment. In these areas the water flow velocity has a special relationship with the substrate that influences aquatic macro and micro invertebrates and algae growth, which are very important to riverine fish and river using predators. In Nepal there is no study of minimum water requirements for survival of fish in nursery pools during dry season. Hence, a precautionary approach of flow regulation be considered to identify how these flows actually affect and influence the various ecological components and processes in the dewatered section of Seti riverine system. Madi Khola meeting Seti river about 1.5 km downstream of the dam axis originates in the Higher Himal Range. It is a perennial snow fed river. The other contribution in the dewatered stretch comes from the groundwater. Exact volume of such contribution is very difficult to guess.

7.2.2 Analytical Method

Methods available to assess the relative merits of proposed riparian release include the In stream Flow Incremental Methodology (IFIM Bovee 1982), the Tenant Method (1976), the

NGRP Method (Northern Great Plains Resource Program 1974) and the Wetted Perimeter Method using outputs of HEC II simulations. 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 with modification adopted in Kali Gandaki A project (EIA study). Flow conditions with different regulated flows are evaluated during different months.

Table 7.1 In stream flow regimens for fish, wildlife, recreation and related environmental resources based on the original tenant Method (Tenant, 1976).

Description	Mean Monthly Annual Flow (Oct.-Mar.)	Mean Monthly Annual Flow (Apr. -Sep.)
Flushing or Maximum	200%	200%*
Optimum Range	60-100%	60-100%
Outstanding	40%	60%
Excellent	30%	50%
Good	20%	40%
Fair or Degrading	10%	30%
Poor or Minimum	10%	10%
Severe Degradation	0-10%	0-10%

*Highest monthly average flow

Table 7.2 In stream flow regimens for fish, wildlife, recreation and related environmental resources based on the modified Tenant Method (Kali Gandaki EIA Study).

Description	Monthly Average Flow	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 Degrading	10-19%	20-30
Minimum	10%	25
Severe Degradation	0-9%	0-20

Table-7.3 Assessment based on 2.4m³/s Release in the Dry Season from the Dam

Month	Natural Flow (m ³ /s)	Proposed diversion m ³ /s	Flow for release (m ³ /s)	Percentage of Natural flow	Modified Tenant Ranking score
Jan	27.00	141	2.70	8.8	0-20 (Severe Degradation)
Feb	23.00	141	2.70	10.43	25 (Minimum)
Mar	24.00	141	2.70	10.0	25 (Minimum)
Apr	27.40	141	2.70	8.88	0-20 (Severe Degradation)
May	41.10	141	2.70	5.85	0-20 (Severe Degradation)
Jun	113.80	141	2.7+1.56	3.47	0-20 (Severe Degradation)
Jul	287.20	141	141.40	49.23	90(Outstanding)
Aug	322.60	141	199.80	62.04	100 (Optimum range)
Sept	225.80	141	100.40	44.46	90(Outstanding)
Oct	107.40	141	2.70	2.51	0-20 (Severe Degradation)
Nov	52.00	141	2.70	4.61	0-20 (Severe Degradation)
Dec	34.40	141	2.70	7.05	0-20 (Severe Degradation)

The study indicates that with the release 2.4 m³/s of water the ecological condition of the river stretch between intake to Madi Seti confluence will be minimum in February & March. The riverine condition in July to August is optimum to outstanding due to availability of higher flows than required for hydropower generations. The aquatic habitat in the month of October to December and May to June will be severely degraded and aquatic life will survive only in pool section of Seti river. The aquatic habitat will also degraded in the month of January and April.

Table-7.4 Assessment based on 6m³/s Release in the Dry Season from the Dam

Month	Natural Flow (m ³ /s)	Proposed diversion m ³ /s	Flow for release (m ³ /s)	Percentage of Natural flow	Modified Tenant Ranking score
Jan	27.00	141	6	22.22	70 (Good)
Feb	23.00	141	6	26.08	70 (Good)
Mar	24.00	141	6	25.00	70 (Good)
Apr	27.40	141	6	21.89	70 (Good)
May	41.10	141	6	14.59	26-50 (Fair)
Jun	113.80	141	6	5.27	0-20 (Severe Degradation)
Jul	287.20	141	141.40	49.23	90(Outstanding)
Aug	322.60	141	199.80	62.04	100 (Optimum range)
Sept	225.80	141	100.40	44.46	90(Outstanding)
Oct	107.40	141	6	5.58	0-20 (Severe Degradation)
Nov	52.00	141	6	11.53	26-50 (Fair)
Dec	34.40	141	6	17.44	26-50 (Fair)

The above ecological condition only marginally improves, if the water release is increased from 2.4 to 6 m³/s in the section between Dam to Madi Seti confluence. The ecological condition of the river stretch between intake to Madi Seti confluence will be good to fair from January to May. The aquatic habitat in the month of June and October still shows severe degradation and aquatic life will survive only in pool section of Seti river.

Table-7.5 Assessment based on 12m³/s Release in the Dry Season from the Dam

Month	Natural Flow (m ³ /s)	Proposed diversion m ³ /s	Flow for release (m ³ /s)	Percentage of Natural flow	Modified Tenant Ranking score
Jan	27.00	141	12	44.44	90 (Outstanding)
Feb	23.00	141	12	52.17	90 (Outstanding)
Mar	24.00	141	12	50.00	90 (Outstanding)
Apr	27.40	141	12	43.79	90 (Outstanding)
May	41.10	141	12	29.19	70 (Good)
Jun	113.80	141	12	10.54	26-50 (Fair)
Jul	287.20	141	141.40	49.23	90(Outstanding)
Aug	322.60	141	199.80	62.04	100 (Optimum range)
Sept	225.80	141	100.40	44.46	90(Outstanding)
Oct	107.40	141	12	11.17	26-50 (Fair)
Nov	52.00	141	12	23.07	70 (Good)
Dec	34.40	141	12	34.88	80 (Excellent)

To improve the river ecological conditions of the stretch between dam and Madi Seti confluence area from severe degrading to fair in critical dry months water release of about 12 m³/s from the dam is required. But such release of water will have serious implications on the hydropower output and to the economic cost benefit of the Seti Storage Project.

The reduced flow in the dewatered section may be crucial to the maintenance of Seti River aquatic ecology between Dam and Madi- Seti confluence in the dry season. Increased release of water by small proportion does not improve the ecological conditions to an acceptable level. Release of higher proportion of flow volume available will have direct implication to cost and benefit of the project.

For the survival of resident and mid range migrant fish population minimum flow will be required for keeping pools and nursery beds with fish and invertebrates in dry season. A hypothetical scenario for three different riparian releases has been visualized and the details are given below. However no scientific data are available to support this assumption.

Table -7.6 Riparian Release Scenario

River Stretch	Impacts	Minimum Discharge Release		
		2.4m ³ /s	6m ³ /s	12 m ³ /s
Dewatered Stretch	Temperature rise	By 4-5 °C	2-3 °C	Non
Reduced flow stretch	Temperature rise	1-2 °C	Non	Non
Dewatered Stretch	Salt concentration	Increase	Slight increase	No changes are expected
Reduced flow stretch	Salt concentration	No changes are expected	No changes are expected	No changes are expected
Dewatered Stretch	Survival of living organism	Some aquatic micro-macro organism, insects aquatic vertebrates will be survive	All the aquatic micro-macro organism, insects aquatic vertebrates will be survive	All the aquatic micro-macro organism, insects aquatic vertebrates will be survive
Reduced flow stretch	Survival of living organism	All the micro and macro organism (Phyto & zooplanktons) aquatic insects and vertebrates will survive	All the micro and macro organism (Phyto & zooplanktons) aquatic insects and vertebrates will survive	All the micro and macro organism (Phyto & zooplanktons) aquatic insects and vertebrates will survive
Dewatered Stretch	Survival of fish and other vertebrates	No fish and aquatic vertebrates will survive in run and riffle habitat. Some fry and fingerlings including adults of resident species may survive in pool habitat.	Resident fish Species like <i>Garra sp.</i> , <i>Puntius sp.</i> , <i>Pseudechenius sulcatus</i> , <i>Glyptothorax</i> and <i>Nemacheilus spp</i> will survive.	All the species recorded from Seti river will survive
Reduced flow stretch	Survival of fish and other vertebrates	All the fish species recorded from Seti river will survive	All the fish species recorded from Seti river will survive	All the fish species found in Seti river will survive

The above scenario clearly indicated that even with the release of 6 m³/s the survival of fish and aquatic life in run and riffle condition is not possible and release of 12m³/s is not economically feasible. Therefore release of 2.4m³/s seems good and it is expected that proposed released could maintain the riverine habitat to a minimum ground. After meeting with Madi, even with 2.4m³/s release from the dam, the Seti river ecological conditions are envisaged to remain good.

7.3 Water Quality Protection Measures

Water quality protection measures will have to be applied during construction and operation phase. The construction contractor will require to develop a waste management plan, which details the use, storage and disposal of toxic, solid and sanitary waste and materials. All batching plant waste water and truck wash down must be diverted to a settling basin for treatment prior to discharge. The storage sites shall be enclosed by dikes sized to contain the entire capacity of tanks with sufficient free board to prevent over flow. The storage area shall be lined to reduced potential surface and ground water pollution in the event of spill. The wastewater should not be mixed with the natural stream/river water before treatment. The used oil and lubricants should be collected regularly in to drums/ barrels or tanks. The settling basin should be used to collect the slurry for settling the heavy particles and other material, which can be recycled or incinerated.

No direct spillage of petrochemical or toxic materials should be allowed in to the aquatic ecosystem. Latrines established at the construction camp (dam and powerhouse site) should be located in areas isolated from surface and ground water.

7.4 Fish Trapping and Hauling Program

Fish trapping and trucking program is recommended in conjunction with hatchery for the Upper Seti Storage Project. This program is well developed and refined in most dam projects in European countries. The program is under implementation in Kali Gandaki "A" Hydroelectric Project as a pilot scheme. This is low cost locally available labor intensive technology and can be easily implemented in any dam project of Nepal. The program includes collection of migratory species below and above the dam during migratory season and release in river to facilitate up and downstream migration. This program is helpful for the collection of necessary brood stocks for proposed hatchery. Seti river provides suitable habitat for diverse species and breeding technology for most of the collected or reported species is not available in Nepal. The fish trapping and hauling program will be suitable mitigation measures for such type of fish species.

The positive aspects of the program is that local fishermen are traditionally involved in fishing practice and by small refinement of traditional fishing gear, and short training the program can be easily implemented. Low cost, local employment opportunity, effectiveness for all migratory and resident species are the other beneficial aspects of the program. The problem of mismanagement, risk of poaching, stress related mortalities and annual cost input are the drawback of the program.

Kali Gandaki Environment Management Unit initiated fish trapping and hauling program in April and May 1998 as a pilot scheme in Marsyangdi Hydroelectric Project. The capture and hauling program was focused to capture the fish below the dam and haul them above the reservoir area. The areas immediate below the dam gate, below the desander gate, reduced flow area, powerhouse tailrace and downstream of powerhouse were selected for the program. The program was implemented by using local fishing gears and 153 fish of 9 species were collected from the downstream of Marsyangdi river and haul them at upstream area. Similar type of program was also implemented in Kali Gandaki river at powerhouse and below powerhouse area. The experience gained from Marsyangdi and Kali Gandaki show that Fish Trapping and Hauling is low cost program and can be easily implemented in Upper Seti Storage Project. It is recommended that proposed program must be implemented in upper Seti storage project. The program such as gears for targeted species, migration timing



and sites for the trapping and hauling should be refined and tested during the construction period. Furthermore the lack of migration and fish behavior data pose serious difficulties for the design of suitable mitigation program for fish found in Nepalese river system. A tagging study is also recommended during the construction phase in conjunction to fish population and diversity monitoring and with trapping and hauling program. The following equipments/gears are required to implement this program.

- Single cab Pickup for tank mount-1
- Hauling tank with 500 liter capacity-1
- Fishing gears (modified and local)
- Equipments and Accessories

7.5 Trash Rack

There are a number of mitigation options practiced to minimize fish entrainment in the powerhouse turbine. Some of the practiced options, though feasible from technical point of view are too costly such as vertical travelling screens, drum screens, inclined screens and stationary screens, while some others are not technically feasible to be incorporated in the selected intake design such as collector channel screening and flushing. Some other options such as electrical fields, lights and acoustical systems are still in testing phase and their effectiveness to deter fishes is still not soundly based. Besides, the change in water, physical conditions (turbidity, suspended solids) in the dry and wet season affects the efficiency of electrical and light systems. (Bell 1990).

To make the system most effective, the design engineer must visit and consult the existing storage project to collect practical experience with operation/design staff of NEA. This issue shall be covered in advance phase of the project.

7.6 Enforcement of Aquatic Animal Protection Act

Fish aggregate in the intake and powerhouse will be susceptible to legal and illegal harvest. The project management is advised to develop some enforcement mechanism in association with local administration, local leaders and Fisheries Development Division HMG/N and Nepal Fisheries Society (NEFIS) to banned illegal fishing in the project area.

7.7 Reservoir Fishery Development

7.7.1 Fish Hatchery

The establishment of a fish hatchery is one of the most acceptable mitigation for dam projects on the native fish fauna. Hatcheries generally play an important role in fish conservation and reservoir fishery development in developing countries. In recent years their efficiency has been increased with better knowledge of the biological and reproductive requirements of fishes. In Nepal there are three commercial fish hatcheries namely Pokhara Fisheries Research Center, Trishuli Fisheries Research Center and Fatepur Fisheries Development Center. These hatcheries are associated with Phewa Multipurpose Dam, the Trishuli Hydroelectric Project and the Chandra Nahar Irrigation Project respectively. These hatcheries are successfully breeding economically important indigenous and exotic fishes and their positive impact on fisheries development in the respective areas is evident.

Recently a fish hatchery is under construction in Kali Gandaki A Hydroelectric Project undertaken by Nepal Electricity Authority. The Kali Gandaki A hatchery aims to propagate Mahseer, Copper Mahseer, Snow trout and other indigenous species.

Establishment of Hatchery

Hatchery generally plays an important role in fish conservation and reservoir fishery development. The stocking of fry of indigenous long distance and mid range migratory species in the reservoir and upstream of reservoir will replenish the natural population affected by the project. Fish hatchery will also compensate the unavoidable loss in Seti Khola and basin also.

The reason for proposing hatchery is;

- Mitigation of fish losses caused by the project construction and operation and maintenance
- Replacement of fish population removed by sport fishing or commercial fishing
- Propagation in areas where the fish population is depleted or eliminated
- Suitable mitigation for most of the fish species
- Local technology available
- Local employment generation specially for fishermen
- Suitable alternative of fish ladder as fish ladder is not feasible in high dam projects.
- Enhancement of fish production in reservoir where the population potential is not fully realized and
- Introduction of species more suitable to a reservoir ecosystem

The proposed hatchery will produce fish fry of migratory fish species as well as other declining fish species. Indigenous fishes will include mahseer (*Tor tor* and *Tor putitora*) copper mahseer (*Neolosocheilus hexagonolepis*) snow trout (*Schizothoracichthys progastus*, *Schizothorax richardsonii* and *Schizothorax plgiostomus*) minor carps (*Labeo dero* and *Labeo angara*) and other economically important species. The hatchery development also include breeding and rearing facilities of exotic carps to promote aqua culture in the area and for reservoir fisheries development. The exotic species includes planktivores and herbivores carps such as silver carp (*Hypophthalmichthys molitris*) bighead carp (*Aristichthys nobilis*) and grass carp (*Ctenopharyngodon idella*). The proposed hatchery will be a small size raceway type structure and can be run by lifting the water from Seti river. The deep tubewell will also be a suitable option for water supply. The fry and fingerlings produced in hatchery will be stocked in the reservoir and upstream of reservoir. The hatchery will produce 2.5 million fry annually. Out of which exotic fish will be 52% whereas indigenous fish contribute 48%. These fries will be distributed for open water stocking, reservoir fisheries development and cage fish culture. The estimated number of fry required for mitigation and enhancement program of different species is as follows.

Table- 7.7 Estimated Number of Fry Required for Upper Seti HEP

S.No	Species	Estimated no. of Fry	Percentage
A. Indigenous Species			
1	Mahseer	200000	16.67
2	Mahseer (Pahele Sahar)	200000	16.67
3	Copper Mahseer	300000	25.00
4	Snow trout (Chuche Asala)	100000	8.33
5	Snow trout (Buche Asala)	100000	8.33
6	Snow trout (Asala)	100000	8.33
7	Minor carps (River rohu)	200000	16.67
	Sub-Total	1200000	100
B. Exotic Species			
1	Bighead carp	400000	30.77
2	Silver carp	400000	30.77
3	Grass carp	500000	38.46
	Sub-Total	1300000	100
Grand Total A+ B		2500000	

To minimize the size of hatchery fifty percent of the brood stock of indigenous species will be reared in the hatchery and remaining 50 % will be collected from the river through trapping and hauling program. The tentative number of brood stock required producing such a number of fry is as follows.

Table- 7.8 Estimated Number of Brood Stock Required to Produce Targeted Fry

Fish species	Target of Production (Fry)	Egg release/Kg of body wt.	Hatchlings (40% survival)	Fry (50% survival)	Approximate number of Brood Stock
A. Indigenous Species					
Mahseer	200000	4000	1600	800	250
Mahseer (Pahele sahar)	200000	4000	1600	800	250
Copper Mahseer	300000	4000	1600	800	375
Chuche Asala	100000	7000	2800	1400	72
Buche Asala	100000	7000	2800	1400	72
Asala	100000	7000	2800	1400	72
River rohu	200000	10000	4000	2000	100
Sub-Total	1200000				1191
					Say 1300
B. Exotic Species					
			50% survival	60% survival	
Bighead carp	400000	25000	12500	7500	54
Silver carp	400000	25000	12500	7500	54
Grass Carp	500000	25000	12500	7500	67
Sub-total	1300000				175
					Say 200
Grand Total (A+ B)		2500000			1500

Hatchery Site

The possible potential sites for hatchery has been identified. However the other location shall also be explore during advance stages of the project study and prior to hatchery design. The following locations has been identified during the field visit

- Belbash at left bank of Seti river between Madi Seti confluence to powerhouse site
- Cultivated land (Left bank) near school compound at Bhimad Bazar (end point of reservoir)

Both the sites are located at private cultivated land and accessible through motarable road. The Belbash site is considered suitable because it is close to dam site and facilities of dam such as staff quarter and other support facilities could be used to run the hatchery complex (Fig-7). This site is also helpful for implementing cage fish culture and open water stocking by reducing transportation cost as site is close to dam. Pumping of water is required to run hatchery at both the sites, as there were no perennial sources. However the pumping requirement could be minimized at Belbash location for few months in rainy season as this site is close to small tributary. Boring will also be suitable options for water supply.

Hatchery Complex

The details of the hatchery component will be finalized during advance phase of the study (detailed design). The hatchery size, design criteria, final selection of location and design of hatchery complex will be conducted in detailed design stage of the project. However the hatchery complex shall include but not limited to the following components.

- Brood stock pond
- Rearing pond
- Nursery pond
- Indoor rearing tanks
- Raceway system
- Office and staff quarter with adequate facilities
- Hatchery building
- Main feeding canal
- Feeding/drain canal
- Breeding equipments & accessories

7.7.2 Strengthening of NARC Fisheries Research Center Begnas Pokhara

This program is recommended as an alternate to fish hatchery. Agriculture Research Center Begnas, Pokhara/NARC is producing fry and fingerlings of Asala, Sahar Katle, minor carps and torrent minnows. The fry and finger of exotic carps such as big head, common, silver and grass carps are also available in the Pokhara Fish Research Center. The estimated fry requirement for the upper Seti storage project is approximately 2.5 million annual.

These fry and fingerlings can be transported by Truck to Seti reservoir and Bhimad area in oxygen packed container for open water stocking with less than 5% mortality (experience with Bhotekoshi HEP in March and April 2003). The temperature and oxygen has to be maintained during transportation period with the help of ice blocks whenever needed. It is

recommended that NEA should make dialogue with NARC authorities and assist for the strengthening of NARC Fisheries Research Center Begnas, Pokhara so that necessary fish fry and fingerlings could be obtained. The positive aspect of the program is, low cost, minimize the long-term liability to NEA and operation and maintenance problem of hatchery. The estimated cost for strengthening program is NRs. 3000000/-. This cost is not included in total mitigation cost as this program is recommended as alternate for hatchery.

7.7.3 Open Water Stocking Program

The open water stocking program is recommended to explore the reservoir potential and to minimize the impact on indigenous cold water fishes. The program will be of two types

- Stocking of indigenous fish together with exotic fish in reservoir to explore the reservoir potential
- Release of fingerlings in riverine condition at upstream of reservoir to minimize the fish loss by dam construction

Stocking in Reservoir

The open water stocking in reservoir will be conducted to utilize the potential of reservoir as well as to mitigate the fish loss. The estimated area for open water stocking in reservoir is 769 ha. The open water stocking will be done at the rate of 1000 fry per hectares. Approximately 8 lakhs fry are required to enhance the available area of reservoir. The open water stocking program will include both exotic and indigenous fish species. The following species combination is recommended in reservoir area to exploit the reservoir potential.

Exotic carps

- Bighead carp
- Silver carp
- Grass carp

Indigenous species

Mahseer
Copper Mahseer
Minor carps (*Labeo sp.*)

The fish yield of different water bodies/ reservoir varies depending upon the food supply, stocking density and water quality. According to available information the reservoir productivity varies from 26 Kg/h to 50 kg/ha. It may produce 100kg/h if properly managed (Jhingran 1990). The fish production of Begnas, Rupa and Phewa lake is 26 kg/h, 37kg/h and 31.5kg/h respectively. Assuming 37-kg/h production of Seti reservoir approximately 25 Mt. fish will produced annually.

Stocking in Upstream of Reservoir/ Riverine Condition

The open water stocking will be done to minimize the impact of the project on native fauna. The open water stocking will include the indigenous current loving fish. The estimated area available in upstream of reservoir to Pokhara valley. Snow trout, copper mahseer and mahseer are recommended for open water stocking program. The estimated number of fry for open water stocking program is 8 lakhs annually.

Cage fish Culture

Fish production in Nepal could be expanded through the rational exploitation of inland waters. In this context the 769 ha Upper Seti Reservoir will offer an additional suitable

habitat. The cage fish culture will replace the loss of fish catch in Seti river. This is also helpful in maintaining the fish population and protein consumption of local people. According to available information 10 to 20% of the reservoir potential could be use for cage fish culture. Out of this about 5% potential is most viable keeping in mind the reservoir operation especially the drawdown. In first phase of the cage fish culture development 1% of the total area is proposed for cage fish culture. Approximately 80000m³ cage can be introduced in an area of 7.69 ha. The estimated fry required for cage culture is 8 lakhs.

Indrasarobar reservoir, Kulekhani is the only reservoir, which is utilized for the fishery development. The experimental result shows that Indrasarobar reservoir is suitable for commercial fish culture and fish production per m³ (5 to 6kg/m³) was promising in comparison to cage fish production in Lake of Pokhara (3- 4 kg/m³). Fisheries Development Center Markhu initiated commercial fish culture from 2045 by involving local people. The center started cage fish culture from five households and 117 households are currently involved in cage fish farming. Out of the total available potential only 11770m³ area is exploited for cage fish culture so far. Approximately 17000-kg fish was sold last year from the farmers (12972kg) and government cage (4058kg) established in Indrasarobar reservoir. (Kantipur Paush 2057). The artificial feeding is not required for the fish culture in Indrasarobar reservoir.

The preliminary discussion with the local people reveals that local fisherman from Bhimad and Patan (Damauli) are interested for the cage fish culture. In view of the important potential for fish production the local 36 fishermen should be accommodated in cage fish culture program. This practice would generate employment and additional income to marginal fisherman families and it would increase the reservoir production also. Considering 6 kg/m³ approximately 480 Mt. fish could be produced annually by cage fish culture. Therefore the total estimated production of Upper Seti reservoir would be 513 Mt. annually.

7.8 Enhancement Measures

7.8.1 Training and Loan Assistance Program

A small scale skill development training and loan assistance program are suggested to compensate the impact on local fishermen. This program is recommended only for the part time (36 households) fishermen. The objective of the program is;

- To provide soft loan to fishermen families
- To increase the living status of the fishermen
- To cover the possible boom market may arise due to implementation of the project
- To provide seed money and technical input

The program can be implemented in collaboration of Agriculture Development Bank or local NGO's. The possible area of support are cage fish culture, livestock farming (Goat, piggery etc.), poultry and small scale retailer shops. The training program should also considered about breeding technique, procedure for handling of fish fry and fingerlings during transportation etc.

7.8.2 Environmental Awareness Program

It was experience with other fishermen villages/area as well as in the project area that earning of fishermen are high but they have no control over their expenses. The objective of the awareness program is to create awareness about the saving and credit mechanism, uses and invests of money etc. The program also includes about the project induced positive and negative impacts likely to be arising due to diversion of water.

8. Environment Management and Monitoring Plan

The proposed Upper Seti storage hydroelectric project will have primary responsibility for the implementation of mitigation measures and monitoring plan.

8.1 Monitoring Plan

Monitoring is an essential aspect of environmental management. It consists collection of data to measures environmental changes associated with construction and operation of the project. Depending on the location or the month of the year certain construction activities may have greater or lesser impacts on fish and aquatic life. The study indicates that proposed project would have significant impact on fish and aquatic life of the area and changes are expected on daily or weekly period. Therefore based on the study, type and size of the project and monitoring experience of similar nature project regular monitoring is recommended throughout construction period.

8.1.1 Baseline Monitoring

Baseline monitoring will be conducted quarterly throughout the construction period. Monitoring will also be conducted in fish migration season, dry and wet season for fish and aquatic life. The monitoring parameters include fish migration data, seasonal fish and aquatic life diversity, water quality and fish catches etc.

8.1.2 Impact Monitoring

Impact monitoring will be conducted for fish and aquatic life during construction period on weekly & monthly basis. The monitoring parameters will include impact of habitat loss and construction disturbances, changes in water quality, muck disposal, fish population and species diversity etc. The implementation of the proposed mitigation measures is also the part of monitoring.

8.1.3 Compliance Monitoring

The compliance monitoring includes:

- ◆ Monitoring of recommended mitigation measures
- ◆ Monitoring of tender clauses

The following points should be incorporated in tender documents.

- The contractor shall be liable for any illegal use of project dynamite for the purpose of fishing.

- The contractor shall not release toxic material or other pollutants that would damage aquatic resources, in to the Seti river and its tributaries.
- The contractor shall not deposit excavated material on land, riverbank except where directed by the engineers.
- The contractor shall to the extent practicable and economical, use excavated rock material (muck) for other purpose, in-order to reduce spoils material to be disposed or dumped permanently in dumping areas.
- The consultant shall identify other suitable fill areas for spoil disposal and took approval from engineers accordingly.
- The contractor shall take all necessary precautions to secure the efficient protection of all streams and waterways against pollution of all kinds arising from excavation of the works including from associates camps and facilities and the presence or activities of staff and labor forces.
- The contractor shall prepare Waste Management Plan which details the controlled usage and treatment of all toxic materials and wastes, sanitary waste and solid waste used or produced on site and in relation to the works.

Table-8.1 Monitoring Plan

A. Construction Phase Monitoring				
Activities	Location	Method	Schedule	Responsibility
Fish population and species diversity monitoring	1-8 Sampling station	Cast net, rod line, snaring loops etc.	Monthly	Monitoring Unit/Project
Fish migration monitoring	1-8 Sampling Station	Tagging/ telemetry and observation	Seasonal	Monitoring Unit/Project
Fishing activity by work force and their families	Construction/Camp area	Observation	Weekly	Monitoring Unit/Contractor
Use of Explosive, herbicide and other illegal fishing practices	Project area	Observation	Weekly	Monitoring Unit/Contractor
Dumping of Waste material and muck	Muck disposal sites	Observation and water quality test	Weekly	Monitoring Unit/Contractor
Water Quality	Intake , below powerhouse and spoil disposal sites	Water test Kit/Laboratory analysis	Monthly	Monitoring Unit/Contractor



Local fish market survey and fish catch	Bhimad and Damauli	Regular visit, group discussion and questionnaire survey	Quarterly	Monitoring Unit
Monitoring of recommended mitigation measures	See program	Field visit	Quarterly	Monitoring Unit/Project
B. Project Operation Phase				
Compensatory flow	Downstream of intake	Observation and measurement	Dry period	NEA
Dewatering Impact	"	Observation measurement and study	"	NEA, HMG/N
Reduced flow impact	"	"	"	HMG/N
Fish Hatchery operation and maintenance	Proposed hatchery site	See Program	See Program	NEA
Fish Trapping and Hauling Program	See. Program	See Program	See Program	NEA
Cage fish culture program	Reservoir area	See program	"	NEA
Open water Stocking program	Upstream of Intake	See Program	Dry Period	NEA
Water Quality Changes	Reservoir area, dewatered zone, reduced flow area and powerhouse tailrace	Test Kit	Monthly	HMG/N, NEA
Impact on local fishermen	Project area	Interview and questionnaire survey	Once within two years of project completion	HMG/N, NEA

8.2 Environment Management

8.2.1 Manpower

The following manpower is recommended for monitoring and management of fish and aquatic life component of Seti river.

- Fisheries expert
- Technician
- Fishermen

8.2.2 Environment Management Cost

The total estimated monitoring and mitigation cost of the upper Seti storage hydroelectric project in fisheries and aquatic life resources is NRs. 1,34,16000/- with annual operation cost NRs. 8,00000/-.

Monitoring

The total estimated construction phase (for 5 years) monitoring cost of the upper Seti storage hydroelectric project in fisheries and aquatic life resources is NRs. 17,16,000/- .The detail cost breakdown is shown in Table 8.2.

Table-8.2 Estimation of Construction Phase Monitoring Cost

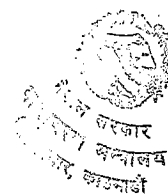
Manpower	Man- month			Rate	Amount
	Field	Office	Total		
Fisheries Expert	6.66	13.33	20	500000	1000000
Fisheries Technician	10	10	20	20000	400000
Fishermen	27	0	27	8000	216000
Others					100000
Total					17,16,000

Mitigation/Enhancement Cost

Several mitigation programs are suggested to minimize the project impact on fish and aquatic life. The estimated capital cost for mitigation measures is NRs. 1,17,00,000/- and annual operation cost NRs. 8,00,000/-.

Table-8.3 Estimation of Mitigation/ Enhancement Program Cost

Program	Estimated Cost	
	Capital Cost	Annual Cost
1. Hatchery establishment	10000000	600000
2. Training and loan Assistance to Fishermen	500000	
3. Environmental Awareness Program	100000	
4. Literacy program	100000	
5. Fish Trapping and Hauling Program	2000000	200000
6. Riparian Release		Opportunity Cost
Total	11700000/-	8,00000



9. Conclusion and Recommendations

Fisheries and Aquatic life study of the Upper Seti Storage Project was undertaken as part of feasibility level Environmental Impact Assessment study. Fish survey of Seti river, previous studies and local information provided in the field determined the presence of 32 species of fish (Appendix-7). A total of 471 fish of nineteen species were collected from Seti river during the field visit. Copper mahseer contributes about 25.26% of the total catch. The composition of mahseer and minnows throughout Seti river are 13.8% and 35 % respectively.

In average >7 fish was caught per hour through out the Seti river by cast net. The average catch per unit effort of Seti river is 0.22 fish with highest catch at station 1 &2 and lowest at Station 3. (Table-4.6). Out of 32 species recorded or reported from Seti river 5 were long distance migrant 6 were midrange migrant and 21 were residents in habit (Appendix-9).

Out of total species recorded from the project area 7 species are vulnerable, 1 is endangered and 2 species are categorized as rare (Appendix-9). All the fish collected/ reported from the Seti river are edible and have considerable food value. Approximately 36-part time (Appendix-14) and 250 occasional fishermen are report from project area. The average annual catch per household of part time fishermen is 165 kg (Table-4.8).

Habitat destruction, loss of spawning ground, possible increase in water pollution due to spoil disposal and other direct and indirect construction activities and increase in fishing pressure are the possible impacts likely to be occur in construction phase of the project. The operation phase impacts includes changes of riverine habitat in to reservoir, blockage of fish migration, de-watering of 1.5 Km river section for about 8.5 months for 18 hours a day, reduced flow, changes in water quality and fish entrainment etc. The impact on local fishermen due to possible reduction in fish catch is also considered to be a significant impact (Appendix-15).

The mitigation measures recommended to minimize the adverse impacts are muck disposal plan, riparian release of 2.4m³/s, construction and operation of fish hatchery, and water quality protection measures. The other programs are open water stocking of exotic and indigenous carps, cage fish culture, fish trapping & hauling, training and loan assistance to fishermen and environmental awareness Strengthening of Begnas Fisheries Center Pokhara/NARC is also recommended as an alternative for the hatchery development.

Baseline, impact and compliance monitoring are suggested during construction and operation phases of the project. The estimated cost for monitoring and mitigation for fish and aquatic life resources is NRs.1, 34,16, 000/- and annual operation cost NRs. 8,00,000/-.

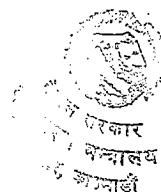
The study indicates that proposed project would have moderate to low impacts on fish and aquatic life if the recommended mitigation measures will be applied.

Recommendations

- Fish migration study with fish tag or telemetry
- Fish population and species diversity in different season and stretch of Seti river
- Detail study and design of fish hatchery
- Open water stocking and cage fish culture
- Updating the EIA study prior to implementation of the project

9. References

- ♦ Arthington A.H. & Zalucki J.M (1998) Comparative Evaluation of Environmental Flow Assessment Techniques: Review Methods Land Water Resources Research Development Corporation Canberra.
- ♦ Hanson, C.H. J. R, white and H. W. Li 1977, Entrapment and Impingement of fishes by Power Plan cooling water intakes: an overview, Marine fisheries Review, Oct. pp7-17
- ♦ Hamilton, F.1822. An account of the fishes found in Ganges and its branches 7: 405, Edinburg
- ♦ HMG/N (1997) Environmental Protection Rule and first Amendment. 1998.
- ♦ HHG/N (2055). Aquatic Animal Protection Act amendment 2055, Nepal Rajpatra, Kathmandu, Nepal.
- ♦ Hutchinson, G.E.1957. A treatise on Limnology, Vol. 1, F. Wiley, New York
- ♦ Jhingran A.G. Recent Advances in Reservoir Fisheries Management, in India. Proceedings of 2nd Asian Reservoir Fisheries Workshop held in Hongzhou, Peoples Republic of China, 15- 19 Oct. 1990, pp 158 to 172.
- ♦ Environment Impact Assessment of Kulekhani III Hydroelectric Project, NEPECON in association with DIP Consult P. Ltd. March 2001
- ♦ IUCN/METCON Environment Impact Assessment of Melamchi Diversion Scheme final Report Dec1999.
- ♦ Jay Ram K.C. 1981, the fresh water fishes of India, Pakistan, Bangladesh, Barma and Sri Lanka. A handbook zoological survey, India Calcutta, 475pp 13 Ps
- ♦ Jhon, A. 1986, Morphological adaptations of Fishes of River Seti and adjoining areas, Nepal, Ph.D., Thesis, Patana University, pp. 328
- ♦ Kantipur (2057). Kantipur daily NewsPaper, Kantipur Publication Kathmandu Paush 2057.
- ♦ Murphy B. R. Wills D. W. (1996) Fisheries Techniques, Second Edition, American Fisheries Society, Bethesda Maryland, USA, 1-6 11pp
- ♦ Macleland, J. 1839. Indian Cyprinidae, Asiatic Research, Calcutta, 19 pp. 217-471
- ♦ National Environment Impact Assessment Guidelines IUCN and NPC 1993.
- ♦ NEA, 1996. Kali Gandaki A Hydroelectric Project, Environment Impact Assessment Report Kali Gandaki A Associates February 1996
- ♦ NEA, 1998. Dudh Koshi Hydroelectric Project, Environmental Impact Assessment, Medium Hydropower Study Project April 1998 p.p. 45 - 50.
- ♦ NEA, 1998. Budhi Ganga Hydroelectric Project, Environmental Impact Assessment, Medium Hydropower Study Project.
- ♦ P. Nautiyal (1994) Mahseer the Game Fish with natural history status and conservation practices in India and Nepal. Rachna publication, Garhwal India.
- ♦ Pradhan B.R and Swar D. Limnology and Fishery Potential of the Indrasarobar Reservoir at Kulekhani, Nepal, Fisheries Section, Hariharbhawan, Pulchoke, Kathmandu
- ♦ Rai A.K. and Swar D.B.Katley (*Neolesocheilus hexagonolepis*) a cold water cyprinidae of Nepal, Inland Fisheries Development Project (Indrasarobar) Kulekhani, Nepal.



- ♦ Shrestha J. 1998, Aquatic Habitats and Natural Water Fish and Fisheries in Nepal. Paper presented at Environmental Assessment Background Training ADB-TA 2613-NEP, NEA-ED. Feb. 2-6, Kathmandu, Nepal.
- ♦ Shrestha, J. 1995. Enumeration of the Fishes of Nepal, Technical Publication No. 10. Biodiversity Profile Project. HMG, Department of National Park and Wildlife pp 150.
- ♦ Shrestha, J. 1994 Fishes, Fishing implements and Methods of Nepal. Smt, M.D. Gupta, Lalitpur, Laskar (Gwalior) India 11-150
- ♦ Shrestha, J. 1992 The Role, Scope and Importance of Natural Water Resources for Increased Fish Production in Nepal. Proc. of Workshop on Human Resources Dev. in Fisheries Research Nepal, HMG/FDD, IDRC April-3 1992, Kathmandu.
- ♦ Shrestha T.K. 1990. Resources Ecology of the Himalayan waters. Curriculum Development Center, TU. Kathmandu.
- ♦ Swar D.B Effects of Impoundment on the Indigenous Fish Population in Indrasarobar Reservoir Nepal. Proceedings of 2nd Asian Reservoir Fisheries Workshop held in Hongzhou, Peoples Republic of China, 15- 19 Oct. 1990, p.p. 111 -118.
- ♦ Terrsshima, A 1984 The three new species of Cyprinidae genus *Schizothorax* from lake Rara, northwestern Nepal, Japanese journal of fish.
- ♦ Tennant, D.L. (1976). Instream flow regime for fish wildlife, recreation and related environmental resources, Fisheries 1:6-10.
- ♦ Tripathi. A.K. (1993). Advances in Environmental Science, Ashish Publishing House New Delhi, India 20-50pp
- ♦ Talwar P.K. & Jhingran .A.G (1991) Inland Fisheries of India and Adjacent Countries Vol. I & II, Oxford & IBH Publishing Co. PVT LTD, New Delhi.
- ♦ Water Resources Sector Guidelines Draft 1994
- ♦ Yoshimura, S. 1936. A contribution to the knowledge of deep water temperature of Japanese lakes, part I summer temperature, Japanese Journal of Astronomy and Geophysics, Vol. XIV, No1, Tokyo.

APPENDICES



Appendix-1

Water Quality Parameters of Seti River

S.No	Discription	Unit	Sampling Location/Station										Remarks
			1	2	3	4	5	6	7	8	9	10	
1	Date	AD	March -9	March-10	March-11	March-12	March-13	March-14	March-15	March-16	March-17		
2	Time		8.00 AM	2.00PM	10.00AM	11.00AM	11.00AM	8.00AM	11.30AM	9.30AM	7.00AM		
3	Climate		Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Cloudy		
4	Air Temperature	0C	20	30	25	30	32	20	30	25	22		
5	Water Temperature	0C	20	21	22	22	22	20	22	21	21		
6	Dissolved Oxygen	mg/l	10.5	10	11	11	11	10	10	9	9		
7	Ph	-	7.9	8	8.3	8.4	8.4	8.1	8.7	8.5	8.5		
8	Alkalinity	mg/l	153.9	153.9	153.9	153.9	153.9	85.5	119.7	119.7	68.4		
9	Total Hardness	mg/l	188.1	188.1	188.1	188.1	188.1	102.6	171	171	85.5		
10	Carbon dioxide	mg/l	20	15	15	15	15	15	15	15	15		
11	Transparency	Cm	147	100%	100%	100%	100%	100%	100%	100%	100%		

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Appendix-2
Phytoplankton Species Recorded at Different Sampling Station

S.No	Species	Sampling Station/Location							
		1	2	3	4	5	6	7	8
A.	Bacillorophyceae								
1	<i>Fragililaria capucina</i>	+	+	+	+	+	+	+	+
2	<i>Fragililaria verescens</i>	+	+	+	+	+	+	+	+
3	<i>Cymbella cistula</i>	+	+	-	+	-	+	-	-
4	<i>Cymbella tumida</i>	+	-	+	-	-	-	+	+
5	<i>Melosira islandica</i>	+	+	+	+	+	+	+	+
6	<i>Melosira varians</i>	-	-	-	+		+	-	-
7	<i>M. granulata</i>	+	-	+	-	+	+	+	+
8	<i>Surirella robusta</i>	-	-	+	-	-	+	-	-
9	<i>Stauroneis anceps</i>	+	-	-	+	-	-	-	+
10	<i>Syndera affmiss</i>	+	+	+	+	+	+	+	+
11	<i>S. ulma</i>	+	+	+	+	+	+	+	+
12	<i>Pinnularia viridis</i>	-	+	+	-	-	+	-	+
13	<i>Cymatopleura solea</i>	+	-	-	-	+	-	-	-
14	<i>Tabularia fenestriata</i>	-	-	-	+	-	-	-	-
15	<i>Navicula radiosa</i>	-	-	+	-	-	+	+	-
16	<i>N. veridula</i>	+	-	-	-	+	-	-	-
	<i>N. pusila</i>	-	-	-	-	-	+	-	+
	<i>Cyclotella stelligera</i>	-	+	-	-	-	-	-	-

19	<i>Acanthes linearis</i>	-	-	-	+	-	-	-	-	-	-	-	-	-	-
20	<i>Rhizosolenia</i> sp.	+	-	-	-	-	-	-	+	-	-	-	-	-	-
21	<i>Gyrosigma</i> sp.	-	-	-	-	+	-	-	-	-	-	-	-	-	-
22	<i>Epithemia argus</i>	-	-	-	-	-	-	-	-	-	-	-	+	-	-
	Cyanophyceae	-	-	-	-	-	-	-	-	-	-	-	-	-	-
23	<i>Oscillatoria irrigua</i>	+	+	+	+	-	-	-	+	+	+	+	-	+	+
24	<i>Spirulina platensis</i>		+	+	-	-	-	-	-	-	-	-	+	-	-
25	<i>Lyngbya majar</i>	-	-	-	+	+	+	+	+	+	+	+	-	+	+
26	<i>Merismopedia tenuissima</i>	+	-	-	+	-	-	-	-	+	+	+	-	-	-
27	<i>Microcystis flosaquae</i>		+	+					+	-	-	-	+	-	-
28	<i>Merismopedia</i> sp.	-	-	-	+	+	+	+	-	-	-	-	+	+	+
	Chlorophyceae	-	-	-	-	-	-	-	-	-	-	-	-	-	-
29	<i>Ankistrodesmus falcatus</i>	-	-	-	+	+	+	+	-	-	-	-	-	-	-
30	<i>Closterium moniliferum</i>	+	-	-	-	-	-	-	+	-	-	-	+	-	-
31	<i>C. lunula</i>	-	-	-	-	-	-	-	-	-	+	+	-	-	-
32	<i>Spirigra</i> sp.	+	+	+	+	+	+	+	+	+	+	+	+	+	+
33	<i>Gemicularia crassipinna</i>	-	-	-	+	-	-	-	-	-	-	-	+	-	-
34	<i>Treubaria crassipinna</i>	+	-	-	-	-	-	-	-	-	-	+	+	+	+
35	<i>Actinastrum</i> sp.	-	-	-	+	+	+	+	-	-	-	-	+	+	+
	Abbreviation	17 sp.	12sp	16sp	18sp	14sp	18sp	17sp	15sp						

+ Present
 - Absent

Appendix-3
Population density (No/liter) of Phytoplankton at different Sampling Station

S.No	Species	Sampling Station/Location							
		1	2	3	4	5	6	7	8
A.	Bacillorophyceae	12200	10600	12600	11000	13400	13000	11000	13800
1	<i>Fragililaria capucina</i>	2800	2600	3000	2400	3200	2600	2200	2800
2	<i>Fragililaria verescens</i>	1200	1400	1200	1400	2600	2400	1600	2600
3	<i>Cymbella cistula</i>	200	200	0	400	0	200	0	0
4	<i>Cymbella tumida</i>	400	0	200	0	0	0	600	400
5	<i>Melosira islandica</i>	1200	1400	1800	1600	2200	1600	1000	1400
6	<i>Melosira varians</i>	0	0	0	1200	0	1200	0	0
7	<i>M. granulata</i>	1200	0	1200	0	1400	1400	1600	1800
8	<i>Surirella robusta</i>	0	0	400	0	0	200	0	0
9	<i>Stauroneis anceps</i>	200	0	0	200	0	0	0	200
10	<i>Syndera affinis</i>	1800	2000	1800	1600	1800	1200	1800	1600
11	<i>S. ulna</i>	2600	2400	2400	1800	1400	1600	1600	1800
12	<i>Pinnularia viridis</i>	0	400	200	0	0	200	0	600
13	<i>Cymatopleura solea</i>	200	0	0	0	200	0	0	0
14	<i>Tabularia fenestrata</i>	0	0	0	200	0	0	0	0
15	<i>Navicula radiosa</i>	0	0	200	0	0	200	200	0
16	<i>N. viridula</i>	200	0	0	0	400	0	0	0
17	<i>N. pusilla</i>	0	0	0	0	0	200	0	600

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18	<i>Cyclotella stelligera</i>	0	200	0	0	0	0	0	0	0	0	0
19	<i>Acanthes linearis</i>	0	0	0	200	0	0	0	0	0	0	0
20	<i>Rhizosolenia sp.</i>	200	0	0	0	0	200	0	0	0	0	0
21	<i>Gyrosigma sp.</i>	0	0	200	0	0	0	0	0	0	0	0
22	<i>Epithemia argus</i>	0	0	0	0	0	0	0	0	400	0	0
B.	Cyanophyceae	800	800	600	1200	800	800	800	800	1000	1600	1600
23	<i>Oscillatoria irrigua</i>	600	200	0	400	200	200	200	200	0	600	600
24	<i>Spirulina platensis</i>	0	200	0	0	0	0	0	0	400	0	0
25	<i>Lyngbya major</i>	0	0	200	200	200	200	0	0	0	400	400
26	<i>Merismopedia tenuissima</i>	200	0	0	400	0	0	400	0	0	0	0
27	<i>Microcystis flosaquae</i>	0	400	0	0	0	400	200	200	200	0	0
28	<i>Merismopedia sp.</i>	0	0	400	200	0	0	0	0	400	600	600
C	Chlorophyceae	1000	200	1000	1200	800	1000	1000	1800	400	400	400
29	<i>Ankistrodesmus falcatus</i>	0	0	400	200	0	0	0	0	0	0	0
30	<i>Closterium moniliferum</i>	200	0	0	0	0	0	0	400	0	0	0
31	<i>C. lunula</i>	0	0	0	0	400	400	0	0	0	0	0
32	<i>Spirigra sp.</i>	600	200	400	400	0	200	600	600	0	0	0
33	<i>Gemicalaria crassipinna</i>	0	0	0	400	400	0	400	400	200	200	200
34	<i>Treubaria crassispina</i>	200	0	0	0	0	0	400	400	200	200	200
35	<i>Actinastrum sp.</i>	0	0	200	200	0	0	0	0	200	200	200

Appendix - 4 **Zooplankton Species Recorded at Different Sampling Station**

S.No	Species	Sampling Station/Location							
		1	2	3	4	5	6	7	8
A.	Rotifers								
1	<i>Chromogaster ovalis</i>	+	-	+	-	-	+	-	-
2	<i>Asplanchna priodonta</i>	-	-	+	-	+	-	-	+
3	<i>Asplanchna girodi</i>	-	+	-	-	-	-	-	-
4	<i>Trichocera sp</i>	-	+	-	+	-	-	+	-
5	<i>Monostyla carnuta</i>	+	-		+	-	+	-	-
6	<i>Polyorthera trigla</i>	+	-	+		-	-	-	+
7	<i>Chromogaster testudo</i>	-	-	-	+	-	-	-	-
8	<i>Epiphanes senta</i>	-	+	+	-	+	-	+	-
9	<i>Colurella obtusa</i>	-	+	-	-	+	+	-	+
B	Cladocera								
10	<i>Alona cosata</i>	-	-	-	-	-	+	+	-
11	<i>Bismina coregoni</i>	-	+	-	-	+	-	-	-
C	Copepoda								
12	<i>Cyclops sp.</i>	-	+	-	-	-	-	-	-
13	<i>Canthocamptus staphylinus</i>	-	-	-	+	-	-	-	+


Present
Absent

Abbreviation

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Appendix-5
Population density (No/liter) of Zooplankton at different Sampling Station

S.No	Species	Sampling Station/Location							
		1	2	3	4	5	6	7	8
A.	Rotifers	120	160	140	80	100	100	60	100
1	<i>Chromogaster ovalis</i>	60		80			20		
2	<i>Asplanchna priodonta</i>			20		60			40
3	<i>Asplanchna girodi</i>		20						
4	<i>Trichocera sp</i>		60		40			20	
5	<i>Monostyla carmota</i>	40			20		60		
6	<i>Polyorthera trigla</i>	20		20					20
7	<i>Chromogaster testudo</i>				20				
8	<i>Epiphanes senta</i>		40	20		20		40	
9	<i>Colurella obtusa</i>		40			20	20		40
B	Cladocera	0	40	0	0	20	60	40	0
10	<i>Alona cosata</i>	0	0	0	0	0	60	40	0
11	<i>Bismina coregoni</i>	0	40	0	0	20	0	0	0
C	Copepoda	0	20	0	20	0	0	0	20
12	<i>Cyclops sp.</i>	0	20	0	0	0	0	0	0
13	<i>Anthracocampus staphylinus</i>	0	0	0	20	0	0	0	20


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Appendix - 6
Aquatic Insects Collected at Different Sampling Station of Seti River

S.No	Species	Sampling Station/Location							
		1	2	3	4	5	6	7	8
A.	Ephemeroptera								
1	<i>Ephemeroptera sp.</i>	+	+	+	+	+	+	+	+
2	<i>Caenis sp</i>	+	+	-	+		+	+	-
3	<i>Stenonema sp</i>	+	+	+	+	+	+	+	+
4	<i>Baetis sp</i>	-	-	+	+	-	-	+	+
5	<i>Ameletus sp</i>	-	+	-	-	+	-	+	+
B	Trichoptera								
6	<i>Hydropsycha sp</i>	+	-	+	-	+	+	-	-
7	<i>Philopotamus sp</i>	+	+	+	+	+	-	+	-
8	<i>Leptocella sp</i>	-	-	-	-	-	-	+	-
C.	Plecoptera								
9	<i>Neoptera sp</i>	+	-	-	+	-	-	+	-
10	<i>Peltopteria sp</i>	-	-	+	-	-	+	+	-
11	<i>Paragneta sp</i>	-	+	+	-	+	-	-	-
	<i>Memoura sp</i>	+	+	-	+	+	-	-	+
	Colleoptera								


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13	<i>Psephenus sp</i>	-	-	+	-	+	-	+	-	-	-
14	<i>Promoresia</i>	+	-	-	+	-	+	-	+	-	+
E.	Diptera										
15	<i>Chironomus sp</i>	-	-	-	+	-	+	-	+	-	-
16	<i>Culex sp</i>	+	-	-	-	-	-	-	-	+	-
17	<i>Simulium sp.</i>	-	-	+	-	+	-	+	-	-	-
18	<i>Tanytarsus sp.</i>	+	-	-	-	-	-	+	-	+	-
19	<i>Tanyptus sp</i>	-	+	-	+	-	-	-	+	+	+
F.	Hemiptera										
20	<i>Girris sp.</i>	+	-	+	-	-	-	-	-	+	-
G.	Odonata										
21	<i>Libellula sp.</i>	-	+	-	-	-	-	-	+	-	-
22	<i>Enallagma sp.</i>	-	-	-	+	-	-	-	-	-	-
23	<i>Octogomphus sp</i>	-	-	-	-	-	-	-	-	+	-

Abbreviation + Present
- Absent

Appendix-7

List of fish Speceis Recorded in Seti river

S.No	Scientific Name	Local Name	Method of confirmation			Local Information 2001
			Present survey	Reported by Jhon 1986	Speceis found in wet season	
1	<i>Anguilla bengalensis</i>	Raj Bam			W	L
2	<i>Amblyceps mangois</i>	Bidur	P	R	W	
3	<i>Barilius barila</i>	Faketa	P		W	
4	<i>Barilius bendilisis</i>	Faketa	P	R	W	
5	<i>Barilius bama</i>	Pate Faketa	P	R	W	
6	<i>Bagarius bagarius</i>	Gouch			W	L
7	<i>Botia almorhae</i>	Baghi	P		W	
8	<i>Chagunius chagunius</i>	Rewa	P		W	
9	<i>Chana gachua</i>	Hile	P	R	W	
10	<i>Channa stritus</i>	Hile		R	W	
11	<i>Channa punctatus</i>	Hile		R	W	
12	<i>Crossocheilus latius</i>	Lohare			W	L
13	<i>Garra annandalei</i>	Naktuwa	P		W	
14	<i>Garra gotyla</i>	Buduna	P	R	W	
15	<i>Glyptothorax sp</i>	Kapree			W	L
16	<i>Labeo angara</i>	Thed/Handey			W	L
17	<i>Labeo dero</i>	Gurde	P		W	L
18	<i>Mastacembelus armatus</i>	Bam	P		W	
19	<i>Neolissocheilus hexagonolepis</i>	Katle	P	R	W	
20	<i>Noemacheilus botia</i>	Gadela	P	R	W	
21	<i>Noemacheilus rupicola</i>	Gadela			W	L
22	<i>Noemacheilus bevani</i>	Gadela		R	W	
23	<i>Glyptosternum blythii</i>	Tilkabre		R	W	
24	<i>Pseudechenius sulcatus</i>	Kabre		R	W	
25	<i>Psilorhynchus pseudechenius</i>	Titae			W	L
26	<i>Puntius conchoniis</i>	Karange	P		W	
27	<i>Clupisoma garua</i>	Jalkapoor			W	L
28	<i>Semiplotus semiplotus</i>	Khurpe	P		W	
29	<i>Schizothorax plagioustomus</i>	Buche Asla	P	R	W	
30	<i>Schizothoracichthys progastus</i>	Chuhhe Asala	P		W	
31	<i>Tor putitora (Ham)</i>	Pahelo Sahar	P		W	
32	<i>Tor tor (Ham)</i>	Sahar	P		W	

Legend:

P = Speceis caught during present survey(2001)

R = Speceis caught by Jhon A.

L = Speceis reported by local fishermen

w =Species reported for wet season



Appendix- 8

Relative Abundance and Species Composition at Different Sampling Station

Sampling station	S.No	Scientific name	Common Name	No. of Fish Caught	Size Range (Cm)	Weight range (Gm)	Average wt of the Total Catch (Gm)	Species Composition%
1	I	<i>Schizothorax plagiosomus</i>	Buche Asla	1	21.5	90	90	1
	II	<i>Schizothoracichthys progastus</i>	Chuche Asla	2	7.5-8	4-5	9	2
	III	<i>Neolissocheilus hexagonolepis</i>	Katle	22	7-27	5-175	1980	22
	IV	<i>Semiplotus semiplotus</i>	Khurpe	2	16-20	50-90	140	2
	V	<i>Mastacembelus armatus</i>	Chuche Bam	1	32	80	80	1
	VI	<i>Tor putitora</i>	Sahar	2	9-13	7-20	27	2
	VII	<i>Barilius barila</i>	Jhuli	33	9-11	7-20	445	34
	VIII	<i>Barilius bendelisis</i>	Faketa	6	7-9	8-10	54	6
	IX	<i>Garra gotyla</i>	Buduna/Nakatuw	29	7-21.5	8-125	1929	29
	X	<i>Chagunius chagunius</i>	Rewa	1	23	130	130	1
Total				99			4884	100
2	I	<i>Schizothorax plagiosomus</i>	Buche Asla	2	7-8	5-10	15	1.68
	II	<i>Tor putitora</i>	Sahar	29	7-12	5-15	290	24.36
	III	<i>Neolissocheilus hexagonolepis</i>	Katle	57	4-11.5	5-10	428	47.89
	IV	<i>Mastacembelus armatus</i>	Chuche Bam	1	17	20	20	0.84
	V	<i>Barilius barila</i>	Pate Faketa	5	4-12	5-10	37	4.2
	VI	<i>Barilius barila</i>	Jhuli	2	10-12	18-20	38	1.68
	VII	<i>Barilius bendelisis</i>	Faketa	10	7-13	8-18	130	8.4
	VIII	<i>Garra gotyla</i>	Buduna/Nakatuw	13	8-17	6-60	429	10.95
Total				119				100
3	I	<i>Barilius barila</i>	Jhuli	30	5-11.5	5-15	300	63.82
	II	<i>Barilius bendelisis</i>	Faketa	2	6-10	5-15	20	4.25
	III	<i>Neolissocheilus hexagonolepis</i>	Katle	15	15-23	35-115	1125	31.93
Total				47			1445	100
	I	<i>Garra gotyla</i>	Buduna	2	11.5-13.5	20-25	45	6.06
	II	<i>Barilius barila</i>	Faketa	21	5-10	5-10	157	63.63


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4	III	<i>Tor putitora</i>	Sahar	7	8-9	6-7	46	21.21
	IV	<i>Noemacheilus botia</i>	Gadela	1	7	6	6	3.04
	V	<i>Botia almorhae</i>	Baghi	2	14-16	45-50	90	6.06
		Total		33			344	100
5	I	<i>Mastacembelus armatus</i>	Chuche Bam	2	23-28	25-45	70	5.55
	II	<i>Botia almorhae</i>	Baghi	2	11-12.5	10-15	25	5.55
	III	<i>Neolissocheilus hexagonolepis</i>	Katle	1	7	6	6	2.78
	IV	<i>Channa gachua</i>	Bhoti	1	11	15	15	2.78
	V	<i>Barilius barila</i>	Faketa	30	4-11	3-10	195	83.34
		Total		36			311	100
6	I	<i>Tor tor</i>	Sahar	9	7-12	5-25	135	19.56
	II	<i>Tor putitora</i>	Sahar	16	5.5-10	5-12	136	34.79
	III	<i>Channa gachua</i>	Bhoti	1	10	12	12	2.17
	IV	<i>Neolissocheilus hexagonolepis</i>	Katle	3	18.5-21.5	100-150	375	6.54
	V	<i>Labeo dero</i>	Gardi	1	22.5	105	105	2.17
	VI	<i>Garra gotyla</i>	Buduna	1	8	7	7	2.17
	VII	<i>Garra annandali</i>	Buduna/Nakatuw	2	6-6.5	5-6	11	4.35
	VIII	<i>Amblyceps mangols</i>	BiJur	1	8.5	6	6	2.17
	IX	<i>Mastacembelus armatus</i>	Chuche Bam	8	17-29	10-55	260	17.39
	X	<i>Semiplotus semiplotus</i>	Khurpe	1	15.5	40	40	2.17
	XI	<i>Barilius barila</i>	Faketa	1	9	7	7	2.17
	XII	<i>Barilius bendelisis</i>	Faketa	2	7-8.5	6-8	14	4.35
		Total		46			1108	100
7	I	<i>Puntius conchoniis</i>	Sidra	1	7.5	6	6	2.44
	II	<i>Mastacembelus armatus</i>	Chuche Bam	1	28	35	35	2.44
	III	<i>Botia almorhae</i>	Baghi	12	11-16	10-45	330	29.26
	IV	<i>Garra gotyla</i>	Buduna	7	8.5-9	7-10	59	17.08
	V	<i>Tor putitora</i>	Sahar	2	4-6	5-6	11	4.88
	VI	<i>Neolissocheilus hexagonolepis</i>	Katle	18	3.5-8	3-7	90	43.9
		Total		41			631	100
8	I	<i>Mastacembelus armatus</i>	Chuche Bam	5	19-45	15-215	575	10
	II	<i>Botia almorhae</i>	Baghi	11	9-17	10-40	275	22
	III	<i>Channa gachua</i>	Hile	4	7-12.5	5-15	40	8
	IV	<i>Puntius conchoniis</i>	Pothi	1	5	4	4	2
	V	<i>Barilius barna</i>	Faketa	20	4-6	3-5	80	40
	VI	<i>Barilius bendelisis</i>	Faketa	1	8.5	7	7	2
	VII	<i>Garra gotyla</i>	Buduna	4	105-15.5	10-45	110	8
	VIII	<i>Labeo dero</i>	Gardi	1	24	160	160	2
	IX	<i>Neolissocheilus hexagonolepis</i>	Katle	3	4-6	5-6	16	6
		Total		50			1267	100
Grand Total 471 Fish								

Appendix-9

Fish Fauna of Seti River

S. No.	Scientific Name	English Name	Common Name	Migratory Status	Protected Status	Economic Importance
1	<i>Amblyceps mangois</i>	Torrent catfish	Bijur	R	R	Oily fish 1, L4
2	<i>Anguilla bengalensis</i>	Fresh Water Eel	Rajbam	LD	V	1 L
3	<i>Barilius barila</i> (Ham)	Minor carp	Faketa	R	C	1, M
4	<i>Barilius bendalensis</i> (Ham)	Minor carp	Faketa	R	C	1, M
5	<i>Barilius bama</i>	Minor carp	Faketa	R	C	1 L
6	<i>Bagarius bagarius</i>	Giant catfish	Gouch	LD	C	1, M
7	<i>Botia almorhae</i>	Loach	Baghi	R	I	1 L
8	<i>Chagunius chagunius</i>	Carp	Rewa	MD	V	1, M, 3, 4
9	<i>Channa gachua</i>	Murrels	Hile	R	C	1 L
10	<i>Channa strius</i>	Murrels	Hile	R	O	1 L
11	<i>Channa punctatus</i>	Murrels	Hile	R	C	1 L
12	<i>Crossocheilus latius</i>	Stone roller	Lohare	R	C	1, M
13	<i>Garra annandalei</i> (Ham)	Stone roller	Nakatuwa	R	C	1, M
14	<i>Garra gotyla</i> (Gray)	Stone roller	Buduna	R	FC	1, M
15	<i>Glyptothorax sp.</i>	River Catfish	Kapree	R	C	1, M
16	<i>Glyptosternum blythii</i>	Cat fish	Tilkabre	R	R	1 L
17	<i>Labeo angara</i>	Minor carp	Thed/Handey	MD	C	1, M
18	<i>Labeo dero</i> (Ham)	Minor carp	Gurdi	MD	C	1 H
19	<i>Mastacembelus armatus</i>	Spiny eel	Bam	R	C	1, M
20	<i>Neolissocheilus</i>	Copper mahseer	Katie	MD	V	1 H2
21	<i>Noemachius rupicola</i> (Mc.)	Stone loach	Gadela	R	C	1 L
22	<i>Noemacheilus botia</i>	Stone loach	Gadela	R	C	1 L
23	<i>Nemacheilus bevari</i>	Stone loach	Gadela	R	C	1 L
24	<i>Psilorhynchus</i>	Stone carp	Kabre	R	V	1, M
25	<i>Clupisoma garua</i>		Jalkapoor	LD	C	1, H
26	<i>Pseudocheilus sulcatus</i>	Catfish	Kabre	R	O	1, M
27	<i>Puntius conchoni</i>	Barbs	Karange	R	C	1, M
28	<i>Schizothorax plagiostomus</i>	Snow-Trout	Buchhe Alsa	MD	V	1 H
29	<i>Schizothoracichthys progastus</i> (Mc. Cl)	Pont nosed snow trout	Chuhhe Asala	MD	V	1 H
30	<i>Semiplotus semiplotus</i>		Khurpe	R	C	1 H
31	<i>Tor putitora</i> (Ham)	Golden Mahseer	Sahar	LD	V	1, H, 2, 3
32	<i>Tor tor</i> (Ham)	Mahseer	Pahelo Sahar	LD	E	1, H, 2, 3

Legend:

Migratory Status

R= Resident

MD=Midrange Migrant

LD= Long distance Migrant

Economic Importance

1= Food value

H= High food value

M=Medium Food value

L=Low food value

3= Medicine

4=Aquarium

Protected Status

V= Vulnerable (7)

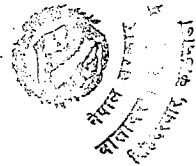
R=Rare(2)

O=Occasional(2)

C=Common(19)

E=Endangered(1)

I= Insufficiently known (1)



Appendix-10

Fish Habitat of the Important Species in Seti river

S. No.	Scientific Name	Local Name	Fish Habitat preference
1	<i>Amblyceps mangois</i>	Bidur	Shallow pool, runs
2	<i>Anguilla bengalensis</i>	Raja Bam	Pool, rapid & runs
3	<i>Barilius barila</i>	Faketa	Shallow pool, riffles
4	<i>Barilius bendelisis</i>	Faketa	Shallow pool, riffles and rapids
5	<i>Barilius bama</i>	Faketa	Shallow pool, riffles
6	<i>Bagarius bagarius</i>	Gouch	Pool
7	<i>Botia almorhae</i>	Baghi	Stream near cultivated areas
8	<i>Channa gachua</i>	Hile	Pools and runs
9	<i>Channa stritus</i>	Hile	Pools and runs
10	<i>Channa punctatus</i>	Hile	Pools and runs
11	<i>Chagunius chagunius</i>	Rewa	Pools, rapids and runs
12	<i>Crossocheilus latius</i>	Lohare	Back water pool
13	<i>Garra annandalei</i>	Buduna/Nakatuwa	Backwater pool confluence point
14	<i>Garra gotyla</i>	Buduna	Backwater pool and confluence point
15	<i>Gloptothorax sp.</i>	Telkabre	Head water springs, creeks and back water rocky boulders
16	<i>Labeo angara</i>	Thed/Handey	Pools, rapids and runs
17	<i>Labeo dero (Ham)</i>	Gurde	Pools, rapids and runs
18	<i>Pseudechenius sulcatus</i>	Kabre	Head waters, rapids
19	<i>Glyptosternum blythii</i>	Tilkabre	Stream with gravel bed
20	<i>Mastacembelus armatus</i>	Eel	Shallow pool with mud
21	<i>Neolissocheilus hexagonolepis</i>	Katle	Pools and rapids
22	<i>Noemacheilus botia</i>	Gadela	Run and rapids
23	<i>Noemacheilus bevanii</i>	Gadela	Run and rapids
24	<i>Noemacheilus rupicola</i>	Gadela	Run and rapids
25	<i>Psilorhynchus pseudechenius</i>	Titae	Stream with boulders
26	<i>Puntius conchoni</i>	Karange	Shallow pool and riffles
27	<i>Clupisoma garua</i>	Jalkapoor	Head water and rapids
28	<i>Schizothorax plagiostomus</i>	Buchhe Asla	Rapids, pools and riffle
29	<i>Semiplotus semiplotus</i>	Khurpe	Shallow pools
30	<i>Schizothoracichthys progastus</i>	Chuhhe Asla	Rapids, pools and riffle
31	<i>Tor putitora</i>	Pahelo Sahar	Pool, rapid and runs
32	<i>Tor tor</i>	Sahar	Pool and rapid

Appendix-11

Ecology and Life history of Long Distance Migratory Fishes of Seti river

Species	Migration pattern												Spawning Season	Spawning Substrate	Food Source	Growth Rate	Age at Spawning	Incubation for eggs	Size at Maturity	Behaviour
	J	F	M	A	M	J	J	A	S	O	N	D								
<i>Tor putitora</i> (Golden Mahseer)					↑	↑	↑	↑	↑	↑	↑	↓	Sept-Oct	Gravel bed	Fruits algae, aquatic insect, fish fry, adult fish	16cm at first year	2.5 years	12-48 hours at temp. 30 C	45cm	Fishes are seen in group circling and jumping
<i>Tor for</i> (Deep bodied Mahseer)					↑	↑	↑	↑	↑	↑	↑	↓	Sept-Oct	Gravel bed	Adult fish, aquatic insect, algae, fish fry	15cm at 1st year	2.5 years	12-48 hrs at temp. 30C	55cm	Schooling circling and jumping behaviour
<i>Anguilla bengalensis</i> (Fresh Water Eel)	↑	↑	↑	↑	↑	↓	↓	↓					June-July	Mud, sand	Fish fry, aquatic insect, mollusc and shrimp	26cm at first year				Crevice dweller avoid direct light piling snapping wriggling overland movement
<i>Bagarius bagarius</i> (Catfish/Gonch)			↑	↑	↑	↑	↑	↑	↑	↑	↑	↓	July-August	Mud, sand and decaying vegetables	Fish, crabs, mollusc, shrimp, tadpole and frog	28cm at first year	3 years	-	80cm	Rest in deep pool singly or in group, produce monotonous grunting noise
<i>Clupiosoma garua</i> (Jalkapoor)					↑	↑	↑	↑	↑	↑	↑	↓	June-July	Fine sand pebble	Fish fry, shrimp, crustaceans, fingerlings, tadpole, frog etc.	18 cm at first year	2 years	-	25 cm	Schooling and jumping behaviour

Upstream
 ↑ ↓
 Downstream

Appendix-12

Ecology and Life History of Medium Distance Migratory Fishes Of Seti river

Species	Migratory pattern												Spawning season	Spawning substrate	Food Source	Growth rate	Age at Spawning	Incubation for eggs	School size	Behaviour
	J	F	M	A	M	J	J	A	S	O	N	D								
<i>Schizothoracichthys progastus</i> (Point nosed snow trout)	↑↑	↑↑	↑↑	↑						↑	↑	↑	Sept-Oct and March-April	Gravel beds	Mud, Aquatic insect, fish fry, algae, drift food	6 to 12 cm at first year	1 year (Size 25-35cm)	15 days at temperature 19 C	20-40	Seen in school of 20-40 fishes during spawning females are circled by male
<i>Schizothorax plagiostomus</i> (Snow trout)	↑↑	↑↑	↑↑	↑						↑	↑	↑	Sept-Oct and March-April	Gravel beds	Mud aquatic insects, fish fry algae, drift food	6 to 12 cm at first year	2 years (Size 20-35 cm)	15 days at temperature 19 C	25-60	Seen in group during spawning, grazing and creeping
<i>Schizothorax richardsonii</i> (Snow trout)	↑↑	↑↑	↑↑	↑						↑	↑	↑	Sept-Oct and March-April	Gravel beds	Mud aquatic insects, fish fry algae, drift food	7-12cm at 1st year	2 years (Size 20-28 cm)	15 days at temperature 19 C	25-60	Seen in group of 40-50 fishes creeping grazing in Seti river
<i>Neolisichneilus hexagonolepis</i> (Copper Mahseer)						↑↑	↑↑	↑↑	↑	↑	↑	↑	Sept-Oct	Gravel beds	Aquatic Insects, algae, fish fry	8-12 cm at 1st year	2 years (Size 20-28cm)	12 days at temperature 19 C	22-55	Seen in group of 10-15 fishes swim, dart and jump to cross obstacles.
<i>Laboe angara</i> (Minor carps/Thead)					↑↑	↑↑	↑↑	↑↑	↑				June-July	Gravel beds	Filamentous algae, portion of higher plants, decaying organic matter	-	2 years	-	10-12	Resting in deep pools
<i>Laboe dero</i> (Minor carps/Gardi)			↑↑	↑↑	↑↑	↑↑	↑↑	↑↑	↑				June-July	Gravel beds	Filamentous algae, microscopic plants, vegetables detritus & mud	-	2 years	-		Took rest in deep pools, live together with gorch
<i>Chahumilus chagunio</i> (Rewa)			↑↑	↑↑	↑↑	↑↑	↑↑	↑↑	↑				May-June	Gravel & pebble beds	Microscopic plants, vegetable matter, detritus	-	2 years	-	6-8	Jumping behaviour



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 Upstream Downstream

Appendix-13

Biological data of Resident Species

Species	Spawning season	Spawning substrate	Food source	Age at spawning	Growth Rate	Incubation time	Size by spawning	Behavior
<i>Glyptosternum blythi</i> (Catfish)	May-June	Gravel, sand and pebbles	Aquatic insects & zooplankton	2 years	3.5 cm in a year		8 cm	Live in school under rock crevices and back water caused by boulders
<i>Pseudeuchneis sulcatus</i> (Torrent catfish)	May-June	Gravel, sand and pebbles	Aquatic insects, earthworm	2 years	6.5 cm in a year	10 days at 19 C	8 cm	Live in cohesive schools, exhibit mass migration to falling springs and creeks
<i>Glyptothorax cavia</i> (River Catfish)	May-June	Gravel and sand	Aquatic insects	2 years	3.5 cm in a year	8-12 days at 18 C	9 cm	Live in cohesive schools, exhibit mass migration to creeks for spawning
<i>Glyptothorax pectinopterus</i> (River Cat fish)	June	Gravel, sandy bed & rooted vegetation	Aquatic insects, Mayfly larva	2 years	3.5 cm in a year	8-12 days depending on temperature	13 cm	Live in school of 15 to 50. They come out to migrate in huge mass during monsoon flood
<i>Garra goyla</i> (Rock Carp)	May-June	Gravel, sand and pebbles, algae bed	Algae, slime moss	2 years	4.5 cm in a year	7-10 days depending on temperature	7.5 cm	Live in school. Mass migration to spawning tributaries, rice fields and springs
<i>Garra anandalei</i> (Stone Roller)	Sept.-Oct.	Gravel, sand, Hydrilla blooms	Algae	2 year	5 cm in a year	10 days at 24C	12 cm	Exhibit local migration in monsoon for spawning season in rice fields, irrigation canal and water mill facility areas.



Appendix-14
List of Fishermen in Seti Storage Project Area

S.No.	Name	Address	Status
1	Master Poday	Bhimad Bazar	Part time
2	Tanka Bahadur	Chan Patan	Part time
3	Maahi Lal	Maley Bagar	Part time
4	Purna Bahadur	Maley Bagar	Part time
5	Dil Bahadur	Maley Bagar	Part time
6	Mohan Raj Sai	Thangdi	Part time
7	Chabi Lal Bote	Patan Gudgudi	Part time
8	Man Bahadur Bote	Patan Gudgudi	Part time
9	Take Bahadur Bote	Patan Gudgudi	Part time
10	Khaila Bote	Patan Gudgudi	Part time
11	Lata Maila Bote	Patan Gudgudi	Part time
12	Hem Bahadur Bote	Patan Gudgudi	Part time
13	Kul Bahadur Bote	Patan Gudgudi	Part time
14	Teeka Ram Bote	Patan Gudgudi	Part time
15	Janga Bahadur Bote	Patan Gudgudi	Part time
16	Dil Bahadur Bote	Patan Gudgudi	Part time
17	Ram Bahadur Bote	Patan Gudgudi	Part time
18	Ghan Bahadur Bote	Patan Gudgudi	Part time
19	Mangal Bahadur Bote	Patan Gudgudi	Part time
20	Bam Bahadur Bote	Patan Gudgudi	Part time
21	Lal Bahadur Botey	Patan-7	Part time
22	Shuk Bahadur Botey	Patan-7	Part time
23	Jeet Bahadur Botey	Patan-7	Part time
24	Ait Bahadur Botey	Patan-7	Part time
25	Bhai Ram Botey	Patan-7	Part time
26	Shyam Bahadur Botey	Patan-7	Part time
27	Kharka Bahadur Botey	Patan-7	Part time
28	Shome Bahadur Bote	Patan-7	Part time
29	Dhan Bahadur Bote (Sano)	Patan-7	Part time
30	Heera Bahadur Bote	Patan-7	Part time
31	Yam Bahadur Bote	Patan-7	Part time
32	Shanseer Bote	Patan-7	Part time
33	Neer Maya Bote	Patan-7	Part time
34	Veer Bahadur Bote	Patan-7	Part time
35	Shanta Bahadur Bote	Patan-7	Part time
36	Bhumi Raj Bote	Patan-7	Part time



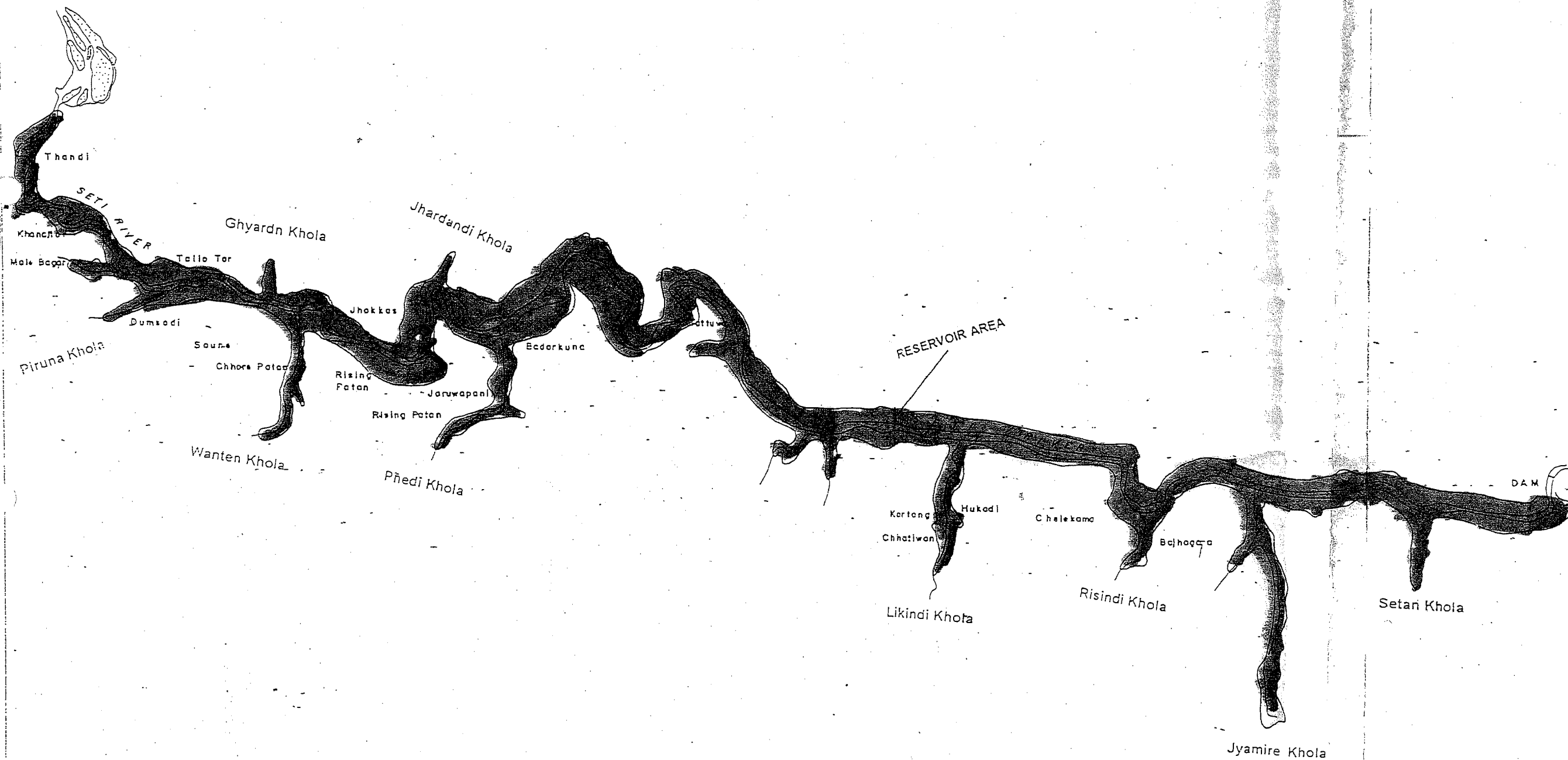
Appendix-15 **Environmental Impact Assessment Matrix of Upper Seti Storage Project (Fish and Aquatic Life)**

S. No	Project Phase/Activities	Impacts	Qualifier			Mitigation Measures		Responsibility
			Magnitude	Extent	Duration			
1. Construction Phase								
I	Construction of diversion dam, tunnel and powerhouse	Changes in flow regime and removal of boulders would affect fish habitat and spawning grounds	M	L	M	Minimize disturbances and use of river boulders for quarry and other purpose		Project Manager/ Contractor/Consultant/Monitoring Unit
II	Spoil disposal	Likely to be increase in sediment level in reduced flow area during dry period.	M	L	M	Detail Muck disposal plan with gabian and geotextile structures to prevent any silt entrance to the river during dry period		Project Manager/ Contractor/Consultant/Monitoring Unit
III	Water Quality changes	Possible deterioration in water quality, due to use of explosive, accidental spill of oil, washed out of concrete batching plant etc.	L	L	M	Water quality protection measures should be applied		Project Manager/ Contractor/Consultant/Monitoring Unit
IV	Employment of more than 1000 workforce	Fishing pressure is likely to increase	L	L	S	Workforce should be banned from fishing especially the illegal fishing. Implement Awareness Program		Project Manager/ Contractor/Consultant/Monitoring Unit



FIGURES





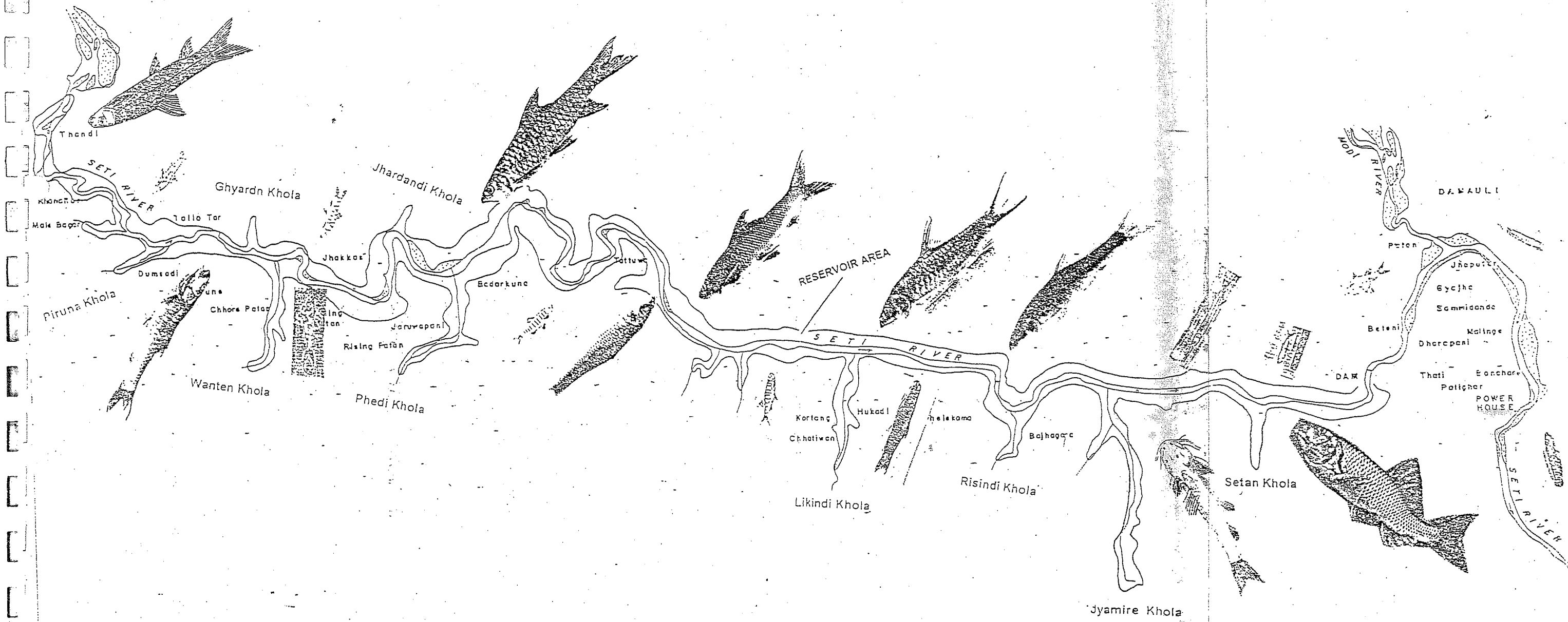


FIG-5. Fish Biodiversity in Upper Seti Storage Project area

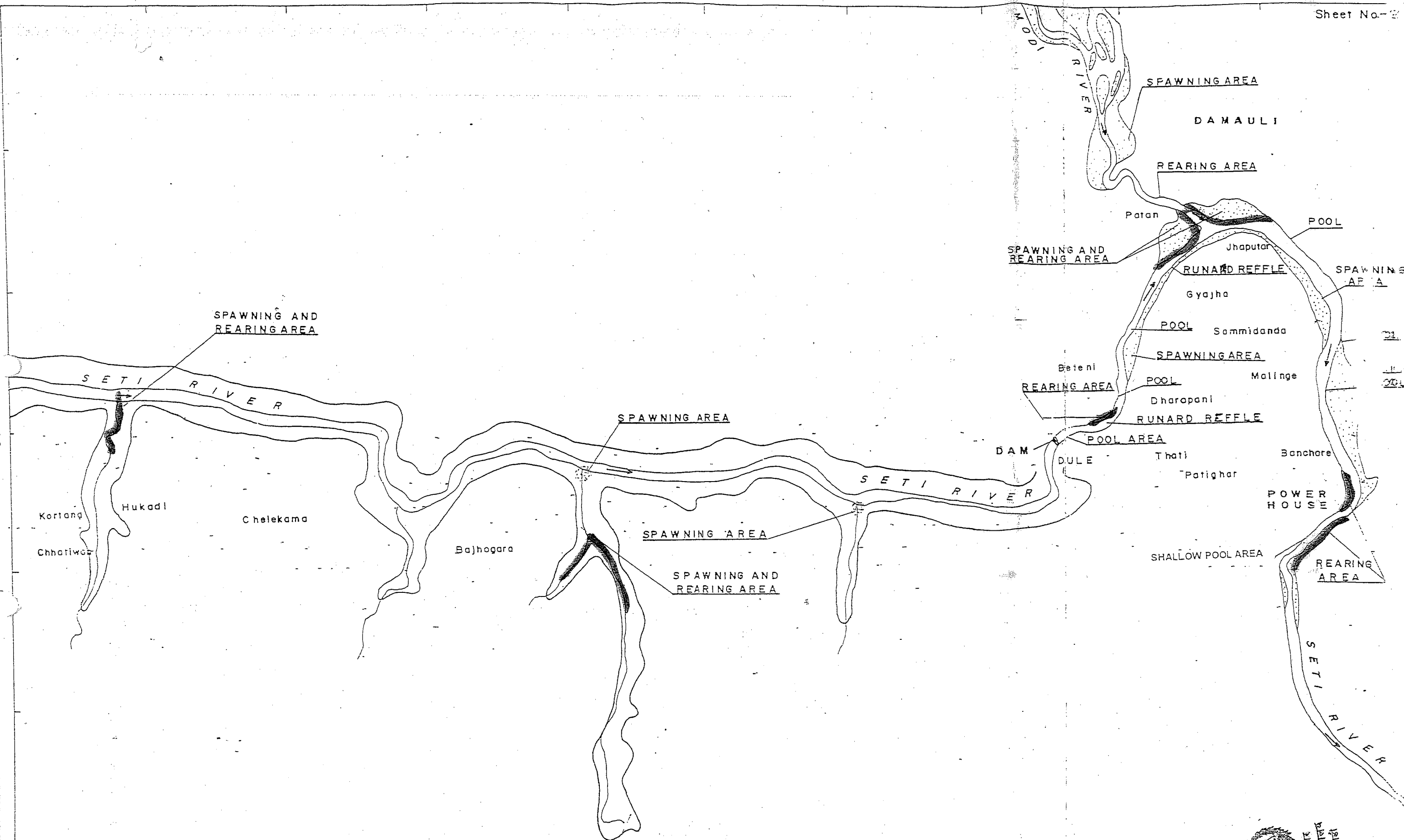
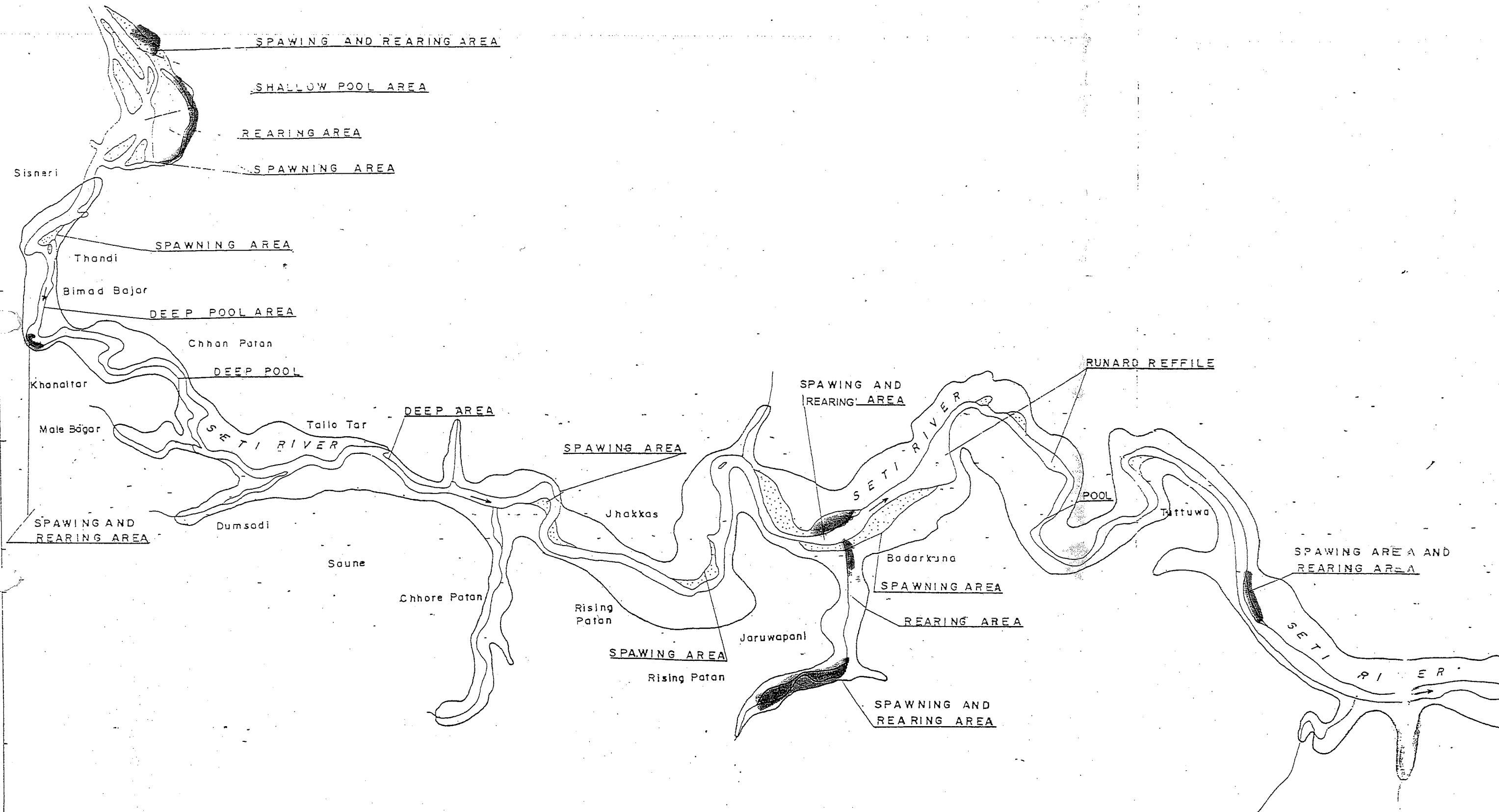
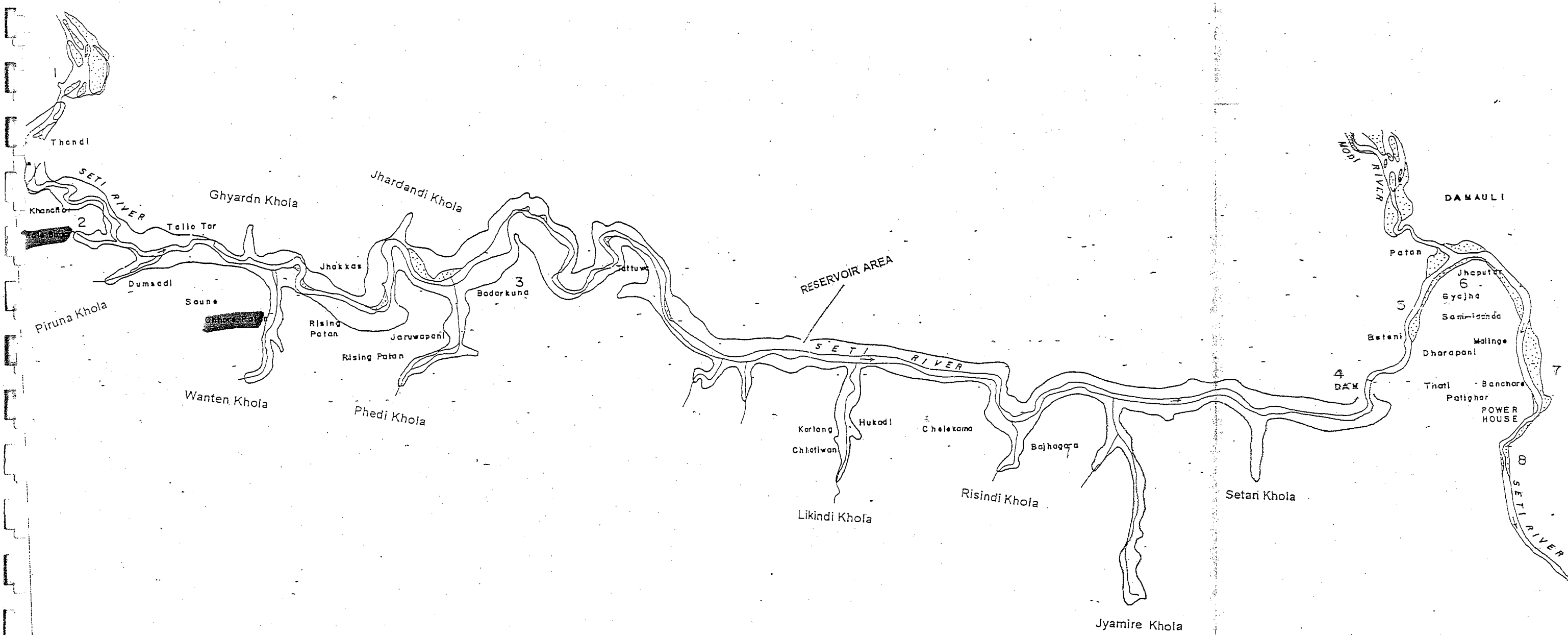
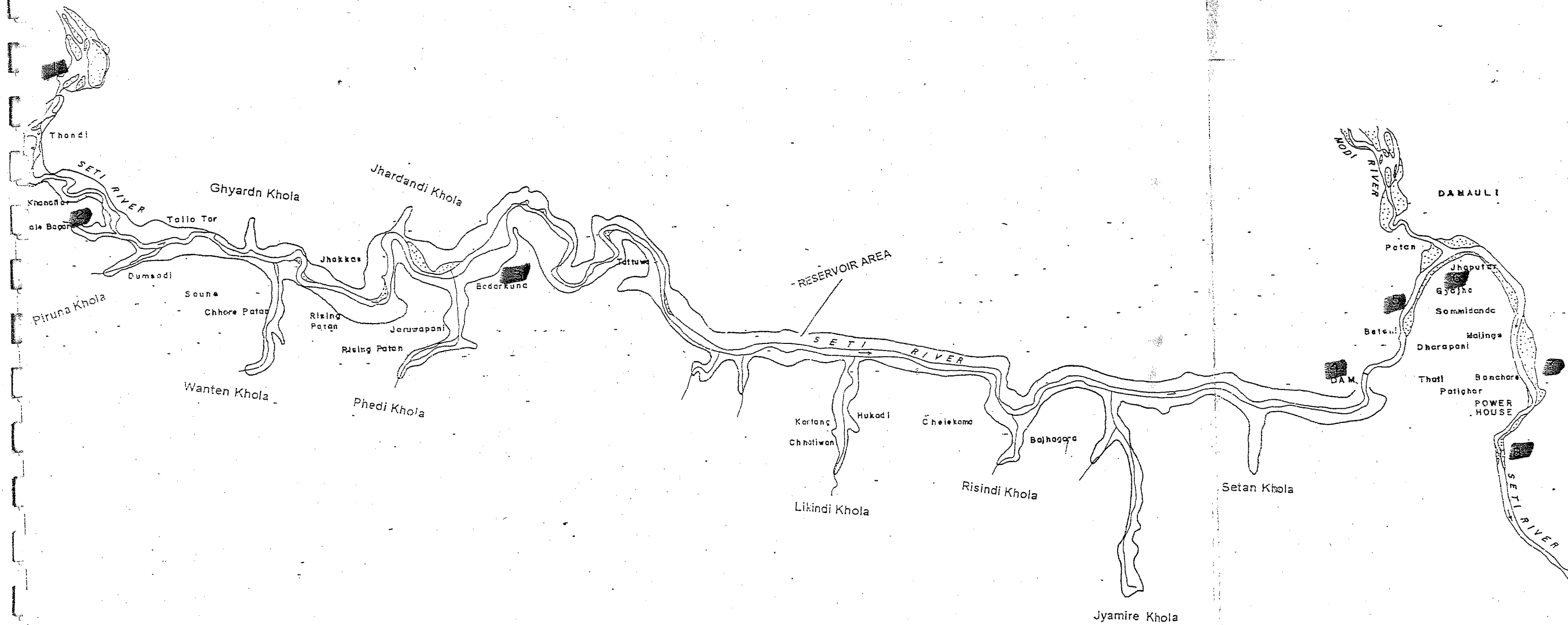


FIG-4 AQUATIC HABITAT DAM AND RESERVIOR AREA









1- 8 Sampling Stations/Sites

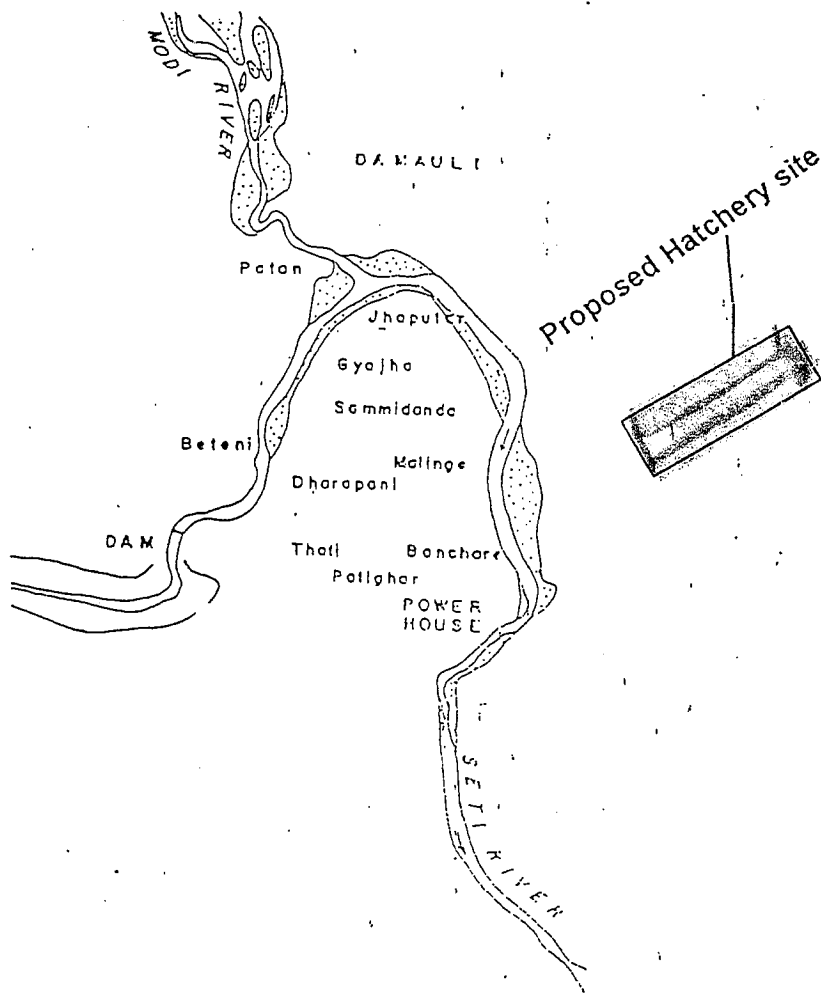


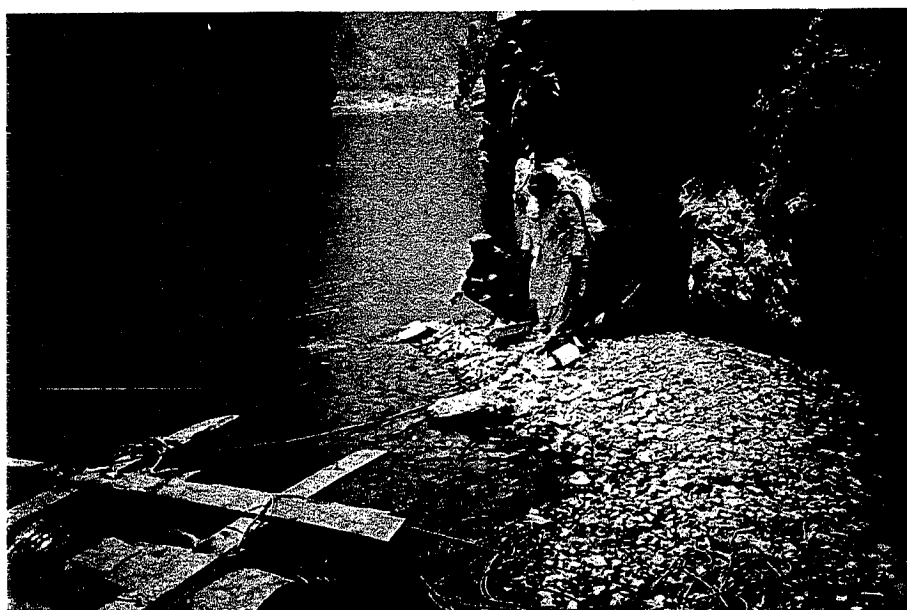
FIG-7. Location Plan of proposed Fish Hatchery

PHOTOGRAPHS





1. Water Quality and Plankton Sampling in Downstream Area



2. Water Quality and Plankton Sampling at Proposed Dam Site



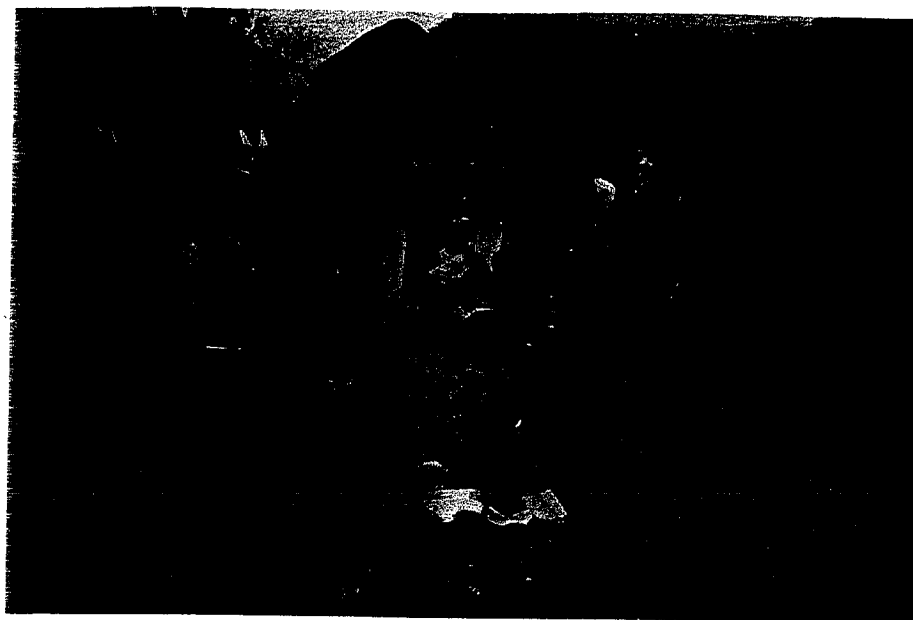


3. Fish sampling in Bandarkuna area

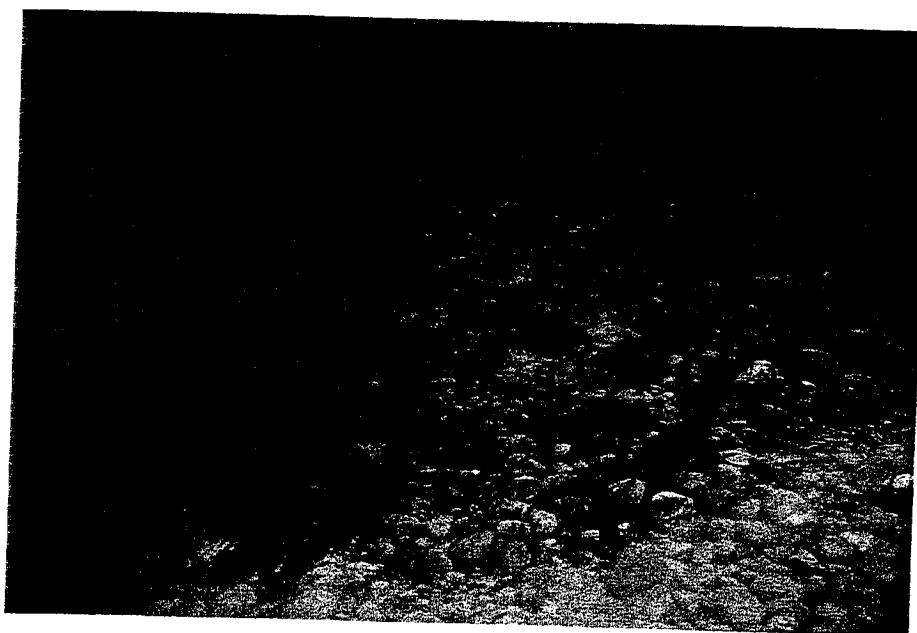


4. Group meeting and questionnaire survey in Chan Patan area

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5. Group meeting and questionnaire survey in Patan area



6. Aquatic Productivity of Seti River

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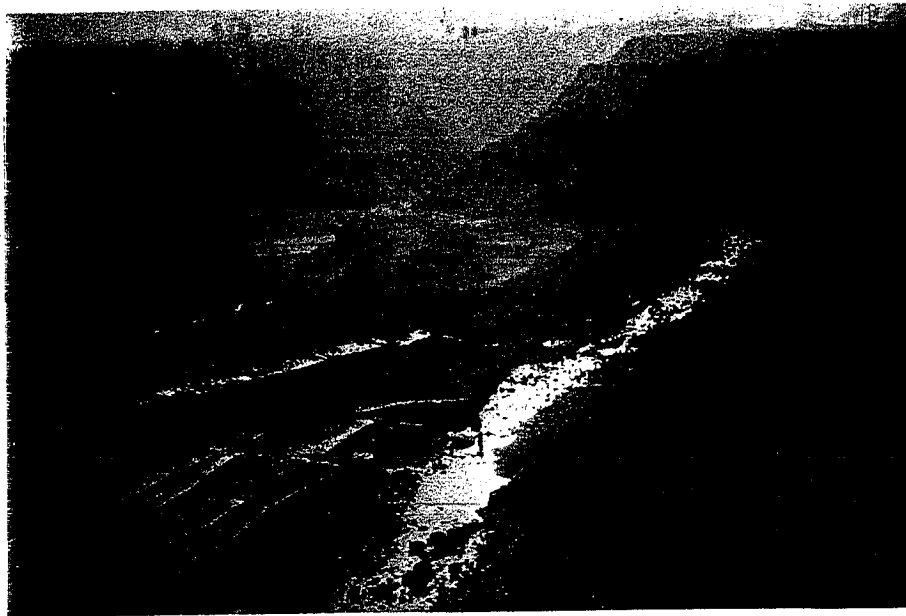


7. Deep pool in reservoir area at Chan Patan



8. Rearing site at left bank of Seti river near Sisneri

सिद्धिचरण
वाजिपुत्र
सिद्धिचरण, काठमाडौं



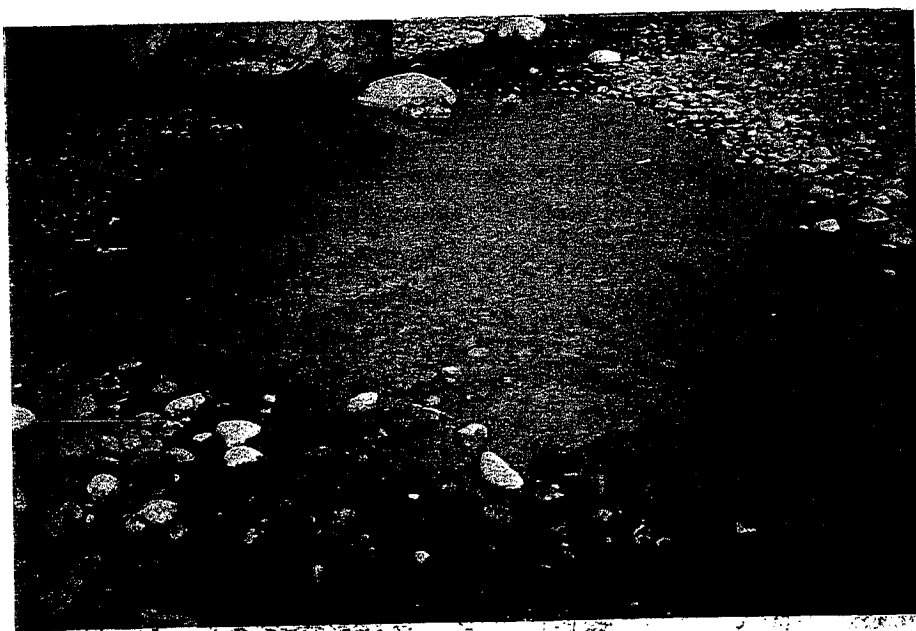
9. Jidi Khola spawning and rearing site likely to be submerge by reservoir



10 Spawning area at left bank of Bandarkuna



11. Spawning area at right bank of Bandarkuna



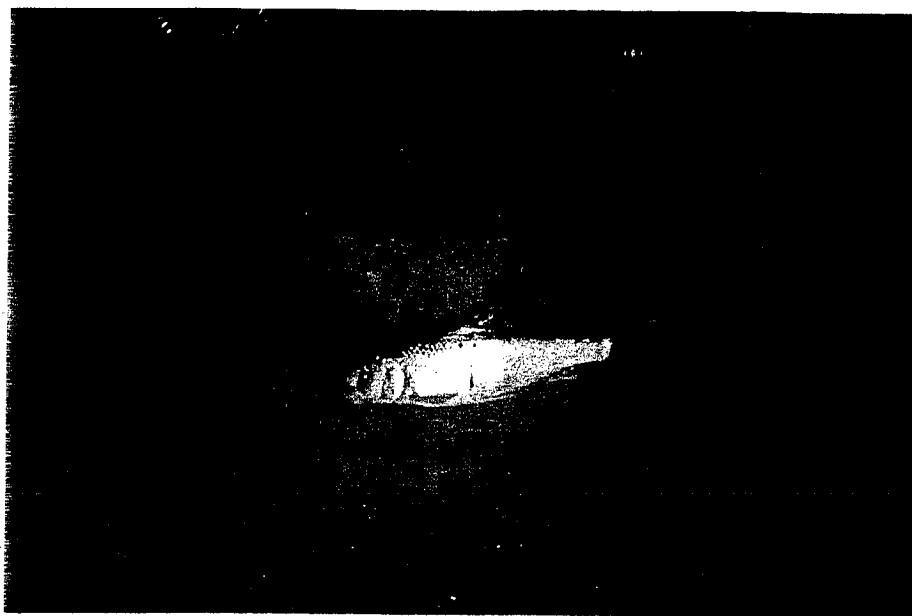
12. Madi Khola suitable spawning and rearing ground



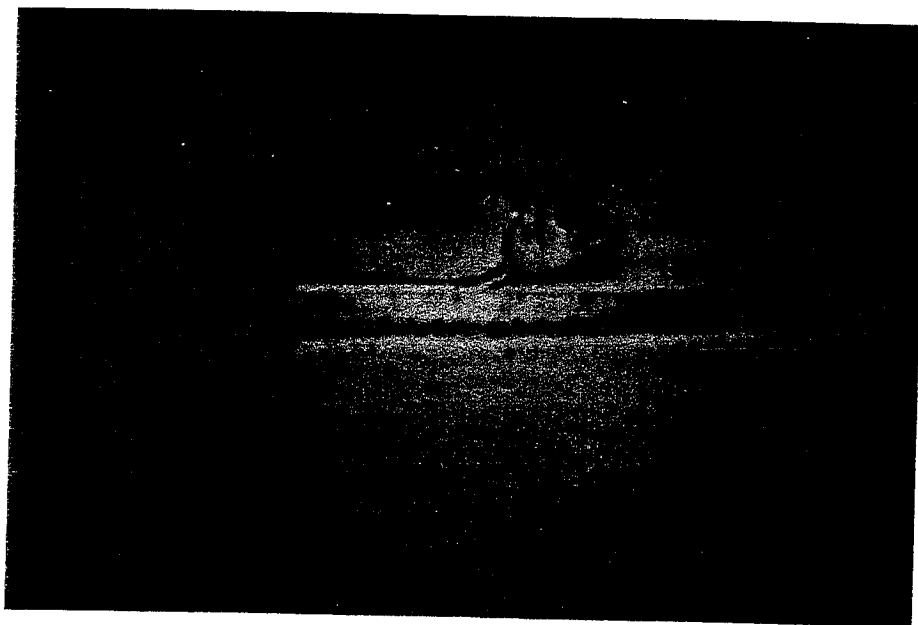
13. Rearing site at left bank of Seti river in Damauli area



14. Riverine habitat and spawning site in reduced flow section



15. *Chagunius chagunius* fish caught in Seti River



16. *Labeo dero* caught in Seti river

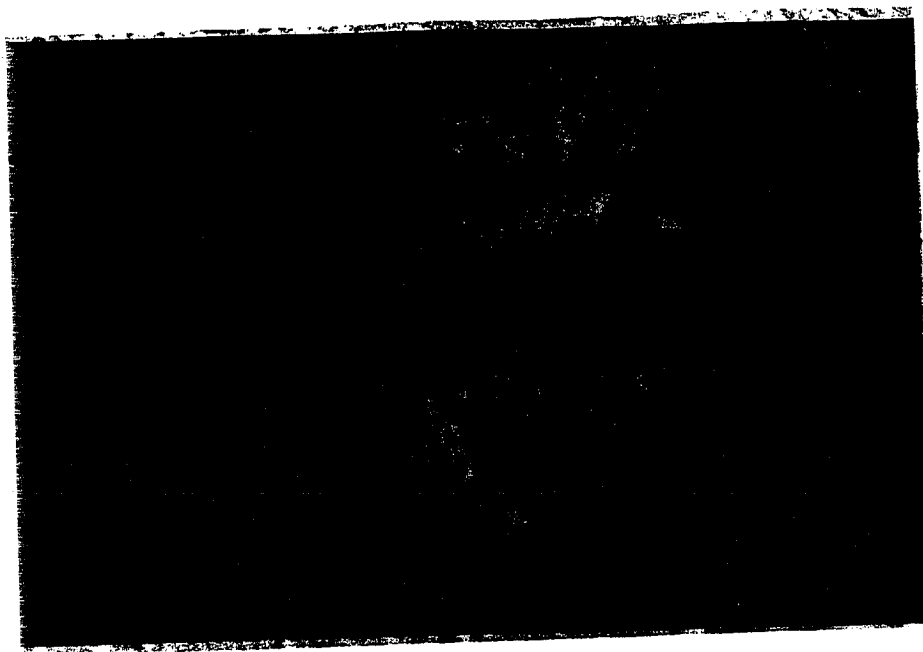




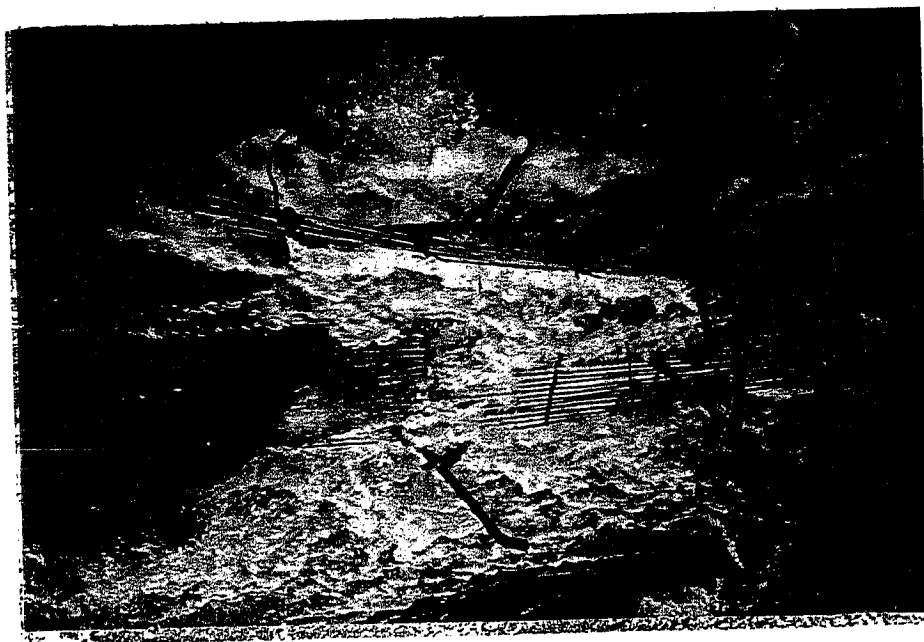
17. *Tor sp.* and *Chana gachua* caught in Seti river



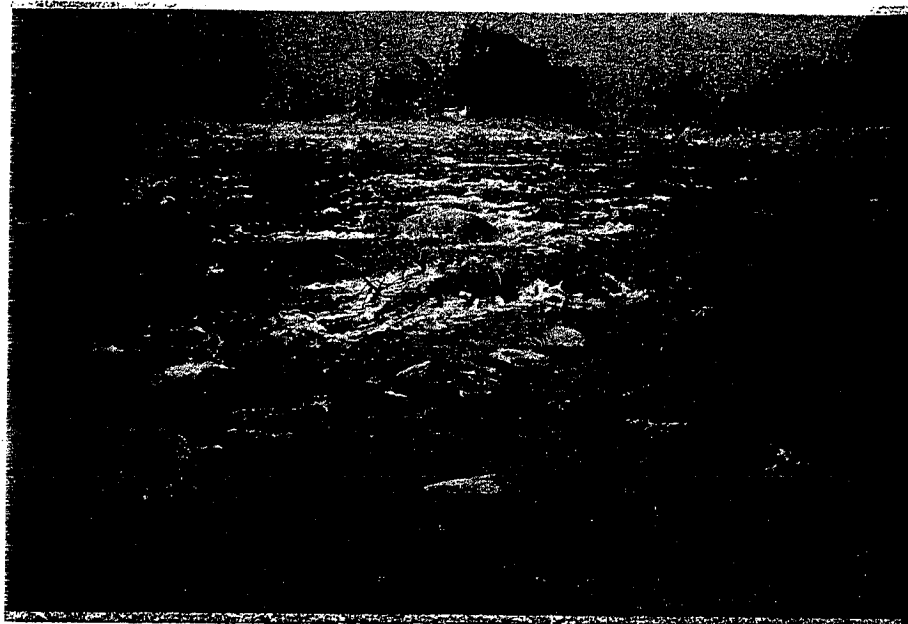
18. Bulk catch of fish in reservoir area



19. *Neolesochelius hexagonolepis* the dominant mid range migrant fish of Seti river



20 Fish trap at upstream of reservoir



21. Fish Trap at Seti Madi confluence



22 Proposed fish hatchery location at Belbash

Appendix F



RESETTLEMENT PLAN

1 Rationale for Land Acquisition and Resettlement

Resettlement Effect can be defined as all negative situations directly caused by the Project, including loss of physical and non-physical assets, including loss of land, property, income generation opportunities, cultural sites, cultural identify, social structures and networks and ties. Efforts have been made to minimize resettlement effects during the selection of the project optimum design. However, as mentioned in Chapter 5, the project is likely to bring about the resettlement effects as follows;

Reservoir FSL 415 m + Risk zone 10 m

■ Affected Cultivated Land	151.22 ha
■ Affected Built up Area	1.7 ha
■ Affected Forest Land	480.09 ha
■ Loss of Agricultural Production	660.77 MT
■ Number of Affected Private Structure	313
■ Number of Affected Community Structure	7
■ Number of Affected Private Land Owners	838 households
	110 households (half of them living in the project facility sites)
■ Number of Affected Structure Owners	
	86 households (about one-third of them having non-legal title)
■ Number of Residential Structure Owners =Relocatee	

This Resettlement Plan (RP) is therefore, prepared to effect the payment of compensation and rehabilitation for the individuals, households, and communities affected by the project in accordance with JICA Guidelines.

2 Review of Policy and Legal Framework

(1) JICA Policy on Resettlement

The JICA Guideline for Environmental and Social Considerations 2004 (JICA Guideline) rests on the following principles:

- Involuntary resettlement should be minimized by exploring all viable project options.
- Affected families/persons should be fully informed and consulted.
- A resettlement plan should be prepared for those to be displaced.
- Affected families/persons should receive compensation sufficiently and support from the project proponents in a timely manner to improve their standard of living, income opportunities, and production levels, or at least to restore them to pre-project levels.
- Involuntary resettlement should be conceived and executed as a development project.
- The resettlement plan implementation has to be monitored by the project proponents.

Regarding the compensation for the non-title holders, the Advisory Council of Environment and Social Considerations Review, a standing advisory council established by JICA, has strongly required the NEA and Study Team to address the provision of the compensation for them if these non-title holders have lived there with structures, and cultivated the land for certain years.

(2) Review of Relevant Government Laws and Policies

Nepal has a long history of involuntary resettlement. However, there is not a clear and comprehensive policy on the resettlement of project displaced families. To date, different development projects have been implementing involuntary resettlement, compensation and rehabilitation activities on the basis of specific circumstances without the framework of a coherent policy. Existing legal provisions of the country on land acquisition, compensation and rehabilitation also are not sufficient enough to address the needs of the project-displaced people. Major legal documents that provide guidance to involuntary resettlement caused by hydropower projects are as follows:

- The Constitution of Nepal (1990)
- The Land Acquisition Act (1977) as amended in 1992
- Water Resources Act (1992)
- Electricity Act (1992)
- Hydropower Regulation (1993)
- Electricity Development and Management Act (2005)

The review of these existing policies and legal framework are presented below.

The Constitution of Nepal 1990

The Constitution of Nepal (1990), as supreme law of the land, has guaranteed the right to property for Nepalese citizens. According to Article 17 of the Constitution, private property could be acquired for the purpose of public interest by providing due compensation to owner of property, following the procedures of providing compensation for any property, as prescribed by law.

The Land Acquisition Act 1977 and Land Acquisition Regulations 1969

The Land Acquisition Act (1977) and the Land Acquisition Rules (1969)¹ are the two main legal instruments that specify the procedures of land acquisition and compensation. The government of Nepal can acquire the land at any place by providing the compensation pursuant to the Land Acquisition Act for any public purpose or for the operation of any development projects initiated by government institution. The principal steps in the land acquisition process are presented below in Table 1.

Table 1: Principal Steps in the Land Acquisition Process

Step	Action	Responsibility	Time Required	Clause No. in LAA
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¹ Rules have never been updated.

1	Identifies the areas of land to be acquired and requests authorization from the concerned Ministry or Department to proceed with acquisition	Project Manager (PM)	Determined during engineering detailed design work	3, 4
2	Ministry/Department officially authorizes the PM to initiate preliminary action for land acquisition	Concerned Ministry/ Department	0.5 month	5
3	Issues notice of preliminary action and affix it in proper places for information	PM	1 month	6(1)
4	After 3 days, begins preliminary investigation including the identification of suitable land required for the project, and submits all documents including description of the damage and the cost estimations for compensation to Chief District Officer (CDO) for further action	PM	1-2 months	6 (2, 3), 7, 8(1)
5	May complain to the CDO about the amount of compensation for losses of their assets	Land & Property Owners	0.5 month	7(3)
6	Reviews all documents submitted by PC, and makes final decision on complaints of compensation for losses	CDO	2 months	9(1)
7	Issues a land acquisition notice which should be displayed at the following places: -Project Office -Office of CDO -At concerned Municipality or VDC Offices -Land Administration or Revenue Offices -Thoroughfares located around the concerned lands -At any other relevant places The notice should also indicate that the land owners shall submit an application claiming compensation within a minimum time limit of 15 days, with evidence of the land ownership certificate. If the owners of the land are allowed to demolish house/compound wall and take construction materials for their resettlement or cut trees or standing crops, then a time limit has to be set for such activities.	CDO	2-3 months	9(2)
8	Inform personally land owners who may not see the notice	CDO	0.5 month	9(3)
9	After receiving the land acquisition notice, suspends any land transaction until the CDO directs it to lift the suspension	Land Revenue Office	0.5 month	9(4)
10	CDO forms a Compensation Fixation Committee (CFC) comprising the following members to determine the amount of compensation payable: -CDO -Land Administrator, or Land Revenue Officer -PC in the case of a Project and officer designated by the CDO for other purposes -A representative of the DDC The compensation will be based on cash compensation. On request from the concerned parties, land to land compensation could be given if the government possesses land ² . CFC will determine the amount of compensation considering: -Current price of land -Value of standing crop, houses, walls, sheds, -Loss incurred as a results of shifting residence or place of business	CFC	2 months	13(2)

2 Although land for land acquisition is introduced by the Act, the government has not taken seriously to provide land for land compensation in the last twenty years of enforcement of the Act.

11	CDO provides information to the concerned parties regarding the list of the persons being compensated	CDO	0.5 month	18(1)
12	May complain to Ministry of Home (MoH) through the CDO within 7 days of the public notification, specifying the reasons for the complaint	Land & Property Owners		11 (1)
13	Consults the PM and decides on such complaint, within 15 days. For this purpose, the MoH shall exercise the powers vested in the District Court to conduct investigations, summoning witnesses, recording statements or procuring documents	CDO	0.5 month	11 (2, 3)
14	Takes possession of the concerned land and hands it over to concerned office for which it is acquired after: Finalization of the amount of compensation by the CFC Decision has been made on complaint, or At any time after expiry of the time limit for filing complaints	CDO	2 months	12(10)
15	Notifies the amount of compensation payable by the concerned Ministry or Department	CDO	0.5 month	19
16	Authorizes the PC to make compensation payment to the land owners	Ministry/Department	0.5 month	13(1)
17	PM makes payment to land owners in presence of Revenue Officer, CDO and DDC officers' representatives	PC	2 month	13(2)
18	Must receive compensation amount within a time limit of 3 months after which he/she will not be entitled to any compensation	Land & Property Owners	3 months	37
19	Takes possession of the land and hands it over to the concerned Ministry or Department and notifies the local Land Revenue Office within 15 days of acquisition	CDO	2 months	22
20	Obtains land ownership certificates and deposits copies with concerned Ministry or Department and project office	PM	1 month	

Source: "Public Works Directives", PWD Management Unit, MoPPW, HMGN, 2002,

Water Resources Act 1992 and Water Resources Regulation 1993

According to Section 16 (1) of the Act, if private land has to be used in order to utilize water resources, the licensed person can request the government to acquire the land through standard procedures (Land Acquisition Act 1977). The government will compensate the affected parties by the project or will make avail the compensation from the license through evaluation of the property as per the prevailing laws. Section 10 states that the compensation amounts shall be paid to the affected persons deducting the depreciation cost of the land and property against which the compensation has to be made.

Electricity Act 1992 and Electricity Rules 1993

Section 33 of the Electricity Act deals with land acquisition issues. The licensed person can request the government to acquire the land for the purpose of electricity generation, transmission, and distribution. The government can acquire the land through the standard procedures (Land Acquisition Act 1977). Due compensation for the acquired land and other property due to the project shall be paid by the applicant of the project.

Hydropower Regulation 1993

Rule 32 and 33 empower the government to acquire the land and property for the development of

hydropower projects and to prohibit the use of land around hydropower development area. The developer should provide the compensation amount to the affected parties, which will be decided by the Compensation Fixation Committee (CFC). According to Rule 35, the CFC will comprise of the members including person nominated by the government, project representative, hydropower specialist nominated by the government, representative of project affected parties, and representative concerned District Revenue Office, and representative elected member of the affected VDCs or Municipality.

Electricity Development and Management Act 2005

The Act provides right for utilization and acquisition of other's land and property for the purpose of hydropower development if the developer may submit an application to the government. The government shall arrange for such land and property acquisition after examining the application of the developer. According to the Section 40 and 41, the developer should compensate the affected parties as per the prevailing laws and exercise the rehabilitation and resettlement program for the affected parties as an integrated program in order to ensure their livelihood to be as equivalent to or higher than the pre-project conditions. Section 42 states that the developer during construction and development of hydropower projects should ensure the maximum benefit of employment or other subsidiary opportunities development for the local affected people.

(3) Constraints of Existing Government Laws and Policies

Over the years, a progressive trend has been recognized to address the involuntary resettlement of the people affected by the development project under the legal framework. However, there exists some confusion and overlapping in the provisions made in prevailing Acts and Regulations regarding the involuntary resettlement. Furthermore, these Acts and Regulations do not fully address the issues of compensation, resettlement and rehabilitation. Some constraints and limitations of existing Acts and Regulations are presented below.

No linkages among Acts and Regulations—Various pieces of Acts and Regulations that are applicable to the hydropower development projects are overlapping with one another to some extent, and also self sanding with no linkages among them.

Not exclusively define the mode of compensation—Although the prevailing Acts and Regulations state the affected people are eligible for the compensation of the affected land property, the mode of compensation is not exclusively defined. The Compensation Fixation Committee (CFC) is empowered to evaluate the affected land and property for the purpose of cash compensation without any guidance. It is not clear whether the evaluation criteria will be based on the current market price or on the prevailing rates of Land Revenue Office. It is the often the case that the rates of Land Revenue Office are far lower than the current market price, which implies that the compensation based on the rates of Land Revenue Office is not enough to ensure the livelihood of the affected people at least to be as

equivalent or higher than the pre-project conditions. Water Resource Act states that compensation payments will be made only after deduction of depreciation. This is against the concept of ensuring to improve the living standard of the affected people, or at least to restore them to pre-project levels. Furthermore, it is also against the best practices of resettlement in Nepal adopted by the guidelines of many international donor agencies such as Asian Development Bank (ADB), World Bank and Organization for Economic Co-operation and Development (OECD).

Different constitution of the Compensation Fixation Committee—In practice, Land Acquisition Act is the umbrella Act with regard to the acquisition for the land and the property. However, the provisions made for the constitution of the CFC differ widely from this umbrella Act and other subsequent Acts such as Water Resource Act, Electricity Act and Electricity Development and Management Act.

Not cover all types of loss—Except for the Electricity Development and Management Act, none of the previous Acts and Regulations has made specific provision of resettlement and rehabilitation. Even the Electricity Development and Management Act recognize the legal title holders of the land and property as the eligible parties alone for compensation, resettlement, and rehabilitation. There are no provisions for compensation, resettlement, and rehabilitation for those who have non-legal holdings although they have used the individual and community properties for generations. None of Acts and Regulations has stipulated an entitlement matrix to regulate the compensation, resettlement and rehabilitation of the displaced people due to the Project.

Efforts to regulate compensation, resettlement and rehabilitation of the project displaced people in Nepal were made several times with the assistance of donor, particularly ADB. The National Planning Commission with the technical assistance of ADB is recently working to prepare a National Policy and Legislation on resettlement and rehabilitation of the project displaced people. Although there were several stakeholder meetings for this new framework, it will take some time to get an approval from the concerned government agencies, cabinet, and the parliament because of the on-going political disturbance in Nepal.

3 Review of Involuntary Resettlement Experiences in Similar Hydroelectric Projects

The government of Nepal does not have a separate policy for dealing with the displacement and resettlement caused by the hydropower development projects, but implements the resettlement and rehabilitation program for the displaced people by formulating project specific policies to satisfy the needs of the respective donor agencies. This section reviews two recent Hydroelectric Projects, namely Kaligandaki A and Middle Marsyangdi and examines the resettlement and rehabilitation measures, which can be considered for application in RP of Upper Seti Hydroelectric Project.

(1) Kaligandaki A

Kaligandaki A Hydroelectric Project, the largest hydropower project constructed so far in Nepal, is a daily poundage type scheme located on Kaligandaki River with an installed capacity of 144 MW. The project generated about 842 GWh of electric energy annually. The main components of the project include a 28.5 km access road, a 44 m high and 105 m long dam at Kaligandaki River, one 5.91 km long headrace tunnel, a powerhouse station at Beltani, and 132 KV transmission lines to sub-stations at Pokhara and Butwal. The project construction work was started in 1997 under the loan assistance of ADB and Overseas Economic Corporation Fund (OECF), now known as Japan Bank for International Cooperation (JBIC) and completed in 2002.

The major resettlement effects of the project are as follows:

- Acquired land -208.68 ha
- Acquired houses-217 houses
- Affected Families -1468 households (SAF and PAF)
- Seriously Affected Families (SAF)-263 households who lost a house or more than 50% of land or more than 60% of income
- Project Affected Families (PAF)- 1205 households
- Relocatee-21 households, out of which 18 are from Bote families.

Due to the influence of ADB guidelines, the project has given much priority to resettlement and rehabilitation program for the affected families and people. The cash compensation was provided to the affected families and people. In the past, compensation rates were usually based on the rate determined by the government without any consultation with the affected people. In the project, the CFC consulted with the representatives of affected families and determined the compensation rate based on the prevailing market price by taking their suggestions into consideration. For those who lost their houses, the project paid for their houses at replacement cost and allowed these families to take construction materials from their old house. For the SAF, the project provided rent money of NRs 1000 per household per month for a period of 4 months. The project also paid the land registration fees for those who need to be relocated when they purchased replacement land. Due consideration was given to 18 Bote families, one of the indigenous people, by building houses, one primary schools and one community meeting hall and giving priorities of employment opportunities.

As mitigation and rehabilitation measures, the project has launched various Community Support Programs including agriculture, forest, health facilities, micro-credit, and so on. Through a series of discussion with the local people, various training such as bee keeping and vegetable cultivation have been conducted under the Agriculture Intensification Program, which has benefited these local people. Employment was prioritized to SAF, AFP from affected VDCs and other people. During the construction phase, 2568 people in total were employed, and more than three-fourths of the SPAFs

and PAFs were employed. To monitor these environmental mitigation measures and rehabilitation, Kali Gandaki Environmental Management Unit was formed, which was the first time in the hydropower projects in Nepal.

The following are lessons learned from the Kaligandaki A Hydroelectric Project.

- **Community consensus valuation approach as an indispensable approach for resettlement and rehabilitation programs** - This project included the representatives of affected communities into the members of CFC and consulted them regarding the compensation rate. Besides this, the project placed emphasis on consultation and dialogue with the affected people to implement Community Support Programs. Such community consensus valuation approach might contribute to rapport building between the project stakeholders and the affected people and smooth implementation of resettlement and rehabilitation programs.
- **Compensation and rehabilitation should be given to SPAFs in a timely and appropriate manner**- It can be said that the Kaligandaki A project has given due consideration and priorities to SPAFs, particularly Bote families who were completely displaced, by providing houses, community infrastructures and employment opportunities. It was reported that the majority of these Bote families were happy with the resettlement and rehabilitation programs provided by the project. However, it was found based on the field visit that some Bote families were not happy because of being displaced twice and being provided with the land and house by the project behind the schedule. There seems to be room for improvement of the way of resettlement and rehabilitation for SPAFs.

(2) Middle Marsyangdi

The Middle Marsyangdi Hydroelectric Project, located on Marsyangdi River in Lamjung district is a daily poundage run of river scheme with an installed capacity of 70 MW and an average annual energy generation of 398 Gwt, hr. The project is jointly financed by the government of Germany, through Kiriditaustall for Wiederaufbau (KfW), and the government of Nepal and NEA. The project construction work has started since June 2001, and will be completed by end of 2007. However, it is behind the schedule due to the insurgency between the Maoists and the authority.

The resettlement effects caused by the project are mainly as follows:

- Acquired land -3833 ha
- Affected Families -379 households
- Relocatees-66 households

The project has strictly complied with the Resettlement Plan provisions of compensation to the affected people. The cash compensation for land and other property was paid to the affected families and people based on the rate fixed by the CFC through negotiations involving these affected families and people. The project also paid various allowance such as loss of business allowance for 3 months,

The project has established a mechanism of maximization of local people employment in the project construction works by regular notification through the Contractor's project management office. As a result, a number of local people have got construction jobs. As of May 2006, close to 43% of construction workers are from local affected people and the people from the vicinity of the project sites. As rehabilitation and enhancement measures, the Neighborhood Support Program including health, education, water supply and sanitation roads, and electrification has been carried out based on the consultation with the affected VDCs. Under this program, the fund has been allocated to different VDC to empower the local people. Several schools were renovated and a health post was upgraded to a health clinic with a laboratory. Various training such as bee keeping, poultry farming, and goat raising was provided to affected families and community people. Resettlement and Rehabilitation Unit (RENU) has been responsible for undertaking these resettlement and rehabilitation programs.

■ **Land acquisition should be accomplished in a single package** – Land and property acquisition have been undertaken by RENU as per the RP provisions. It was found that the land take in the same area was executed in different times as to the requirement of the project. As a result, the land value of the earlier land acquisition was lower than the land acquired in the later periods. Because of this, some affected people whose land was acquired earlier felt that the project has treated them differentially, which has adversely affected them. At least in the same place, the land acquisition should be accomplished around the same time so that the affected people would not have feeling of unfairness.

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विहवरवार, काज्नाडी

VDCs. The affected areas due to the implementation of the project vary from one place to another within one VDC. It is necessary to develop an appropriate mechanism of planning and allocating budget of these enhancement programs, in which the close consultation with the affected communities and affected people can be duly ensured within one VDC.

4 Resettlement Policy Framework for the Project

(1) Resettlement Policies

The resettlement activities to be pursued by of the project will be guided by the following basic policies:

- Land acquisition and involuntary resettlement shall be avoided where feasible or minimized to the extent possible through the incorporation of social considerations into project design options.
- Where population displacement is unavoidable, individuals, households and community losing assets, livelihood and other resources shall be informed and consulted
- Affected Persons (APs) shall be compensated at replacement costs for all losses and damaged assets. The absence of legal titles to lands, property, and facilities shall not be a bar to compensation.
- APs shall be fully compensated and resettled before their houses are demolished and their land and facilities are acquired.
- A resettlement plan shall be prepared and consulted with APs in advance of the implementation of the project
- The resettlement plan implementation shall be monitored
- The resettlement shall be executed as part of the development project.
- After RP implementation, the economic and social conditions of the APs should be improved or at least maintained.

(2) Compensation Policy for the Project

The following compensation policies are part of the overall policy on resettlement/relocation. The Land Acquisition Act 1977, Water Resource Act (1992) and Water Resource Regulation (1993) will be the key legal procedures that shall be followed for the compensation determination and payments.

1) The permanent loss of land (agricultural, residential, commercial and forestry).

- APs whose land (agricultural, residential, commercial and forestry) will be acquired permanently for project main component (dam, powerhouse, tailrace, switch yards, reservoir inundation area etc.) and facility sites (access roads, batching yards, camps, spoil disposal yards

etc.), the land shall be paid at replacement rate based on the valuation of lands by the Compensation Fixation Committee (CFC). Such land parcel registration shall be transferred to the developer.

- If the remaining land parcel after permanent acquisition is too small (i.e. less than 64 square meter) and the APs does not own adjoining plot and is willing to dispose the land, the entire plot shall be acquired at the replacement cost.
- Landowners of the risk zone that is a 10 m vertical distance from the FSL will be compensated in cash at the replacement cost as per NEA's practices. The CFC in consultation with local government and APs shall decide the replacement costs of the land.
- Landowners of the permanently acquired lands in three Risk Zones, namely Wantang Khola, Phedi Khola, and Tittuwa will be compensated in cash at the replacement cost. The CFC in consultation with local government and APs shall decide the replacement costs of the land.

2) The loss of crop/plants/trees

- Crops that will be damaged during project construction shall be compensated to APs based on the current fair market value determined by District Forest Office, District Agriculture Office or other government agencies to the maximum of one year production.

3) The loss of houses and other structures including utility facilities

- Houses and other structures including utility facilities (electricity, telephone, water supply, toilets, bio-gas plants etc.) shall be compensated based on their replacement cost which is the cost of materials and labor in the locality or as evaluated by the district norms at the time of relocation. No depreciation shall be applied. Additionally, the associated land plots of the houses shall be provided as Middle Marsyangdi Hydroelectric Project did. The house owners/structure owners shall be responsible for dismantling the affected house/structure and shall own salvageable materials.

4) The loss of community facilities and resources

- The project affected community facilities (such as temples, irrigation canals, footbridges, graves and ghats (a ghat is a Hindu cremation place which is a small and open platform-like structure at river bank) shall be compensated at replacement cost or restored to their previous condition or replaced in areas identified in consultation with affected communities and the relevant authorities.
- The standing stock of forest products in the Community Forests will be the property of the Community Forest User Groups or will be according to the prevailing laws.



- The compensation for the resources such as community forests and religious forests, grass land or shrub land shall be included the loss of fuel wood volumes and grazing lands.

5) *The loss of government property*

- Government infrastructure and facilities including utilities affected by the project shall be repaired or replaced or compensated at replacement costs in consultation with the relevant departmental authorities.
- Government forest areas shall be acquired in consultation with the Department of Forestry and any trees therein shall be the property of Department of Forest as per the prevailing laws.

6) *Grant of disturbance compensation*

- Disturbance compensation equivalent to the daily minimum wage for one person in the project-affected area multiplied by 180 days will be compensated as disturbance compensation to the affected households. This grant shall be used to defray the affected household's daily expenses while adjusting to their new environment.

7) *Transportation allowance to displaced households and owners of the affected community structures*

- For APs of acquired house structure and owners of affected community structure, an additional transport allowance of NRs. 18,000³ as a grant shall be paid to cover the transportation of the salvaged materials.

8) *Land Plot Grants to Relocatee*

- For APs, whose residential house structure is acquired by the project and has to relocate his residential location, will be granted a land plot as a gift plot close to the existing residential area if available. Since there are no appropriate large resettlement sites within or near the project affected areas, the relocate will be provided an amount equivalent to the gift land area rather than the land plot in consultation with them irrespective of the relocate affected residential land size⁴. The gift plot equivalent to one Ropani land (508m²) is proposed based on the experience of Middle Marsyangdi Hydroelectric Project.

9) *Compensation for business losses*

- Compensation for business losses in amount up to NRs 30000 will be paid or based on daily income which ever is lower, as reflected on income tax return multiplied by the number of days of business stoppage due to the project, but in no case shall it be more than 90 days.

■ ³ The rate of transportation allowance was set based on the rate taken by Middle Marsyangdi Hydroelectric Project in consideration with price boost.

⁴ Further, the Household Survey revealed that a majority of the people would prefer cash compensation and want to relocate themselves in areas of their wish.

10) House Rental Allowances

- House rental compensation @ rate of NRs. 200/day for 180 days will be compensated to the affected households. This grant shall be used to rent the house close to the new construction site of the house.

(3) Valuation Process

Valuation of land and other property shall follow the government of Nepal Acts and Regulations and the ADB resettlement policy.

1) Valuation of land

Valuation of the land on project's structural components, reservoir area and facility sites will be made by the CFC as per section 13 of the Land Acquisition Act 1977. The composition of the CFC members will be as per Rule 88 of Electricity Rules⁵. The land evaluation cost shall be based on the replacement cost. Consideration to residential, urban, and rural agricultural land and closeness to motorable road, main foot trail etc shall be taken while evaluating the land replacement cost of the affected areas.

2) Valuation of house and other structures and utilities

Decisions on the valuation of house and other structures and utilities by CFC shall be based on the valuation norms of the District Development Committee or valuation made by District Office of Housing. Depreciation shall not be included in the valuation.

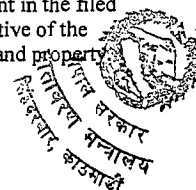
3) Valuation of trees and biomass

Decisions on the valuation of trees and biomass by CFC shall be based on the valuation norms of the District Forest Office or Valuation made by the officers of District Forest Office.

4) Valuation of damaged crops and agriculture produce

Decision on the valuation of damaged crops and agriculture produce by the CFC shall be based on the valuation norms of the District Agriculture Office or Valuation made by the officers of District Agricultural Office. Valuation shall be made to the actual damage of the crops and agriculture produce.

⁵ Rule 88 of Electricity Rules stipulates that a compensation fixation committee under the chairmanship of government appointed person, concerned person or the representative of the project, an expert appointed by the government in the filed of electricity, property owner or his/her representative, representative of the Land Revenue Office, representative of the concerned Village Development Committee/Municipality shall decide the compensation of the affected land and property.



(4) Participation of Affected and Displaced Families

The affected and displaced families shall be informed and consulted during the pre-relocation activities on compensation package and procedures for payment and settlement of conflicts/disagreements. They will also be regularly informed and consulted during RP implementation. Requests for meeting/consultations with CFC to resolve related issues/concerns could be coursed through the Project Management Office (PMO).

(5) Entitlement/Eligibility of Affected Households/Persons

The following APs, communities and government agencies as defined are eligible for payment of compensation as provided in the RP:

- **Landowner** - A person who owns land/s within the project-affected areas with legal ownership documents. In some exceptional cases, a person who owns land/s within the project-affected areas regardless of proof of such ownership will also be entitled. However, special decisions by the concerned governmental agency shall be made taking into account the local government/ or community's recommendation also.
- **Land tenant** - A person who works on a project-affected land owned by another person with a legal proof from Land Revenue Office.
- **Structure owner** - A person who owns a project-affected building/structure including a dwelling unit but resides in an area not affected by the project.
- **Business owner** - A person who owns or conduct a business within the project-affected area, the operation of which will be disrupted by the construction of the project.
- **Community** - A community who owns project affected building structures or resources and utilizes buildings or resources of the affected areas.
- **Government Agency** - A government agency that owns project affected building structures or resources and utilizes buildings and resources of the affected areas.
- **Relocatees** – APs who are actually residing in the affected areas at the time of the conduct of socioeconomic survey and have to move their residences as a result of project construction.
The different types of relocatees are:
 - a. House and plot owner - a person of family who owns and actually occupies an affected house and lot.
 - b. House owner tenant - a person of family who owns and actually occupies a project-affected

house with or without the consent of the lot owner.

c. Informal Settler - a person of family who owns and actually occupies a project-affected house located on a government land or on a private land but without the consent of the owner.

d. House occupant - a person or family who occupies an affected house either as an occupant free of charge or on rent

Table 2 shows Entitlement Matrix for the basic compensation to be provided to each AF/AP, communities and government agencies.

(6) Cut-Off Date/Non-Eligibility for Compensation

The validation of APs in this report based on the field survey including house-to-house structure inventory survey of the project affected area that was completed on September 21st 2006. Ministry of Water Resources is yet to publish a public notification pursuant to the Water Resource Act, section 16.3 and Water Resource Regulation, Rule 33.2 in the Nepal Gazette as cut off date for the project compensation and benefits to APs since it is still at the stage of feasibility study. However, concerned agencies are advised to announce a public notification on the cut off date once the implementation of the project is officially finalized to prevent the speculation in land. Furthermore, setting the cut off date will discourage people for further investments in the project affected area. Such public notification should state that the households or persons who will introduce new houses/structures at the project affected areas after the cut-off date will be considered non-eligible households/persons and therefore will neither be compensated for their properties nor will be granted relocation benefits.



Table 2: Entitlement Matrix for the Project APs

Types of APs	Type of Compensation/Rehabilitation									
	1) Permanent loss of Land at replacement cost	2) Loss of crops and Natural resources	3) Loss of House and other structures at replacement cost	4) Loss of community facilities and resources	5) Loss of government property	6) Grant for disturbance compensation to displaced households	7) Grant of Transportation allowance to displaced households/c community structure	8) Grant of land plot	9) Loss of Business	10) House rental allowance
Landowner	X	X								
Land tenant	X	X								
Structure owner			X							
Business owner										
Community		X		X			X		X	
Government Agency		X			X					
Relocatees										
House and Lot owner	X	X	X			X	X	X	X	X
House owner tenant	X	X	X			X	X	X	X	X
Informal Settler			X			X	X	X	X	X
House occupant						X	X	X	X	X

Note: Compensation to permanent land with tenant shall be halved between the owner and tenant as per Land Reform Act provisions. The loss of crops and natural resources on such land however shall be paid to the tenant only.

5 Community Consultation and Dialogues

(1) Project Stakeholders

The stakeholders other than NEA, Department of Electricity Development, Ministry of Water Resource, Ministry of Environment, Science and Technology are listed and categorized in Table 3.

Table 3: Project Stakeholders

Stakeholders	Descriptions
Affected Persons /Families/ Communities / Government Agencies	Landowners, house and lot owners, house owners, informal settlers, house occupants, and structure/business owners, various community user groups, community and government agencies whose properties will be affected and/or will be displaced by the project's construction.
District Government Office (District Development Committee) and Offices of Local Governments (Village Development Committees and Municipalities)	All district government offices and local government offices that have jurisdiction on the area occupied by the project.

(2) Mechanisms for Stakeholders' Participation

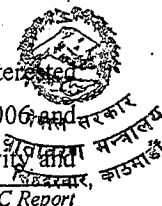
It is NEA's responsibility to inform all relevant stakeholders of the important aspects of the project so that they can be informed about the decisions on how the construction and operation of the project will affect them and how they can best benefit from it.

1) Dialogues/Consultation

Consultation with the affected APs and communities was started during the socio-economic surveys of the households conducted by NEA in the affected areas since 2001. Public hearings on the project were conducted by NEA on 25th January 2004 in Damauli. During the Study supported by JICA, NEA carried out three-time stakeholder meetings in both Damauli and Kathmandu in June and December, 2006 and in May 2007 as per JICA Guidelines (See Chapter - Stakeholder Meeting). A number of APs, local government officials, NGOs and donor agencies participated in these meetings. Such consultation, however, shall continue during the detail design study period. In order to ensure the participation of all types of APs in the consultation meeting, it is better to keep a record of participants by type of APs such as the owner of private lands, the owner of private structures, and relocatee. If some APs are found not to participate in the meeting, the follow-up activities should be undertaken to disseminate necessary information to them. APs, communities and local governments shall be consulted for evaluation of the land and properties for compensation and shall be the part of the Compensation Fixation Committee.

2) Information Campaign

Project brochures were prepared and distributed to the affected APs, local governments and interested local NGOs and CBOs during public hearing and stakeholder meetings in 2004 and later in 2006 and 2007. The brochures gave information on the project alignment, potential impacts and its gravity and



steps taken by the project to minimize the impacts.

NEA project office shall organize and will be responsible for the presentation and dissemination of information sought by APs on related issues. A field team from the project management office should regularly provide information at the site level to the APs, local government and NGOs as and when required during planning and implementation of RP.

3) Local Government Endorsement

As per the Environmental Protection Rule, local government endorsement on the project is mandatory pre-requisite for project development. Interaction, discussions, and consultation with regard the project were conducted in the various occasions with the heads and members of local government. Of the 8 project affected local governments, i.e. 1 municipality and 7 VDCs of the Tanahu district, all the local governments have given endorsement for the project development. The copies of the local government endorsement are attached in the EIA report prepared by NEA (2005).

4) Role of NGOs and CBOs

As in any national development project, APs seek the assistance of non-government and/or community-based organizations (NGOs/CBOs) for a nonpartisan or impartial assessment of the project. These groups are encouraged to participate in public hearings or stakeholder meetings and community dialogues and voice out their concerns about the project.

6 Resolution of Conflicts, Appeals and Grievance Procedures

Issues, which may arise concerning the land rights and dissatisfactions on the land and property acquisition, value fixation etc. shall be addressed by the Chief District Officer and Ministry of Home as per the legal provisions of the Land Acquisition Act 1977 (Section 7 and 11).

Issues, which may arise concerning payment of lands, crops and improvements and relocation, will be settled by the Project Management Office (PMO). They will be assisted by NEA's legal wing to handle all the legal matters/concerns.

Issues related to the insufficiency of the compensation costs shall be refereed to CFC as a last resort to settle the issue.

(1) Setting up a Complaint Desk⁶

The PMO shall set up a Complaint Desk at its field office to be manned by administrative officer assisted by a field supervisor. All complaints and concerns shall be received at this desk and resolved. Likewise, the PMO shall refer to the concerned office/group all other issues, which cannot be resolved.

⁶ It some projects, it is called a grievance redress committee.

The APs shall be informed about the status of his/her concerns as soon as possible.

(2) Procedure

The following procedure will be observed in the settlement of conflicts or concerns.

- PMO receives the issue/concern from APs and determines if there is a conflict.
- AP/PMO representative discuss and resolve issue concern. If this is settled, the process ends.
- If not, PMO elevates the concern to the NEA's legal adviser for evaluation/review and resolution.
- If the concern is resolved, the process ends. If not, the PMO through Legal Adviser forwards concern to CFC, which evaluates and provides solution. If resolved at this stage, the process ends.
- If the concern remains unresolved, and If AP is still not satisfied, this is elevated to the Court of Appeals and finally to the Supreme Court by AP.

7 Institutional Organization

The NEA is responsible for overall implementation of this RP and shall provide the necessary resources such as the budget and the manpower. To ensure smooth implementation of the RP, the NEA PMO as well as the relocatees are tasked with the following responsibilities. A full fledged PMO will be established by NEA to execute all the responsibilities of project during construction, where as during operation, NEA Operation Department will look into the matters of rehabilitation and enhancements.

(1) Organizational Linkages and Responsibilities

1) Project Management Office (PMO)

- Conducts consultations/dialogues and project presentation with the APs and concerned VDCs, municipalities, District Development Committee and District Offices respectively
- Secures project endorsements
- Identifies affected households/persons and prepares initial valuation of houses/structures as a start point to Compensation Fixation Committee
- Surveys and values lands, crops/improvements and recommends payment of the same to the NEA Board
- Prepares and secures approval of the RP
- Secure necessary budget for RP
- Identifies affected landowners and tenants and negotiates for the acceptance of payment of affected lands, crops, trees and plants as well as prepares estimates and allocate and forward for approval of budget for the payment of the same
- Facilitates the resolution of resettlement issues

- Implement RP and provide updates to NEA central office
- 2) Account Section, PMO
- Processes and disburses payments for relocation in consultation with PMO
- 3) Relocatees
- Relocate/transfer their houses and structures outside the project boundaries within thirty (30) days after receipt of payment due them
 - Cooperate with the PMO/NEA offices and other government agencies in the implementation of the RP
 - Help maintain peace and order during and after relocation
 - Comply with all the provisions set forth in connection with the payment of their houses/structures

8 Institutional Capability Building and Strengthening

Some of the staff currently working in NEA has been involved in the resettlement planning, structure inventory surveys and socio-economic surveys of the APs in other NEA hydropower projects. They have skills in dealing and maintaining public relationship with the APs and in the conflict resolution.

Some of these NEA staffs will be deputed for RP implementation in the PMO, and will head the RP and SAP Implementation Sub-unit (RSISU), which is newly established (See also Part F Environmental Management Plan). The new staffs to be appointed in the PMO by NEA shall be given training through workshops and seminars from the experienced staffs of NEA involved in other hydropower projects with an objective to strengthen institutional capacity building of the personals prior to the start of RP implementation.

9 Implementation Schedule

(1) Relocation Schedule

In any timeframe, the implementation of RP should be accomplished at least three months before the start of construction works in the project components construction sites such as Dam, powerhouse, tailrace, switch yards etc and in the project facility sites. In the reservoir area, RP completion should be accomplished at least six month before the start of project work in the reservoir. Furthermore, community related works and resolution of issues shall continuously be undertaken until completion of RP implementation. Implementation of RP begins upon its approval by NEA Board. Major activities during RP implementation include final determination of costs by Compensation Fixation Committee for permanent land acquisition, land use restriction, house and other structures etc as per RP policy of the project; documentation, processing and payment of relocation compensation; and supervision and monitoring of RP.

A third party monitoring team shall be engaged to oversee the implementation of the RP to ensure that

its provisions are properly followed.

(2) Relation of Relocation Activities to Project Schedule

To ensure that the project will be completed on time, NEA Board assigned a Project Manager (PM) to oversee the project implementation by establishing a separate Project Management Office (PMO) with sufficient staffs and resources. The PM is tasked to coordinate and monitor all the activities with the concerned NEA top management during the early stage of the project to ensure that decisions or approval of the related matters would be finished prior to actual project construction/implementation.

Some relocation activities during the planning stage such as information campaigns with the APs and local governments and arrangements to facilitate final determination of compensation costs from CFC are needed. Besides, co-ordination to obtain approvals and permission from other concerned Government of Nepal offices is equally important.

(3) Procedures for RP implementation

- PMO has secured cadastral maps, VDC and DDC maps, etc. necessary for the first hand identification of land required for the projects & land ownership.
- PMO has prepared a master list of the land plots and ownership status from the field book from the District Survey Office and District Land Revenue Office
- PMO request the concerned District Administration Office to acquire necessary land and properties in line with the Land Acquisition Act and other related Acts, Rules and Regulations.
- PMO notifies the people of the project area with plots and owners or tenants to be affected
- PMO requests the District Survey Office to identify the land plots affected by the project and survey and delineate the affected land to finalize the land parcels affected by the project.
- PMO gathers, consolidates or examines the needed documentary requirements such as land titles, proofs of ownership, tax declarations, etc. to facilitate the payment of project claim.
- PMO requests the District Forest Office, the District Development Committee Office and the District Agriculture Offices etc. to evaluate the compensation amount of respective properties.
- PMO prepares public notification of the affected property and request concerned Chief District Officer for notification with details of land parcels, owners/tenants, structures, and other property in the project affected areas.
- PMO assists CFC on investigation, negotiation with APs, and evaluation of the properties for the determinations of the compensation as per RP policy.
- PMO starts paying compensation amounts immediately after all Government decisions.
- PMO co-ordinates and conducts regular consultation with APs, local communities, NGOs, VDC and DDC throughout process in matters related to information dissemination, identification and evaluation of the property, negotiations with APs to resolve any issues of RP.
- PMO monitors the RP and prepare regular updates of RP implementation.

(4) Involvement of APs, Local Government and NGOs

Active participation of APs, NGOs and local governments including VDC, Municipality and DDC will be encouraged to ensure the smooth and successful implementation of the RP. These could be accomplished through the following means:

1) Affected Persons (APs)

- Allowing entry for the preliminary survey of the affected areas by the project
- Collating of documents to support their relocation claims so that assistance and grievances are submitted on time for processing.
- Participation in the count of resources (crops/plants/trees) and cooperation in the valuation of the same including those of their affected lands.
- Chose a representative for participation in the CFC meetings for evaluation of the compensation at market based prices
- Examination/review of the computations of relocation compensations and affixing their signatures on the assistance and grants to facilitate payment of their claims.
- Allowing entry of the construction crew to the affected lands upon receipt of payment and timely dismantling of their houses/structures.

2) NGOs

- Participate in the community dialogues/meetings to resolve issues that may arise during relocation implementation.
- Participate in the detailing the Social Action Programs
- Participate in the RP implementation
- Participate in the implementation of Social Action Programs when necessary

3) Local Governments

Local Governments shall be involved in the RP process in two ways: firstly, as per the role and assignment stated in the prevailing Acts, Laws, Rules and Regulations and secondly, on the request of the PMO. Major roles are:

- Assist to relocatee in looking for suitable places to transfer to facilitate their early relocation.
- Participate in the CFC meetings for the evaluation of compensation
- Participate in the dialogues/meetings with the APs for the resolution of some conflicts associated with the processing/payment of their claims.
- Assist PMO in the prevention of illegal encroachers or new settlers in the affected areas to take advantage of relocation compensation and benefits being granted by the project.

10 Monitoring and Evaluation

Monitoring and evaluation are important activities of the RP because these will keep track of NEA's commitments to programs and projects and will ensure the attainment of the program's goals and objectives.

While RP evaluation will be done internally by NEA through PMO. Monitoring of the RP implementation will be done both internally and externally. Internal monitoring will be undertaken by NEA through the PMO and the Department of Electricity Development, Ministry of Water Resources while external monitoring will be contracted out to a third party.

Performance indicators that reflect the program's objectives will be the basis of monitoring and evaluation. The parameters/indicators for monitoring and evaluation will be the RP policy, the entitlement matrix and the procedures elaborated elsewhere in this RP.

(1) Internal Monitoring

The project will be monitoring its own concern particularly the status of their activities as well as expenditures. The expenses will be audited by the NEA Audit Department. The implementation schedule on relocation and rehabilitation will be used in monitoring the activities. Monthly status reports are prepared by the PMO on payment of RP compensation, assistance and grants. The implementation of continuing information campaigns, dialogues, issues and concerns of stakeholders are also included in the PMO report.

The project management will ensure that the monitoring by PMO is conducted as per the requirement. It will regularly review the reports and provide comments and suggestions for improvements. The reports shall also be sent for review and comments to Department of Electricity Development, Ministry of Water Resources and Ministry of Environment, Science and Technology for their review and suggestions.

(2) External Monitoring

The project Manager will contract out external monitoring of the RP implementation to a third party. A term of reference will be prepared by the PMO and reviewed and agreed upon by the funding agency and the third party. NEA will provide cost from the project budget.

(3) Post-relocation evaluation

After completion of resettlement and development activities, a process and impact evaluation will be undertaken as per prevailing Laws. The evaluation will specially assess whether the living standards of the relocatees have been restored or enhanced. It will also review the RP program's efficiency, impact and sustainability. The evaluation results shall serve as NEA's tool or reference to improve the formulation of future relocation/resettlement and rehabilitation programs.

11 Compensation and Benefits to Affected Families (AFs) and Affected Persons (APs)

(1) Compensation and Benefits to Affected Families and Affected Persons

Based on compensation policy for the project described in Section 4, the identified AFs/APs of the project area will receive the following compensation and benefits:



Table 4: Proposed Compensation and Benefits of AFs/APs

Affected Households/Persons /Community	Compensation and Benefits
Land owner/ legal title holder and occupier of the land during the cut off date.	1. 100% payment on mark-based rates of the permanent land occupancy for the project components and project facility sites 2. 100% payments of the agricultural production for one year of the agricultural lands
Structure owner other than residential (registered or unregistered or in others land) at the time of cut off date.	1. Replacement cost of structure/associated utilities 2. Transportation allowance
Residential structure owner (registered or unregistered or living with a structures in others land) at the time of cut off date.	1. Replacement cost of house structure/associated utilities without deducting depreciation 2. Disturbance compensation allowance for 180 days for one person at the minimum district wage rate for one person of the house 3. Transportation allowance (lump sum) NRs. 18000 4. House rental allowance for 180 days @ of NRs. 200 per day 5. Gift land plot or equivalent cost of the gift land plot (508m ²) in the adjoining area of the residential structure
Community structure	1. Replacement cost of structures and facilities without depreciation 2. Transportation allowance (lump sum) NRs. 18000

(2) Cost Estimates for Compensation and Benefits of Affected Persons and Affected Families

The cost estimates for the proposed compensation and benefits of APs and AFs are summarized below.

1) Cost Estimation for the Private Land

The cultivated lands are under private ownership. Although there is discrepancy in land area as per GIS and Cadastral maps, the land area including cultivated and build up of the GIS map has been accounted for the cost estimation. Table 5 indicates the cost estimation for the lands to be acquired by the Project. The land under government ownership is not accounted.

Table 5: Cost Estimation for the Private Land

Particulars	Million NRs.
Reservoir FSL 415 m +10 m*	542.76
Risk Zone in 3 places (Wantang Khola, Phedi Khola, Tittuwa)*	32.43
Project Facility Sites **	424.32
Total	999.51

Note: *Cost of land NRs. 250,000/ Ropani (0.051 ha) for reservoir area. Rates obtained from focus group discussions

** The land cost is NRs. 600000/0.051 ha, for project facility sites, based on focus group discussions

2) Cost Estimation for Structures

The cost estimation for the affected structures including both private and community are presented in below.

Table 6: Cost Estimation for the Structures

Particulars	Million NRs.
Reservoir FSL 415 m +10 m	12.89
Risk Zone in 3 places	3.33

(Wantang Khola, Phedi Khola, Tittuwa)	
Project Facility Sites	17.75
Total	33.97

Note: Structures cost estimations as per district and Government of Nepal norms.

Pakki House with stone mud motar, and khar roof = NRs. 550/ft²

Pakki hose with stone mud motar and GI sheet roof = NRs 600/ft²

Pakki house with brick and cement or cement block and GI roof = NRs 750/ft²

Pakki house with bick cement or pillar with concrete roof = NRs 900/ft²

Kachhi cowshed with wood and GI sheet roof = NRs 350/ft²

Kachii cowshed or other shed with wood and Khar roof = NRs. 250/ft²

3) Cost Estimation for Agriculture Production Equivalent to One Year Production

Table 7 indicates the cost estimation for agriculture production equivalent to one year production.

Table 7: Cost Estimation for Agriculture Production Equivalent to One Year Production

Particulars	Million NRs.
Reservoir FSL 415 m +10 m	0.46
Risk Zone in 3 places (Wantang Khola, Phedi Khola, Tittuwa)	0.027
Project Facility Sites	0.16
Total	0.647

Note: Estimated upland and irrigated land in the project area = 60 percent irrigation khet land, and 40 percent upland (bari land)

Cropping intensity and production per ha of land in irrigated khet land

Crop Type	Cropping % in the land	Production/ha MT	Production/ha (in NRs)
Paddy	100	3.15	3064
Wheat	20	1.9	1880
Maize	33	2	1540
early paddy	26	3.1	3064

Based on Tanahu district average

Cropping intensity and production per ha of land in upland (bari land)

Crop Type	Cropping % in the land	Production/ha MT	Production/ha (in NRs)
Maize	100	2.5	1540
Millet	40	1.2	1600
Pulses	50	0.9	2445

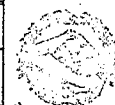
Based on Tanahu district average

4) Other Rehabilitation Compensation to Relocatee

As per the RP policy described in Section 4, the AFs whose residential house structure is to be affected shall be provided disturbance competition, house rental compensation, transportation allowance, and a gift land plot or its equivalent amount of the cost. The cost estimation for such rehabilitation compensation is shown in Table 8.

Table 8: Other Rehabilitation Compensation to Relocate

Particulars	Million NRs.
Reservoir FSL 415 m +10 m	11.07
Risk Zone in 3 places (Wantang Khola, Phedi Khola, Tittuwa)	2.348
Project Facility Sites	31.53



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Total	44.95
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Note:

- *Disturbance allowance 1 day/relocatee = NRs. 150, for 180 days
- **House rentals 1 day/relocatee = NRs. 200 for 180 days
- ***Transportation costs/relocatee = NRs. 18000 (lump sum)
- ****Gift land plot Reservoir area= NRs. 250000 (as per focus group discussion)
- ***** Gift land plot Project Facility sites= NRs. 600000 (as per focus group discussion)

5) Transportation Allowance to Affected Structure Owners other than the Affected Residential Structure Owners

Both private and community structure owners shall be compensated transportation allowance for the salvaged of the structure materials as follows.

Table 9: Transportation Allowance to Affected Structure Owners other than the Affected Residential Structure Owners

Particulars	Million NRs.
Reservoir FSL 415 m +10 m	0.34
Risk Zone in 3 places (Wantang Khola, Phedi Khola, Tittuwa)	0
Project Facility Sites	0.09
Community Structures	0.126
Total	0.56

Note: Transportation costs/Owner = NRs. 18000 (lump sum) based on the experience of Middle Marsyangdi

6) Monitoring Cost

During the construction phase, it is necessary for a third party such as the environmental consultants appointed by the developer, i.e., NEA to conduct monitoring in close coordination with the PMO. During the operation phase, the socio-economic conditions of the APs and AFs will be monitored by the developer in every 2nd year for a period of 10 years. It is recommended that independent monitoring consultant be employed by the developer comprising a sociologist and an expert of resettlement planning and monitoring. The cost for 10 years or 5 time monitoring is estimated below.

Table 10: Monitoring Costs during Operation Period

Particulars	Number	Duration	Cost/month	Million NRs.
Sociologist	1	2	75000	0.15
Resettlement monitoring expert	1	2	75000	0.15
Transport/support facility	1	1	30000	0.03
Report and documentation	1	1	30000	0.03
Total one time monitoring				0.36
Total 5 times or 10 years monitoring				1.8

Source: Estimates are based on the experience of Middle Marsyangdi.

7) Cost Summary for the Resettlement Plan

The cost estimates for the proposed compensation and benefits of APs or AFs are summarized below.

Table 11: Cost Summary

Reservoir FSL 415(m) + Risk Zones 10 m	Million NRs.
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Cost Estimation for the Private Land	999.51
Cost Estimation for the Structures	33.97
Cost Estimates for Agriculture Production Equivalent to One Year Production	0.65
Other Rehabilitation Compensation to Relocatee	44.95
Transportation Allowance to affected Structure Owners Other than the Affected Residential Structure Owners	0.56
Monitoring for 10 years	1.80
Grand Total	1081.4



Appendix G



SOCIAL ACTION PLAN FRAMEWORK

1. Background

The Resettlement Plan (RP) addresses what types of APs will be eligible for what types of compensation and benefits in order to mitigate, particularly, economic impacts on APs. However, it does not respond to the socio-economic effects on the communities such as loss of community resources and property. As assessed in Chapter 5, the adverse impacts to the communities are related with the loss of infrastructures such as motorable roads, suspension bridges and foot trails. The project will also affect the forestland, shrub land, grass land and river flood plain areas. Furthermore, there will be significant loss of the natural resources including forest resources and water resources on which communities are dependent traditionally for livestock raising, agricultural practices, and even for livelihood. The loss of these lands and resources can be considered as a loss of community livelihood, which could not and should not be overlooked in rural villages. The poor, destitute, and disadvantaged groups or communities bear the burden of losses than the high class and affluent people of the society. It is therefore necessary to develop a mechanism to compensate the losses and restoration of livelihood of these people. The framework of Social Action Plan (SAP), i.e. a package of social programs, is conceptualized in the context of the project to reverse these impoverishment risks caused by the Project.

2 Basis of Identification of Social Programs

The formulation of Social Programs is based on the assessment of socio-economic effects on the affected persons and community through the Field Survey, the Household Survey and Focus Group Discussion in the project-affected VDCs and municipality under the Supplemental EIA Survey (See Chapter 2). During Focus Group Discussion undertaken in 13 different places of the project-affected VDCs and municipality, the communities were asked to list three urgent development needs in the context of the local area and categorize those needs into first and second priorities. Prioritization of the development needs differ from community to community. Their felt development needs, when compiled and assessed for all communities of the project areas, are summarized below in Table 1.

Table 1: First and Second Priority Needs and Proposed Social Action Programs¹

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

Source: Supplemental EIA Survey, JICA. 2006

All of the above listed community development needs, irrespective of the prioritization by the communities, are related to the livelihood and quality of life enhancement. Besides these needs, local women addressed their felt needs of various women development activities in order to improve their knowledge and skills, and enhance their socio-economic status. There are number of Government of Nepal agencies working in the above development areas. Similarly, a host of national and international non-governmental organizations are also working. However, services provided are not sufficient to meet the needs of the people in the project area. Obviously peoples are looking forward some assistance from the side of the project to fulfill their development needs. In the above context, the social action programs have been framed keeping the poor, destitute and disadvantageous groups in the centre of the designed programs.

¹ Regarding the upgrading of affected stretches of road, further examination is needed. The construction of new roads outside the affected areas is out of scope of the project.

3. Social Programs

It is proposed that the eight social programs should be conducted to mitigate socio-economic impacts on the affected communities and affected persons and rehabilitate the quality of life of these communities and persons. Eight social programs with the tentative schedule are summarized below.

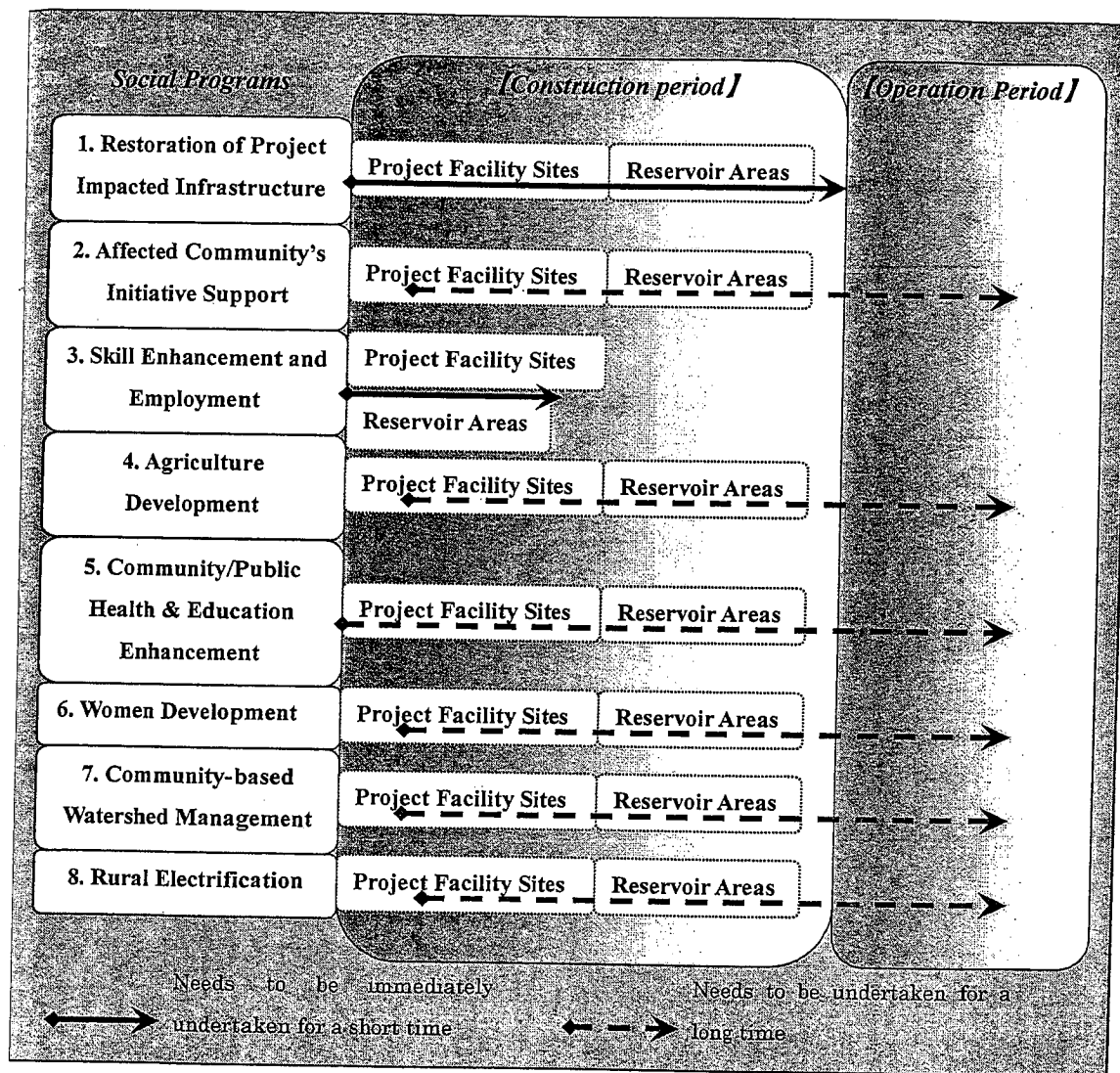


Figure 5.3-1 Proposed Eight Social Programs

(1) Restoration of Project Impacted Infrastructure

The reservoir of FSL 415 m will impound a host of infrastructure facilities, such as motorable roads, suspension bridges, foot trails, irrigation canals, electricity distribution lines, temples and resting places, and so on (See Chapter 5). Table 2 estimates the approximate cost of the lost infrastructures at the reservoir area.

Table 2: Costs of the Infrastructures Affected by Reservoir Inundation

S.N.	Type of Infrastructures (FSL 415 m)	Million NRs.
1.	Motorable road	0.9
2.	Motorable Bridge and Suspension bridge	16.28
3.	Foot trails	1.5
4.	Irrigation canals	3
5.	Electricity Distribution Line	0.105
Total		21.785

Except for the irrigation canal, and water supply sources lying under the inundation, the rest of the other infrastructures need rerouting above the reservoir inundation zone. The irrigation canals, as all the land irrigated by these canals fall below the reservoir levels, do not require rerouting. The water supply sources (the spring sources) also could not be relocated, however, provisions for alternative sources are made under the community's initiative support program.

The suspension bridges, the critical transport infrastructure across Seti, will have to be relocated at appropriate places close to the present suspension bridge locations. The span of the reservoir across Seti at many places is narrower than 300m. Suspension bridges of over 370m span have been built and operational in Nepal. It is therefore, proposed to relocate the existing suspension bridges by the longer suspension bridges in the nearby areas.

Table 3 presents the cost estimations for the rerouting and relocation of the existing infrastructures affected by the reservoir.

Table 3: Cost Estimates for the Replacement of Infrastructures Affected by the Reservoir

S.N.	Type of Infrastructures (FSL 415 m)	Million NRs.
1.	Motorable road	6.125
2.	Motorable Bridge and Suspension bridge	77.7
3.	Foot trails	1.5
4.	Electricity Distribution Line	0.175
Total		85.5

The above allocated amount shall be expedited to the local community for the restoration of the affected infrastructure by contracting out such construction work to the local community groups as much as possible. This can be helpful to increase the income of these people, to some extent.

(2) Community's Initiatives Support Program

The project area people have many expectations from the project. The expressions in the focus group discussions and stakeholder meetings reflect the desire of the local people from the project. It is not possible for the project alone to fulfill the people's aspiration of development. However, the project can provide some assistance to meet their development needs on priority basis. Community's initiative support program is designed as a financial assistance program to the project affected communities of the 7 project affected VDCs of the Reservoir area namely, Bhimad, Majkot, Rising Ranipokhari, Chhang, Kotdurbar, Jamune, Kahun Shivapur and Vyas Municipality.

This program has allocated some development funds to each of the affected VDCs. The VDCs will use this fund for the development of the affected wards. The affected ward communities will select development programs of their requirement and can use the allocated funds for the selected programs in condition that the affected VDCs or wards can contribute to about 25% of the estimated cost (in cash or in kind) of the selected program. From this financial assistance, large development works may not be possible, but will certainly help in executing a numbers of medium and small scale community infrastructure development programs such as, motor road, school buildings, water supply schemes, foot trail development, irrigation systems, posts etc. It is also expected that the contribution from the affected VDCs or wards or communities will enhance a sense of ownership for the program. The allocated cost for this program is presented in Table 4.

Table 4: Allocated Costs for Community's Initiative Support Program

S.N.	Program VDCs/Municipality (FSL 415 m)	Million NRs.
1	Bhimad	2.61
2	Majkot	4.69
3	Chhang	8.08
4	Rising Ranipokhari	8.34
5	Kotdurbar	8.34
6	Jamune	8.34
7	Kahun Shivapur	8.60
8	Vyas	3.13
Total		52.13

Note: Basis of cost allocation is Lump sum from the experience of Middle Marsyangdi Hydropower Project

(3) Skill Enhancement and Employment Program

Hydropower construction project requires a large pool of workers skilled, semi-skilled and labor force. Focus group discussion meetings as well as local stakeholder meetings clearly reflect the employment expectations of the people from the project.

To provide job opportunity to the local people in the project, by itself is a mitigation measure to lessen diverse types of social, cultural and other public health risks. Besides, this is a key income restoration

option that a project could possibly provide to the local communities. Experiences of the completed and ongoing projects shows very low employment of the local area people in skilful jobs. Only opportunity availed to the local people from the project is expected to be the labor work. In the existing social set up labor work in front of their kith and kin is below dignity option. Besides, local agriculture labor rates are higher than the district rates, and most of the local does not prefer to join the labor jobs unless no options are available for livelihood.

Hence to provide better jobs, skill enhancement suited to project construction works from the local interested and eligible people particularly from the poor, destitute, and disadvantaged communities is a necessity for higher local employment in the project. Experiences of the project skill trainings reveals that the trainee could not get a job in the project on the pretext that the training is not up to the standard for project works. It is therefore, the quality of the training should meet the requirement for the project employment. The training shall also provide certification on level of training taken and quality of trainee performance in the training tests. Such type of training, will take a bit long time, however, will provide life long skills which could be used in other locations or could be adopted as skill for self-employment.

Besides, there are many peoples in the area who have working skills but due to lack of certificates, or accreditation from recognized institutions are not getting jobs of their potentials. A pre-project survey of the people's skills and testing of skills, certification and accreditation of skills will also help getting project employment.

To accommodate the trainees in the project works, trainings should be carried as early as possible before the start of the construction works. Only public notification on newspaper is not sufficient for the motivation of the people for trainings. Besides, tiffin should be given to these people during the training periods, because many of the poor, destitute or disadvantaged people could not afford living expenses during the training.

Specific articulation of the contractual clauses is also required in the contract document, such that the trainee have maximum chances of fetching skill and semi-skill jobs in the project.

The allocated cost for skill enhancement and employment program is indicated below in Table 5.

Table 5: Allocated Costs for Skill Enhancement and Employment Program

S.N.	Training Programs (FSL 415 m)	Million NRs.
1	Carpentry	0.71
2	Masons	0.71
3	Vehicle Driving	1.52
4	Plumbing	1.52
5	Electrical Wiring	1.52
6	Welding	2.54
7	Automobile maintenance	1.62
Total		10.14

Note: Basis of cost allocation is Lump sum from the experience of Middle Marsyangdi Hydropower Project

(4) Agricultural Development Program

The reservoir area inundates a large expanse of agricultural land. The loss of agriculture productivity has a direct implication on the livelihood and quality of life of the people impacted directly or indirectly. Rural agricultural jobs are based on the availability of the land for agriculture. Loss of agricultural land, will also impact people who work on the land. To supplement the loss of productivity as well as the loss of rural employment on agricultural land, it is essential to enhance the capabilities of the people on the agricultural front. This could be done by providing training to people regarding the new methods of agricultural enhancement. Horticulture and herbal farming practices could enhance the income level of the people significantly.

Site specific agricultural development, horticulture development or herbal farming program shall be decided upon detail consultation with the local area people and assessment of agricultural, horticulture and herbal production potentials. Besides, it shall explore various options of production increment by the distribution of improved seeds, alternative crops, improved livestock, improved fodder production, vegetable cultivation etc.

The project affected areas are close to the market centers or have access to the market centers such as Pokhara and Kathmandu. Promotion of Rural-Urban Partnership Program as promoted by UNDP in many districts in Nepal, to create market linkage between the towns and rural hinterlands will be of utmost significance in the project area context. Constitution of community based, co-operative type micro-enterprise groups at local levels will be helpful to organize collection depots of local agricultural, horticultural, and herbal produces and arrange for marketing at the Bhimad, Damauli or in Pokhara and Kathmandu. Coordination of the agricultural development program including horticultural and herbal production particularly in Majkot, Rising Ranipokhari, Jamune, Chhang, Kotdurbar, Kahun Shivapur hinterlands with Rural-Urban Partnership Program shall open venues of sustainable agricultural development and income generation in the rural areas. In the context of the all weather road up to Rising Patan and programs of extension of the access road deep into hinterland, it provides needed infrastructure for such rural urban market linkages.

Since the details of agricultural/horticultural/herbal development programs shall be worked out only after consultations with the communities, only cost allocations have been proposed (Table 6). It is understood that these allocated costs will not be exceeded by the program designers while preparing the detailed agricultural/horticultural/herbal development programs in respective areas.

Table 6: Allocated Costs for Agricultural Development Programs

S.N.	Programs (FSL 415 m)	Million NRs.
1	Agriculture Development (trainings, improved seeds etc.)	5.50
2	Vegetable farming (trainings, improved seeds etc)	2.75
3	Horticulture development (trainings, distribution of saplings etc.)	11.00
4	Herbal farming (training, distribution of seeds, processing etc.)	8.25
Total		27.51

Note: Basis of cost allocation is Lump sum from the experience of Middle Marsyangdi Hydropower Project



(5) Community/Public Health and Education Enhancement

This program shall focus on two areas, one near the construction site and the other in the close vicinity of the reservoir affected VDCs.

In the construction sites, influx of the outside workers, their families and shopkeepers including hotel and restaurant owners, consumable item dealers, vegetable grocers etc. not only put pressure on the existing institutions such as schools, health care centers, telecommunications but also create burden on the existing water supply and sanitation conditions. Experience in the construction camps and labor camps of the development projects, reveals a general decline in the sanitary conditions with implications on the community/public health of the area.

Considering the likelihood of the impact, targeted support programs on public health, sanitation, water supply, health and education institutions are proposed at Benitar, Huksetar, Jhaputar, Betini and Beltar areas.

The program will focus on support for adequate schooling accommodations at Beltar, and Benipatan. Sanitation facilities such as water supply taps, toilets and waste management shall be planned based on the perceived influx of outsiders. A health clinic facility manned by a Medical Doctor shall be established at Benipatan, Betini and Jhaputar on rotational basis during construction phase. Besides, a preventative health program shall be designed and implemented. Education on environmental sanitation and water will be part of the program to prevent fecal-borne diseases such as cholera and other gastro-intestinal diseases from becoming a problem in the construction areas. A focused program on public awareness and education on HIV-AIDS and prevention shall be launched to avoid or minimize the impacts of communicable disease. Malaria is a likely health issue due to influx of population and poor wastewater management and shall be addressed through proper education on sanitation, water management, and other appropriate measures to control and prevent Malaria vectors.

In the reservoir affected VDCs, a special education enhancement and health support service programs shall be launched. These programs will basically focus on the software components of education and health with some support on the facilities and infrastructures.

Although the details of the program sub-components will be designed at the later stage during Detail Design Phase, tentative estimations of the costs have been made considering the present level of understanding of the project activities and the project impact areas. Table 7 and 8 itemized the allocation of funds for the proposed program sub-components.

Table 7: Allocated Costs for Community/Public Health and Education Enhancement Programs at the Project Construction Sites

S.N.	Program sub-components	Million NRs.
1.	Extension and improvements of water supply systems and taps, construction of public toilets and waste management systems in the boom towns at Beteni, Benipatan, Huksetar, Jhaputar, Beltar	2.90
2.	Support to educational institutions at Benipatan, and Beltar to cater the additional school going children (room space, teacher, etc.)	3.38
3.	Rotational clinical facility manned with a medical doctor during construction phase at Beteni, Benipatan, Huksetar, Jhaputar, Beltar	1.93
4.	Education and prevention programs on environmental sanitation, water related disease, STD, HIV/AIDS, and malaria at the construction camps, labor camps, boom towns and settlements close to project camp sites	1.45
Total		9.66

Note: Basis of cost allocation is Lump sum from the experience of Middle Marsyangdi Hydropower Project

Table 8: Allocated Costs for Community/Public Health and Education Enhancement Programs at the Reservoir Affected VDCs/Municipality

S.N.	Program VDCs/Municipality	Million NRs.
1	Bhimad	0.31
2	Majkot	0.56
3	Chhang	0.97
4	Rising Ranipokhari	1.00
5	Kotdurbar	1.00
6	Jamune	1.00
7	Kahun Shivapur	1.03
8	Vyas	0.38
Total		6.27

Note: Basis of cost allocation is Lump sum from the experience of Middle Marsyangdi Hydropower Project

(6) Women Development Program

The focus group discussions only involving women of the project affected area, reveals their status in the society. Most of them have only primary education; have very limited rights on the property, majority depends upon the male counterpart for decision making and above all have the highest burden of work load such as household and agricultural work. Their participation in the community development or in any social organization is very minimal. Livelihood skills are limited to agriculture and household requirements. Although they represent more than half of the population in the project area, their social status generally remains low.

Although girl trafficking is not noted as a serious problem in the area at present, high mobility of the outsiders even in the hinterlands during the construction period, is likely to raise such issues. Ignorance to sexual health among the women of the project area is likely to expose them with the STD, HIV and AIDS. There is a great need of family health and sexual health education to the women in the project affected area.

A specially designed women development program is designed to enhance their quality of life. It includes income generation skills including micro-credit funds, health education and awareness program on STD, HIV and AIDS, family planning and girl trafficking and so on. The programs shall

be launched in the 7 VDCs and one municipality of the reservoir affected area as a part of women development program.

Details of the programs will be designed in the detailed design phase through consultation with the APs, affected communities, District Women Development Office and other stakeholders. However, tentative costs for the women development programs are presented in Table 9.

Table 9: Allocated Costs for Women Development Program

S.N.	Program VDCs/Municipality	Million NRs.
1.	Bhimad	0.65
2.	Majkot	1.17
3.	Chhang	2.02
4.	Rising Ranipokhari	2.08
5.	Kotdurbar	2.08
6.	Jamune	2.08
7.	Kahun Shivapur	2.15
8.	Vyas	0.78
Total		13.03

Note: Basis of cost allocation is Lump sum from the experience of Middle Marsyangdi Hydropower Project

(7) Community-based Watershed Management

The reservoir life depends upon the sedimentation rate in the reservoir. As elaborated in physical environmental section, the area close to the reservoir has a higher potential of high sediment volume contribution to the reservoir. Centrally operated watershed management programs, at times, are not effective to control the rate of sediment flow into the reservoir. It is therefore, a separate program of community based watershed management program is proposed for the 7 VDCs and one municipality affected by the reservoir.

The program shall be launched and managed by the communities located close to the reservoir even in the affected VDCs. Technical support to the program shall be provided by the team of watershed management experts to the communities. Program details will be worked out by the technical experts in the detail design phase. However, the main components of such programs will include afforestation in the community degraded lands, bio-engineering works for erosion control, surface drainage management works in active landslide areas, stream training works to control stream erosion and to arrest the stream sediment loads etc. Table 10 presents the estimated amount for the community based watershed management programs.²

² For the afforestation in the risk zones, i.e., 10 m high from the reservoir, the cost has been estimated separately (See Part B). Besides that, the preventive measures for the erosion and the slope failure in Bhimad Bazaar will be estimated separately as the civil engineering work.

Table 10: Cost Estimates for the Watershed Management Programs

S.N.	Program VDCs/Municipality	Million NRs.
1.	Bhimad	0.62
2.	Majkot	1.11
3.	Chhang	1.91
4.	Rising Ranipokhari	1.97
5.	Kotdurbar	1.97
6.	Jamune	1.97
7.	Kahun Shivapur	2.03
8.	Vyas	0.74
Total		12.31

Note: Basis of cost allocation is Lump sum from the experience of Middle Marsyangdi Hydropower Project

(8) Rural Electrification

Rural electrification is one of the strong demands of the local area people of the project area. During the stakeholders meetings held in Damauli in June and December 2006 and May 2007, a number of local people in affected VDCs articulated that the project should carry out rural electrification program. Many parts of Bhimad, Rising Ranipokhari, Majkot, Chhang, Jamune, Kahun Shivapur and Bhimad are connected to electricity. Meanwhile, Kotdurbar VDC is yet to be connected to electricity. Even in the VDCs, which are connected to electricity, the distribution lines are yet to cover the entire households of the VDCs. As this project is a hydroelectric project, it is high expectation and demand that the project should at least meet their electricity connection needs. It is therefore proposed to connect the unconnected parts of the project directly affected VDCs to the National Electricity Grid as one of the development gesture of the project. Table 11 presents the allocated costs for Rural Electrification of these areas.

Table 11: Cost Estimates for the Rural Electrification Programs

S.N.	Program VDCs/Municipality	Million NRs.
1.	Bhimad	0.98
2.	Majkot	1.76
3.	Chhang	3.03
4.	Rising Ranipokhari	3.13
5.	Kotdurbar	3.13
6.	Jamune	3.13
7.	Kahun Shivapur	3.23
8.	Vyas	1.17
Total		19.55

Note: Basis of cost allocation is Lump sum from the experience of Middle Marsyangdi Hydropower Project

4 Information Dissemination and Feedback

Timely and proper dissemination of information by responsible authority through various means including media is an essential part of the project implementation and operation strategy. No information or misinformation, sometimes, creates problems in the project execution. To avoid such

gaps and to strengthen the project planning and execution, two-way feedback between the project and concerned stakeholders, it is proposed to institute information dissemination and feedback program as a part of the social program.

This program shall include, besides, establishment of public information centre at the project site, dissemination of information through Local FM stations. It shall also include stakeholders meeting programs within the project area on regular basis. Allocated costs for information dissemination and feedback are included in the administrative and management costs in Environmental Management Plan.

5 Further Social Program Design

The social programs listed in section above are generalized Program of Activities. Tentative cost allocations are made to ensure the allocation of necessary costs in the project. However, the project in its detail design phase should restructure the programs in detail through extensive public consultations and field visits. Experiences of the similar hydroelectric projects revealed that such consultations are essential to implement the rehabilitation programs effectively. Since there are a great diversity of communities within the affected VDCs/municipality in terms of the ethnic, caste and culture, the current living standard, the depth of impacts, and the felt needs, it is not so easy in the practice for the project to meet various needs of the local people.

It is, therefore, recommended that the project closely coordinate with not only DDC, affected VDCs/Municipality and other government agencies but also INGOs/NGOs and CBOs working in the affected VDCs/municipality and having the grass-root level network. There are a number of INGOs/NGOs, and CBOs in the Vyas, Bhimad, Chhang, Rising Patan and Kahun Shivapur VDCs, which have had experience of planning and executing the social programs in these areas. As local level NGOs and CBOs play a greater role in social mobilization, their participation in the project implementation is definitely envisaged to remove social bottlenecks, which at times, are crucial in the project management³.

In the detail design phase, it is also recommended to mobilize the NGOs and CBOs working in the area to design social programs, as to the concepts presented, within the allocated budget framework.

6 Social Program Administration

The project itself will be responsible for planning and implementing the Social Action Plan. In this context, the Project Management Office (PMO) shall be responsible for the implementation of the

³ There are a number of NGOs/CBOs working with different objectives in Nepal. When selecting NGOs/CBOs as suitable partners that are expected to facilitate affected communities in development activities, it is necessary to consult with local stakeholders such as DDC, representatives of affected VDCs and affected communities in advance and set the clear selection criteria to ensure more transparency of the selection process.

Social Action Plan Programs. Since Environment and Social Studies Department of NEA is short of manpower and resources, project specific offices are executing such social programs in the ongoing projects. It is therefore, the same model of social program administration is also proposed for the project.

A separate Environmental and Social Management Unit (ESMU) under the Project Director of the PMO is proposed. All the logistics required for ESMU will be provided by the Project. There will be a full time staff delegated from NEA heading the unit supported by consultants. A full time Socio-economist/Community Liaison Expert and a Community Development Expert are proposed as outside consultants. These experts will work with local development NGOs and CBOs contracted to assist in implementing SAP components.

Internal monitoring of SAP shall be carried out by the ESMU. An independent external monitoring and evaluation is proposed for the project to fulfill the requirements of funding donor agency. Monitoring and evaluation by external independent agency is envisaged to help assess SAP implementation and reorient the SAP, if so needed.

In accordance with the peace keeping process in the nation, the expected role of DDC and VDCs will be much more important than ever before. If the local election is completed by the time when the project is launched, it is important to coordinate with newly selected DDC members, VDC chairpersons and the mayor, and implement SAP in affected VDCs/municipality effectively and efficiently.

7 Cost Summary for SAP

The cost estimates for the proposed social programs are summarized below in Table 12.

Table 12: Cost Summary for SAP

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

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

Appendix H





नेपाल सरकार
जलस्रोत विकास मन्त्रालय

विद्युत विकास विभाग

(.....)

फोन नं. ४८७९२४७, ४४८०२९८
४८७९५०७, ४४८०३२६
४८८०४२५, ४८८२९३०
४८६९६४३, ४४८९६९४
४८७६९९०, ४४७९९२९
फ्याक्स (९७७-१)-४४८०२५७
पोष्ट बक्स नं. २५०७
थापागाउँ, अनामनगर
काठमाडौं, नेपाल
मिति: २०६६/१०/२१

त्र संख्या :- १६४५

विषय:- माथिल्लो सेती (दमौली) जलाशयुक्त ज.वि.आ.को विद्युत
उत्पादनको सर्वेक्षण अनुमतिपत्रको म्याद थप तथा संशोधन बारे ।

श्री नेपाल विद्युत प्राधिकरण
दरबारमार्ग, काठमाडौं ।

उपरोक्त विषयको तहांको दरखास्त उपर कारवाही हुंदा नेपाल सरकार, जलस्रोत मन्त्रालय (सचिवालय) को मिति २०६६/०९/२५ को निर्णय अनुसार उक्त आयोजनाको विद्युत उत्पादनको सर्वेक्षण अनुमतिपत्रको म्याद २०६६/११/२३ सम्म थप भई अनुमतिपत्रको प्रकरण (३) मा उल्लेख भएको जडित क्षमता "१२२००० किलोवाट" संशोधन भई "१२७००० किलोवाट" कायम भएको व्यहोरा निर्देशानुसार अनुरोध छ । साथै विद्युत उत्पादनको सर्वेक्षण अनुमतिपत्रको म्यादभित्रै विद्युत उत्पादनको लागि दरखास्त पेश गर्न समेत सचेत गराउन निर्णय भएको व्यहोरा निर्देशानुसार जानकारी गराइन्छ ।

(श्याम किशोर यादव)
सि.डि.ई.

बोधार्थ:

- श्री जलस्रोत मन्त्रालय, सिंहदरबार ।
- श्री विद्युत विकास विभाग
 - आयोजना अध्ययन महाशाखा, अनामनगर ।
 - निरीक्षण महाशाखा, अनामनगर ।
 - आर्थिक प्रशासन शाखा, अनामनगर ।
- श्री जिल्ला जलस्रोत समिति, तनहुँ ।

नेपाल सरकार
जलस्रोत विकास मन्त्रालय
काठमाडौं
मिति २०६६/१०/२१

श्री जलस्रोत विकास विभाग (अध्ययन विभाग)

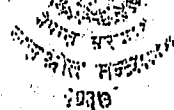
२१/१३





नेपाल सरकार

जलस्रोत मन्त्रालय



मिति - ८/२२
४२११५१६/४२११५०४
४२११५३०/४२११५०५

फ्याक्स: ९७७-१-४२११५१०
E-mail: mowr@most.gov.np
सिंहदरवार, काठमाडौं ।

मिति: २०६१/१२/२०

प.स: ०६४/६६
च.न: ४२

विषय: बुढीगण्डकी र माथिल्लो सेती आयोजनाको विकास-निर्माण गर्ने

→ श्री कार्यकारी निर्देशक,
नेपाल विद्युत प्राधिकरण,
केन्द्रीय कार्यालय, काठमाडौं ।

२४/२०६
मिति: २०६१/१२/२०

६०० मेगावाट क्षमताको बुढीगण्डकी जलाशययुक्त आयोजना तत्कालीन नेपाल सरकार (मन्त्रिपरिषद्) को निर्णयानुसार प्रतिस्पर्धाको माध्यमद्वारा विकास गर्ने निर्णय भएको र सोही अनुसार दुई पटक खुला प्रतिस्पर्धा गर्दा पनि प्रबर्द्धकहरू नआएको हुनाले उक्त आयोजना नेपाल विद्युत प्राधिकरणलाई उपयुक्त साभेदारसँग मिली विकास निर्माण गर्न सैद्धान्तिक सहमति दिने गरी नेपाल सरकार (मन्त्रिपरिषद्) बाट मिति २०६१/१२/१९ मा निर्णय भएकाले सोही अनुसार कार्यान्वयनको व्यवस्था मिलाउन जानकारी गराउँछु ।

साथै १२७ मेगावाट क्षमताको माथिल्लो सेती जलाशययुक्त आयोजनाको प्रबर्द्धन गर्ने सिलसिलामा "नेपाल विद्युत प्राधिकरणसँग अनुमतिपत्र रहेको उक्त आयोजना उपयुक्त साभेदारसँग मिली शीघ्र निर्माणमा लैजाने" गरी मन्त्रिपरिषद्को मिति २०६१/१२/१९ को निर्णय भएकाले सो निर्णयको कार्यान्वयन गर्न पनि जानकारी गराइन्छ ।

उक्त दुवै विषय कार्यान्वयनका प्रगति समय-समयमा यस मन्त्रालयलाई जानकारी गराउन हुन समेत सूचित गरिन्छ ।

सादर अवगतार्थ
माननीय जलस्रोत मन्त्रीज्यू ।

बोधार्थ:
विद्युत विकास विभाग,
काठमाडौं ।

(शंकर प्रसाद कोइराला)
सचिव

श्री दुखाने, प्रकाश
उपा.को.
५/२१
२०६१/१२/२०
५/२१

३६५ ०४३३१२२
२०६१/१२/२०
२०६१/१२/२०
२०६१/१२/२०



नेपाल सरकार
जलस्रोत मन्त्रालय

वातावरण तथा सामाजिक अध्ययन विभाग
दर्ता नं. २०९
दर्ता मिति ०६०८/०८/१०
फोन नं.

४४७९२४७
४४८०२१८
४४७९५०७
४४८०३२६
४४८०४२५
४४८२१३०
४४६१६४३
४४८१६१४
४४७६१९०
४४७९९२१

विद्युत विकास विभाग

इन्जिनियरिङ रोजना

दर्ता नं. १२५
मिति: ०६५/११/२३

आयोजना विकास विभाग

०६०

०६५/११/२३

पत्र संख्या :-
११६

विषय:- माथिल्लो सेती जलविद्युत आयोजनाको विद्युत उत्पादनको सर्वेक्षण अनुमतिपत्रको म्याद थप बारे ।

फ्याक्स (२७७-१)-४४८०२५७

पोष्ट बक्स नं. २५०७

थापागाउँ, अनामनगर

काठमाडौं, नेपाल

मिति: २०६५/११/१६

श्री नेपाल विद्युत प्राधिकरण,
दरबारमार्ग, काठमाण्डौ ।

नेपाल विद्युत प्राधिकरण

गो.द.नं. ४२४

मिति: २०६५/११/१९

उपरोक्त सम्बन्धमा तहान्ने दिनु भएको निवेदनमाथी कारबाही हुंदा मिति २०६५/११/१४ को नेपाल सरकार, जलस्रोत मन्त्रालय (सचिव स्तर) को निर्णयानुसार माथिल्लो सेती जलविद्युत आयोजनाको विद्युत उत्पादनको सर्वेक्षण अनुमतिपत्र (बि.बि.बि. ०६१/६२ बि.उ.स. ०१६९)को म्याद मिति २०६५/११/२३ सम्म थप भएको व्यहोरा अनुरोध छ ।

बोधार्थ:

१. श्री जलस्रोत मन्त्रालय, सिंहदरवार ।
२. श्री आयोजना अध्ययन महाशाखा, विद्युत विकास विभाग ।
३. श्री निरीक्षण महाशाखा, विद्युत विकास विभाग ।
४. श्री आर्थिक प्रसासन शाखा, विद्युत विकास विभाग ।
५. श्री जिल्ला जलस्रोत समिति, तनहु ।

(शिव प्रसाद उप्रेती)

सि.डि.ई.

आयोजना विकास विभाग
श्री वातावरण तथा सामाजिक अध्ययन विभाग
श्री साटो, दुहा तथा कंकिट प्रयोगशाला
श्री तालिम केन्द्र विभाग
श्री माथिल्लो तामाकोशी ज.वि.आ.
श्री प्रशासन/श्री सेवा
इ.पे.डि महाशाखा
१. शत को गर्ने २. पैसा गर्ने ३. छलफल गर्ने
४. परिपत्र गर्ने ५.
मिति: २०६५/११/२३

गर्जना प्रमुख, बि.प्रा.स.	श्री उप-कार्यकारी निर्देशक, अर्थ
महा-प्रमुख, विद्युतकरण	श्री उप-कार्यकारी निर्देशक, प्रशासन
महा-प्रमुख, उत्पादन	श्री उप-कार्यकारी निर्देशक, आन्तरिक सेवा परिषद
श्री महा-प्रमुख, प्रसारण तथा प्रणाली संचालन	श्री परियोजना प्रमुख, मध्यमवर्त्याइन्दी ज.वि.परियोजना
श्री महा-प्रमुख, इन्जिनियरिङ सेवा	श्री निर्देशक, सचिवालय
श्री उप-कार्यकारी निर्देशक, योजना, अनुगमन तथा सूचना प्रविधि श्री	
१. शत को गर्ने २. पैसा गर्ने ३. छलफल गर्ने ४. परिपत्र गर्ने	सही मिति

प्राप्त वातावरण विभाग
११/११/२३
४/२६

कम क २/१३
ल १०





श्री ५६औं सरकार
जलस्रोत मन्त्रालय

विद्युत उत्पादनको सर्वेक्षण अनुमतिपत्र

अनुमतिपत्र संख्या : वि.वि.वि./०६१/६२ वि.उ.स./०१६१

श्री कार्यकारी निर्देशक,
नेपाल विद्युत प्राधिकरण,
दरबार मार्ग, काठमाडौं।

महाशय,

विद्युत उत्पादनको सर्वेक्षणको लागि अनुमतिपत्र पाउन मिति २०६१/०५/१५ मा दिनु भएको दरखास्त अनुसार वेहायको विवरण खोली विद्युत ऐन, २०४९ को दफा ४ को उपदफा (२) र विद्युत नियमावली, २०५० को नियम ८ बमोजिम यो अनुमतिपत्र प्रदान गरिएको छ।

१. विद्युत उत्पादनको सर्वेक्षण गर्न चाहने व्यक्ति वा संगठित संस्थाको पूरा नाम र ठेगाना :-
श्री नेपाल विद्युत प्राधिकरण
दरबार मार्ग, काठमाडौं।

२. उत्पादनको सर्वेक्षण गरिने विद्युतको किसिम : जलविद्युत।

३. जलविद्युत उत्पादनको लागि सर्वेक्षण गरिने जलस्रोतको नाम : सेती नदी।
(गण्डकी अञ्चल, तनहुँ जिल्लामा अवस्थित सेती नदीमा पडिबान भएको १,२२,००० किलोवाट क्षमताको माथिल्लो सेती जलाशययुक्त जलविद्युत आयोजना)।

४. सर्वेक्षण गर्ने क्षेत्र :-

क) अञ्चल	गण्डकी
ख) जिल्ला	तनहुँ
ग) गा.वि.स./नगरपालिका	ब्यास नगरपालिका
घ) पूर्व	८४° १७' ३०" पू
उत्तर	२८° २०' ३०" उ

पश्चिम	८४° ०२' ३०" पू
दक्षिण	२७° ५४' ००" उ

५. सर्वेक्षणको प्रकृति :-

वित्तुत सम्भाव्यता अध्ययन तथा वातावरणीय प्रभाव मूल्यांकन अध्ययन।

६. अनुमतिपत्र बहाल रहने अवधि :-

मिति : २०६१/११/२४ देखि २०६३/११/२३ सम्म

क्रमशः



नेपाल सरकार
जलस्रोत मन्त्रालय
निर्देशक, काठमाडौं

७. अन्य गतिवृत्तः

- क) त्यस संस्थाको विद्युत विकास विभाग समक्ष मिति २०६१/०१/११ मा पेश गरेको आयोजना सम्बन्धी कार्य तालिका अनुसार अनुमतिपत्रको प्रकरण ६ मा उल्लेखित अवधि भित्र सम्पन्न गर्नुपर्ने आवश्यक अध्ययन कार्यहरू पूरा गरी यस विभागमा जम्मेखनीय प्रगति सहितको गुणात्मक प्रतिवेदन तथा कार्य, प्रगति विवरणहरू सन्तोषजनक रूपमा पेश गरेको अवस्थामा साव बौकी रहेका अध्ययन कार्यहरू सम्पन्न गर्न विद्युत ऐन, २०४९ तथा विद्युत नियमावली, २०५० बमोजिम नबिकरणको लागि दरखास्त पेश गरेमा यस अनुमतिपत्रको नबिकरण गर्न सकिने छ।
- ख) धी ५ को सरकारबाट जल विद्युत आयोजनाहरूको अध्ययन कार्य गर्दा अपनाउनु पर्ने प्रक्रिया बारे तयार गरिएको "Guidelines for study of Hydropower Project, December, 2003" बमोजिम आयोजनाको अध्ययन कार्य गरी परिमार्जित प्रतिवेदन पेश गर्नु पर्नेछ।
- ग) वातावरण सम्बन्धी अध्ययन वातावरण संरक्षण ऐन, २०५३ तथा वातावरण संरक्षण नियमावली, २०५४ (पहिलो संशोधन, २०५४ सहित) र अन्य वातावरण सम्बन्धी प्रचलित कानूनी प्रावधानहरू अनुसार गर्नु पर्नेछ।
- घ) विद्युत नियमावली, २०५० को नियम २१ बमोजिम सर्वेक्षणको कार्य ३ महिना भित्र शुरू गरी सूचारु रूपले सञ्चालन गर्नु पर्नेछ र कार्य प्रगति विवरण प्रत्येक ६/६ महिनामा विद्युत विकास विभागलाई दिनु पर्नेछ। साथै अध्ययन कार्यको निरन्तर अनुगमन गर्नुका लागि आवश्यक विवरणहरू प्रत्येक ३/३ महिनामा विद्युत विकास विभागलाई उपलब्ध गराउनु पर्नेछ।
- ङ) यस अनुमतिद्वारा सर्वेक्षण गर्न अनुमतिपत्र दिइएको आयोजनाको निसर्ग गर्नु खाहेमा विद्युत नियमावली २०५० को नियम १९ बमोजिम यस सर्वेक्षण अनुमतिपत्रको म्यादभित्र नियम १२ बमोजिमको विवरणहरू खलाई विद्युत उत्पादनको अनुमतिपत्रको लागि दरखास्त दिनु पर्नेछ।
- च) सर्वेक्षण कार्य गरिने स्थानको मोटामोटी नक्सा संलग्न अनुसूची १ बमोजिम हुनेछ।
- छ) त्यस संस्थाको स्वासित्वको संरचनामा कुनै हेरफेर वा परिवर्तन आएमा सो को जानकारी विद्युत विकास विभागलाई दिनु पर्नेछ।
- ज) यस अनुमतिपत्रमा कुनै संशोधन गर्नु परेमा जलस्रोत मन्त्रालय र त्यस संस्थाको आपसी सहमतिमा गर्न सकिने छ।

अनुमतिपत्र दिने अधिकारीको

सही

मिति २०६१/११/२४

नाम महेश नाथ अमाव

पद सचिव

जलस्रोत मन्त्रालय

अनुमतिपत्र संख्या : वि.वि.वि./०६१/४२ वि.उ.स./०१६९



नेपाल
श्री-५ को सरकार
जलस्रोत मन्त्रालय
विद्युत विकास विभाग
(.....विद्युत विकास विभाग.....)
२०५०

फोन नं.:

४४७९२४७
४४८०२१८
४४७९५०७
४४८०३२६
४४८०४२५
४४८०२१३०
४४६९६४३
४४८१६१४
४४७६१९०
४४७९६२१

पत्र संख्या:-

११९६

गणकत (१७७-१)-४४८०२२७

गोष्ट वकस नं. २५०७

आपागाउँ, अनामनगर

काठमाडौं, नेपाल ।

मिति: २०६३।१।७

विषय:- माथिल्लो सेती जलविद्युत आयोजनाको विद्युत उत्पादनको सर्वेक्षण
अनुमतीपत्रको संसोधन संबन्धमा ।

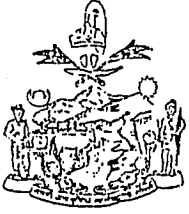
श्री नेपाल विद्युत प्राधिकरण,
दरबारमार्ग, काठमाण्डौ ।

उपरोक्त सम्बन्धमा त्यस कार्यालयको मिति २०६२।१०।२ च.न.६७ को पत्र प्राप्त भई व्यहोरा
अबगत भयो । तत्सम्बन्धमा कार्बाही अगाडी बढाउदा श्री ५ को सरकारको मिति २०६३।२।२
को निर्णयानुसार माथिल्लो सेती जलविद्युत आयोजनाको विद्युत उत्पादनको सर्वेक्षण अनुमतीपत्रको
प्रकरण ४ को सर्वेक्षण गर्ने क्षेत्रमा तनहु जिल्ला अन्तर्गत व्यास नगरपालीका मात्र रहेकोमा
सोही जिल्लाको भिमाद, पोखरी भञ्ज्याङ्ग, कोट दरवार, काहु शिवपुर, वृषिङ रानी पोखरी,
माझकोट, जामुने तथा दाङ गा.वि.स.हरु समेत समाबेस गरिएको व्यहोरा अनुरोध छ ।

(Signature)

(शिव प्रसाद उप्रेती)
सि.डि.ई.





श्री ५ को सस्कार
जलस्रोत मन्त्रालय
विद्युत विकास विभाग
(.....२०५०.....)

फोन नं.:

४४७९२४१
४४८०२१८
४४७९५०१
४४८०३२१
४४८०४२५
४४८२१३०
४४६१६४
४४८१६१४
४४७६१९१
४४७९९२१

पत्र संख्या:-

१.५.९६०

प्याक्स (९७७-१)-४४८०२५७

पोष्ट बक्स नं. २५०७

थापागाउँ, अनामनगर

काठमाडौं, नेपाल ।

२०६११२१५

मिति:

विषय:- माथिल्लो सेती जलाशययुक्त जलविद्युत आयोजनाको विद्युत उत्पादनको सर्वेक्षणको अनुमतिपत्र बारेमा ।

श्री कार्यकारी निर्देशक,
नेपाल विद्युत प्राधिकरण,
दरबार मार्ग, काठमाडौं ।

उपरोक्त सम्बन्धमा तहांले गण्डकी अञ्चल, तनहु जिल्ला, सेती नदीमा पहिचान भएको १,२२,००० कि.वा. क्षमताको माथिल्लो सेती जलाशययुक्त जलविद्युत आयोजनाको विद्युत उत्पादनको सर्वेक्षण अनुमती प्राप्त गर्न मिति २०६११०१७ मा दिनु भएको दरखास्त अनुसार श्री ५ को सरकार (सचिवस्तर) को मिति २०६११११२४ को निर्णयानुसार विद्युत ऐन, २०४९ को दफा ४ को उपदफा (२) र विद्युत नियमावली, २०५० को नियम बमोजिम प्रदान गरिएको विद्युत उत्पादनको सर्वेक्षण अनुमतीपत्र निर्देशानुसार पठाइएको व्यहोरा अनुरोध छ ।

संलग्न: विद्युत उत्पादनको सर्वेक्षण अनुमतीपत्रको (वि.वि.वि. ०६११६२ वि.उ.स. ०१६९) को सक्कल थान १ (एक) यसै साथ संलग्न छ ।

(राम गोपाल लागेजु)
इन्जिनियर

बोधार्थ:

१. जलस्रोत मन्त्रालय, सिंहदरबार ।
२. विद्युत विकास विभाग
आयोजना अध्ययन महाशाखा
निरिक्षण महाशाखा
३. श्री अध्यक्ष, जिल्ला जलस्रोत समिति, तनहुं ।

Appendix I



नेपाल विद्युत् प्राधिकरण

(श्री ५ को सरकारको स्वामित्व)

विकास

आयोजना तयारी तथा अध्ययन विभाग वातावरणीय प्रभाव मूल्यांकन अध्ययन बारे सार्वजनिक सूचना

प्रथमपटक प्रकाशित मिति २०५७/०१/२२

तनहुँ जिल्लामा पर्ने अग्नर सेती जलाशयसँग आयोजनाको संभाव्यता अध्ययन अन्तर्गत वातावरणीय प्रभाव मूल्यांकन (EIA) अध्ययन कार्य गर्ने सम्बन्धमा श्री ५ को सरकारद्वारा प्रकाशित वातावरण संरक्षण नियमावली २०५४ को दफा (४) बगोजिम निम्न क्षेत्रहरूमा के कस्तो प्रभाव पर्ने हो सो बारे क्षेत्र निर्धारण (Scoping) गर्नु पर्ने भएकोले आयोजना कार्यान्वयनबाट वातावरणमा पर्ने संनिने प्रभावको सम्बन्धमा यो सूचना प्रकाशित भएको मितिदेखि ३० दिन भित्र तलका ठेगानाहरूमा राख्न सुझाव पठाई सहयोग गरिदिनु हुन आयोजना क्षेत्रमा रहेका गा.वि.स., नगरपालिका, विद्यालय, अस्पताल, स्वास्थ्य चौकी, सरोकारवाला व्यक्ति तथा संघ-संस्थाहरूलाई अनुरोध गरिएको छ।

१. भौतिक वातावरण (Physical Environment)
२. जैविक वातावरण (Biotic Environment)
३. सामाजिक वातावरण (Socio-Cultural Environment)
४. आर्थिक-क्षेत्रगत प्रभाव (Economic Impact)

उक्त आयोजनाको संभाव्यता अध्ययन अनुसार मुख्य संरचनाहरूको निर्माण निम्न टाढाबाट हुने छन्।

तनहुँ जिल्ला:

बौध निर्माण स्थल: दागीसी नगरपालिका अन्तर्गत पर्ने गाउँहरू: बटेनी, हुमसेटार, पाटन र चिसपरे। काहु-शिवपुर गा.वि.स. अन्तर्गत पर्ने गाउँहरू: डाँटी, पातीधर, धारापानी र ग्यान्जा।
विद्युत् गा. निर्माण स्थल: काहु-शिवपुर गा.वि.स. अन्तर्गत पर्ने गाउँहरू: सगौडाडा, गालिङ्गे र बन्चरे।
खोखरी-भञ्ज्याङ्ग गा.वि.स. अन्तर्गत पर्ने गाउँहरू: शिगलखार, बेलबासे र शिगलचौर।
जलाशय फैलिने गा.वि.स.: काहु-शिवपुर गा.वि.स. अन्तर्गत पर्ने गाउँहरू: लोभमा र खानबुन।
कोटदरबार गा.वि.स. अन्तर्गत पर्ने गाउँहरू: बाभोगारा, हुकडी, चिलेकाण, गरडाडाँट, चाप र कोरटान।
राप्तीपोखरी गा.वि.स. अन्तर्गत पर्ने गाउँहरू: दुद्रुमा, बदरकुण्ड, जलोजे, जह्वापानी, शिजिपाटन, र गेरुवासाटार।
गुभाङकोट गा.वि.स. अन्तर्गत पर्ने गाउँहरू: खैरपाटन, साउने र जुमसाडी।
भिमाद गा.वि.स. अन्तर्गत पर्ने गाउँहरू: सनासाटार, नापटार, र चिसपरे।
भिमादखोर र गेरुवापानी गा.वि.स. अन्तर्गत पर्ने गाउँहरू: सगौडाडा, जलपाटन, जलजो, टार, भजवरा, चौमपान र चिसपरे।

सुझाव बुझ्नुपर्ने स्थान:

१. नेपाल विद्युत् प्राधिकरण, विकास
आयोजना तयारी तथा अध्ययन विभाग
प्रतापशयसँग आयोजनाहरूको छनौट तथा संभाव्यता अध्ययनको आयोजना,
दरबारमार्ग, काठमाडौं
फोन नं. २२५५९२ प्यानम नं. २४८८४९
२. गाउँ सुझा तथा कफिट प्रयोगशाला,
नेपाल विद्युत् प्राधिकरण भवनमा पाट, खगम्बु, काठमाडौं
फोन नं. २७१३२१ प्यानम नं. २७८३३६



सत

२३४ १-१०-२ " " X
 " १ ख ४०६ ०-१२-२ " " पहलमान " "
 " " " " " इगोल " "
 कैफियत:-के. नं ४०६ मा यो कित्ता जग्गा राजु धनलालको वतां अंशबाट नगे
 हुन आएको ना.मा. वतां गर्न बाँकी छ ।

यत शपिङ्ग
 ग कार्य गर्न
 र स्यायी लेखा
 लवन्दी बोलपत्र

नय भित्र कनचारी
 ०/- (फितां नहुने)

को १.०० वजेसम्म
 प्रमा समय भित्र वतां
 न, बोलपत्रमा अंक र
 लिङ्ग (Filling)
 नैछ ।

को कोषको खातामा
 क जमानो पत्र

००वजे बोलपत्र
 उक्त समयमा
 पनि बोलपत्र
 तको कारवाही



नेपाल विद्युत प्राधिकरण माथिल्लो सेती जलाशययुक्त जलविद्युत आयोजना

वातावरणीय प्रभाव मूल्यांकन गरे सार्वजनिक
 सन्ताड (Public Hearing) सम्बन्धी सूचना

नेपाल विद्युत प्राधिकरणबाट निर्माणको लागि प्रस्ताव गरी वातावरणीय प्रभाव
 मूल्यांकन भइरहेको माथिल्लो सेती जलाशययुक्त जलविद्युत आयोजना अन्तर्गत
 तनहुँ जिल्लाको व्यास नगरपालिका तथा गा.वि.स.हरू क्रमशः काहुशिवपुर,
 पोखरी भञ्ज्याङ्ग, कोटदरवार, रानीपोखरी, माझकोट, छान, जानुने र भिमादमा
 आयोजना निर्माणको लागि प्रस्ताव गरी वातावरणीय प्रभाव मूल्यांकन कार्य
 भइरहेको छ । वातावरण संरक्षण नियमावली, २०५४ को पहिलो संशोधन
 २०५५ को नियम ७ बमोजिम उक्त कार्यको लागि सार्वजनिक सुनुवाई गर्नुपर्ने
 भएकोले सोही अनुसारको राय, सुझाव संकलन गर्न निम्न मिति, स्थान र
 समयमा सम्बन्धित नगरपालिका, गा.वि.स., जिल्ला विकास समिति, विद्यालय,
 अस्पताल, स्वास्थ्य चौकी, सरोकारवाला व्यक्ति तथा संघ संस्थाहरूले सक्रिय
 रूपमा सहभागी भई आफ्नो राय सुझाव दिनुहुन अनुरोध गरिन्छ ।

स्थान: व्यास नगरपालिका, दमौली, तनहुँ ।
 मिति : २०६०, माघ ११ गते, आइतवार ।
 समय : दिनको ११:०० बजे ।

आयोजक:

माटो, ढुङ्गा तथा कंक्रीट प्रयोगशाला, ने.वि.प्रा.

जानकारीको लागि यो सूचना प्रक
 जानकारीको लागि यम केन्द्रमा आई र

बालबालिका हकदावी ग

यस सूचनासाथ प्रकाशित भए
 मातृवादा, काँक्रेपुरको च.न. ३०३ को
 १ को बालिका प्रतिष्ठा पाँछ नाम गाँछ
 च.न. को प्रभाव अन्तर्गत वर्ष १ कि.धा
 २०६०।०।२६ ई.ख. यस अन्तर्गत तथा
 नेपाल बालनपुरमा आश्रित छन । निज
 लागे माहेश्वर र निज बालिकाको चल
 मस्था वा जो कोहीले पनि यो सूचना
 न-प्रमाणितभन यस अन्तर्गत तथा दुहुरा
 बालनपुरमा सम्बन्धित गराउन नहुने । अ
 नम्मा नडाउन श्री ५ को प्रमाणको न
 व्यहोरा सूचित गरिन्छ ।



शितल

असहाय तथा दुहुरा बालबालिका संर

पो.व.नं. ३

फोन नं. ५

जाबलाखेल एकान्त

Appendix J





"नगरलाई स्वच्छ, सफा र सुन्दर राखौ ।"

फ्याक्स नं ९७७-०६५-५६०९६२

व्यास नगरपालिका कार्यालय VYAS MUNICIPALITY OFFICE

फोन ०६५

५६०६३२
५६०९६३
५६०२३३

(शाखा)

दमौली, तनहुँ

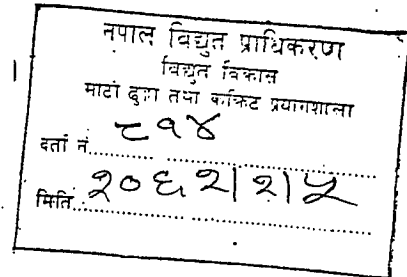
संख्या: ०६९१६२

मिति: २०६२।२।३

चलानी नम्बर: ४९०३

विषय: सिफारिस गरिएको सम्बन्धमा ।

श्री नेपाल विद्युत प्राधिकरण,
माटो ढुंगा क्रिकेट प्रयोगशाला,
स्वयम्भु, काठमाण्डौ ।



प्रस्तुत विषयमा त्यस प्रयोगशालाको मिति २०६२।१।२२ च.नं.४३२ को प्राप्त पत्र अनुसार नेपाल विद्युत प्राधिकरणबाट निर्माणका लागि Volume I र II को Report म उल्लिखित शर्तहरूको आधारमा माथिल्लो सेती जलाशययुक्त जल विद्युत आयोजना कार्यान्वयनका लागि सिफारिस गरिएको व्यहोरा अनुरोध गरिन्छ ।

(कृष्ण शर्मा पौड्याल)
कार्यकारी अधिकृत

कार्यकारी अधिकृत





माझकोट गाउँ विकास समितिको कार्यालय



पत्र संख्या :- ८६८१८६९
चलावी नम्बर :- २६५

मिति :- २०७३.०५.१६

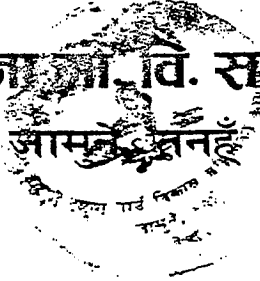
विषय :- शिपारीस गरिबी बन्धन
श्री तपाईंको प्रयोग
नेपाल विद्युत प्राधिकरण
काठमाडौं

उपरोक्त बन्धनमा लक्ष आर्जन गर्ने
२०७३.०५.१२ को प्रमाणमा नेपाल विद्युत प्राधिकरण
निर्माणको प्रस्ताव गरिहालेको देखिने जलशक्ति
जन सिफ्ट आर्जनको यहाँ
आर्जनको लागि
... ..
... ..

मोहन वीर गुरुङ्ग
(जा.वि.स. सचिव)



श्री जामुने नमूना मा. वि. स. को कार्यालय



पत्र संख्या :-

चलानी नम्बर :- ४८४

मिति :- २०६०/११/२९

विषय :- विफावीस गरीको सम्बन्धमा ।

श्री प्रा. वि. स. तहसील कार्यालय,
नेपाल विद्युत प्राधिकरण, हनुमानगढ
काठमाडौं ।

उपरोक्त सम्बन्धमा तपाईंको मिति २०६०/०९/२४ ०९:६:२०
०६९ च. त. ४९६ को पत्रानुसार नेपाल विद्युत प्राधिकरणबाट निर्माणको
प्रस्ताव गरीएको माथिल्लो सैती अलगायत अल विद्युत आपोसनाको क
वपन गर्दा यस गरी वि. स. लाई कतावरणमा कुनै ठूलो प्रभाव नपरे
भएकोले पछिल्लो उक्त आपोसना कार्यालयमा गरी विफावीस गरीको
आरोप गरीन्छ ।

२०६०/११/२९
राजेश्वर निश
३३३३





श्री छाड गाउँ विकास समितिको कार्यालय

छाड, तनहुँ

पत्र सङ्ख्या :

चलानी नम्बर :



गण्डकी अञ्चल

मिति :

२०७३/०३/१२

विषय :- विद्यार्थी गाउँलेको खेवद्वारा -

१. माइ, दुइ, तथा कंठि प्रयोगशाला

नेपाल विद्युत प्राधिकरण सचिवालय

काठमाडौं

उपरोक्त खेवद्वारा तर्फबाट नेपाल विद्युत प्राधिकरणको कार्यालयमा
२०७३/०३/१२ र २०७३/०३/१३ गते कतारमा नेपाल विद्युत प्राधिकरण
द्वारा नदिएको कालात्तमा प्रस्ताव गरीएको माथिल्लो
खेवले जनाइएको जस्तै नेपाल विद्युत प्राधिकरणको कार्यालयमा
सम्बन्धित गरी तर्फबाट कतारमा विद्युत प्राधिकरणको कार्यालयमा
सुझाव दिएको प्रस्ताव तर्फबाट गरेको निर्णय
विद्युत प्राधिकरणको कार्यालयमा गरी विद्युत
प्राधिकरणको कार्यालयमा विद्युत प्राधिकरणको कार्यालयमा
गरीएको।

२०७३/०३/१२

तीर्थराज वाग्ले
अध्यक्ष



श्री भीमाद नगरमुख गाउँ विकास समितिको कार्यालय

भीमाद, तनहुँ

पत्र संख्या :- ०६०/०६९

चलानी नम्बर :- ३५९

दिनांक: ०६/०९/२०७०

मिति :- २०७०-०९-१५

विषय :- सिफारीस सम्बन्धमा ।

श्री नेपाल विद्युत प्राधिकरण

भागे, दुङ्गा तथा काँक्रेट प्रयोगशाला

प्रस्तुत विषयमा तपाईं प्रयोगशालाको मिति २०६०-९-१५
च.नं.४९८ को प्राप्त पत्रानुसार नेपाल विद्युत प्राधिकरण
बाट निर्माणको लागी प्रस्ताव गरीएको "आवीरले" जल
जलाशयबाट जल विद्युत आयोजना" कार्यान्वयनको
प्रारम्भिक चरणमा पुगेको तथा उक्त योजना -
कार्यान्वयनको लागी शा. वि. स. को सी. रोस आवस्य
परेको भन्ने बुझिने आएको सम्बन्धमा उक्त
आयोजना यस क्षेत्रको क्षेत्रीय विकास तथा श्रवण
शुद्धीको जलजोतको उपयोगको लागी अती आवश्यक
रहेको र उक्त आयोजना निर्माणबाट यस गा.
स. क्षेत्रमा हुने वातावरणीय असर पर्ने समेत भई
आयोजना कार्यान्वयन गरीदिनु हुन सिफारीस साथ
अनुसन्ध गरीन्छ ।

चन्द्रकान्त विमलिसिन्हा
गा.वि.स. सचिव एवं अध्यक्ष





श्री गाउँ विकास समितिको कार्यालय

पोखरी भञ्ज्याङ
गाउँ विकास समिति नं. ३
पौन्यौ प्रजापति वि. ३

मिति :- २०६०.०१.१५

प.सं. :- ०६०/३१
च.नं. :- १८०

विषय :- सिफारिस गरिएको कुरा

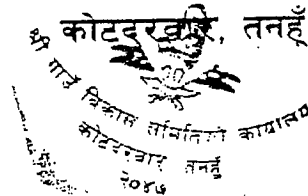
श्री आ.दा. कुँडा, लम्बा, केशिपुर मोगोशाला
नेपाल विद्युत प्राधिकरण स्थापना
नं. १६५१०५१

सल्लुत विषयमा यस कार्यालयको
२०६०/५/२४ नं. ०६०/३१-४२८ का सं.
नेपाल विद्युत प्राधिकरण कार्यालयको
पुस्तक जारिएका आधिकारिक सल्लाह
कुल जना विद्युत आपूर्तिमा कोषाध्यक्ष
जहाँ यस समिति सल्लाह कार्यालयमा कुल
अंक १८५५ प्रमाण रणन भएकाले कुल
न्यूनता गरी कोषाध्यक्ष जहाँ दिने लाना
सिफारिस गरिएको जहाँ अनुसन्धान

(Signature)
२०६०/५/१५



श्री कोटदरवार गा.वि.स. को कार्यालय



फोन २५३६०

पत्र संख्या : ०६०/६९

चलानी नम्बर : ९८९

मिति ०६०/३/२८

विषय : सिफारीश गरिएको कारो

श्री माटो टुङ्गा तथा कंक्रिट प्रयोगशाला
नेपाल विद्युत प्राधिकरण, स्वयम्भू,
काठमाडौं

उपरोक्त विषयमा त्यस कार्यलयको मिति
०६०/३/२४ व.सं ०६०/६९-चने. ४९५ को पत्रानुसार
नेपाल विद्युत प्राधिकरणबाट निर्माणको लागी
स्ताव गरिएको माथिल्लो सेले जलाशयहरू :
विद्युत आयोजनाको कार्यन्वयन गर्दा यस
वि.सुलाई कातावरणमा पुग्ने उल्लेख्य प्रभाव
भएको यथासिद्ध उक्त आयोजना कार्यन्वयन
सिफारीश गरिएको छ। अनुरोध छ।

(Signature)
०६०/३/२८
अध्यक्ष





काठमाडौं सिन्धुपुर गा. वि. स. को कार्यालय
तनहुँ

पत्र संख्या :- ०६०/०६५

चलानी नम्बर :- १६२

मिति :- २०६०.०१.०१

विषय :- सिफारिस गरिएको बारे।

श्री नेपाल विद्युत प्राधिकरण
माथो ढुङ्गा कंस्ट्रक्शन् प्रयोगशाला
स्वयम्भू, काठमाडौं

उपरोक्त विषयमा त्यस प्रयोगशालाको प.सं. ०६०/२५
नं. ४९६ मिति २०६०/११/२५ गतेको प्राप्त पत्र
नेपाल विद्युत प्राधिकरण बाट निर्माणका लागि
गरिएको माथिल्लो खोले जलास्थायुक्त जल विद्युत
आयोजनाको कुम्भेन्वयन को लागि सिफारिस गर्न
अनुसार उक्त आयोजना संचालन को लागि सिफारिस ग
द्वारा अनुमति गरिन्छ।

(बाबुराम शर्मा)
बाबुराम शर्मा
सचिव



श्री ऋषिङ्ग रानीपोखरी गाउँ विकास समितिको

कार्यालय

पल्ल्याङ तनहुँ

फोन नं. ०६३-३२९२३३

पत्र संख्या : ०६०/०६०

सलानी नं. :

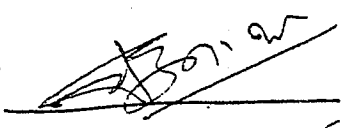
१३४

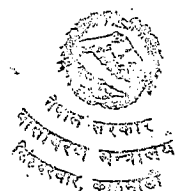
विषय :- सिफारीस सम्बन्धमा।

मिति ०६०/०६०

श्री नेपाल विद्युत प्राधिकरण
माटो ढुङ्गा तथा कंक्रीट प्रयोगशाला
स्वयम्भु काठमाडौं।

उपरोक्त विषयमा त्यस प्रयोगशालाको ०६०/०६० च. नं. ४२३ मिति ०६०/०६० गतेको प्र
पत्रानुसार नेपाल विद्युत प्राधिकरणबाट निर्माणका
प्रस्ताव गरिएको माथिल्लो खोला जलाशययुक्त
विद्युत आयोजनाको कार्यन्वयनको लागि सिफ
भाग भए अनुसार उक्त आयोजना खोला न
लागी सिफारीस गरिएको व्यहोरा अनुरोध
गर्दछु।

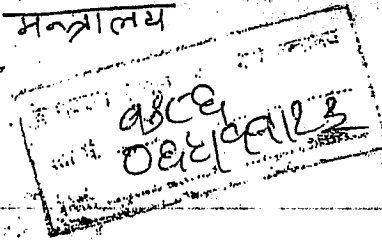

चन्द्र नाथ पाँ
सहायक





मिति : २०६२-११-१८

श्री वातावरण, विज्ञान तथा प्रविधि मन्त्रालय
वातावरणीय मूल्याङ्कन शाखा
सिंहदरवार, काठमाडौं ।



जी

बिषय : माथिल्लो सेती जलाशय युक्त जलविद्युत
आयोजनाको प्रतिवेदन सम्बन्धमा राय-
सुझाव प्रस्तुत गरेको बारे ।

प्रतिवेदन, उपरोक्त सम्बन्धमा त्यस मन्त्रालयबाट मिति २०६२-१०-२
मा प्रकाशित सूचना प्रति हाम्रो ध्यानाकर्षण गर्ने निम्न व्यहोरा
राय सुझावको रूपमा प्रस्तुत गरिएको हो,


१. माथिल्लो सेती जलाशय युक्त जलविद्युत आयोजना तनहुँको
प्रस्तावित बाँध स्थल नजिक भादी नदी तथा सेती नदी दोभान
नजिक साविक गुणादी र्हेन्द्रपुर वार्ड नं. १/ग हाल व्याशा
नगर पालीका क्षेत्रमा निवेदकहरूको कि. नं. १४
को २४-२-१-१ शेपनी र कि. नं. १८ को २४-१३-१
शेपनी आवादी निजी भोगचलनको झरजग्गा पर्दछ ।

२. आयोजनाबाट अत्यन्त प्रभावित हुने उक्त हाम्रो झरवाला
क्षेत्रमा विकास निर्माणको कार्य गर्दा नागरीकको व्यक्तीगत
सम्पत्तीको प्रक्षीत दरमाड (बजार मूल्य) को मापदण्ड
अपनाई क्षतीपूर्ति दिने कार्य हुनु पर्दछ साथै आपसी सह
मा जलविद्युत आयोजनाको शेवर (सेस्थापक शेयरधनीको
रूपमा) धनीमा स्थापित गरिनु पर्ने राय सुझाव दिन चाहने


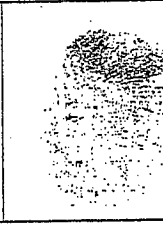
३. प्रभावित क्षेत्रका वसिन्दालाई शिक्षा, स्वास्थ्य, रोजगारी, सडक
तथा विद्युतको अवस्थित सुविधा तथा अन्य सुविधा

२३५६३८३ श्री ५ को सरकार संकेत नं. ०२७
 ०४-१०-००५ गृह मन्त्रालय
 जिल्ला प्रशासन कार्यालय, काठमाडौं

नेपाली नागरिकताको प्रमाण-पत्र
 नाम :- चन्द्रेश्वर प्रसाद भट्टराई
 ना. प्र. नं. :-
 जन्मस्थान :- तेनहुँ जिल्ला
 जन्म मिति :- २०२० साल ०४ महिना १० गते
 स्थायी वासस्थान :- सुर्खेत जिल्ला
 उ.म.न.प्र.स.वि.स. :- सुर्खेत जिल्ला
 जन्म मिति :- ०४ महिना १० गते
 बाबुको नाम, थर र ठेगाना :- श्री प्रसाद उपर्याय
 पतिको नाम, थर र ठेगाना :- X



नेपाल नागरिकता ऐन, २०२० बमोजिम यो नागरिकता प्रमाण-पत्र दिइएको छ।
 नागरिकताको किसिम :- प्राकृतिक
 प्रमाण-पत्र पाउने व्यक्तिको सही :- चन्द्रेश्वर प्रसाद भट्टराई
 अठ्ठाको छाप

दायाँ	बायाँ
	

प्रमाण-पत्र दिने अधिकारीको :-
 दस्तखत :- श्री प्रसाद उपर्याय
 नाम, थर :- श्री प्रसाद उपर्याय
 दजा :- ००१०३०
 मिति :- २०२०/११/१०

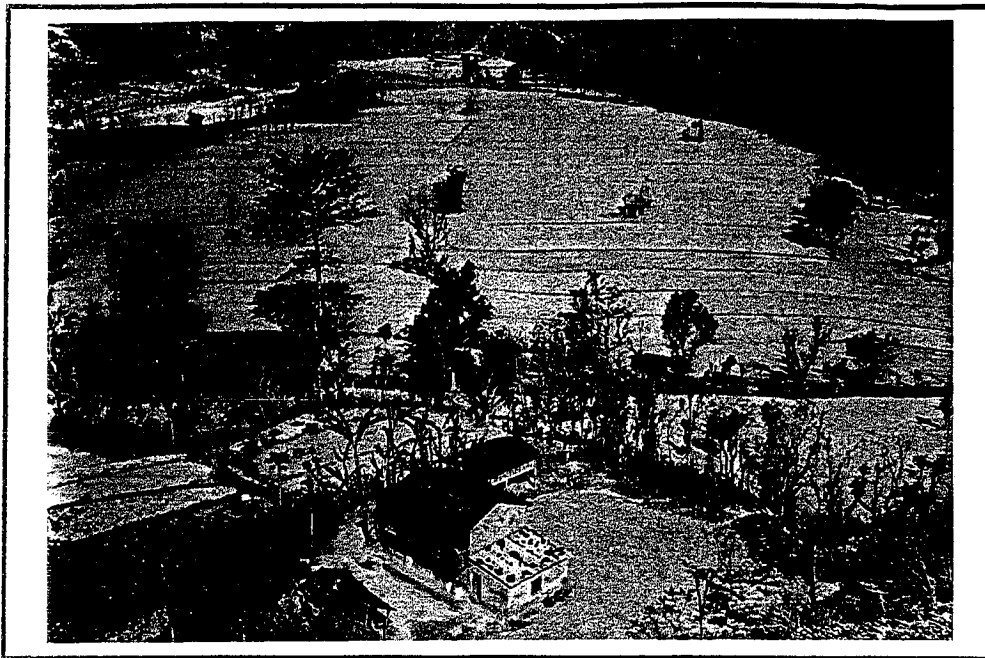


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مجلس الشورى

[illegible]

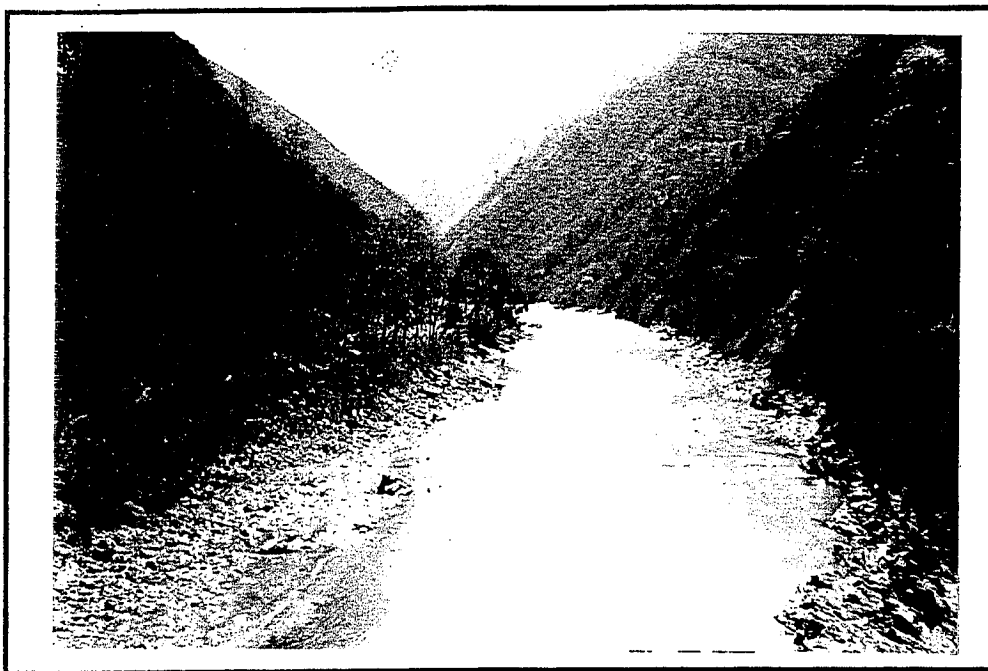


Agriculture land of Seti river to be submerged

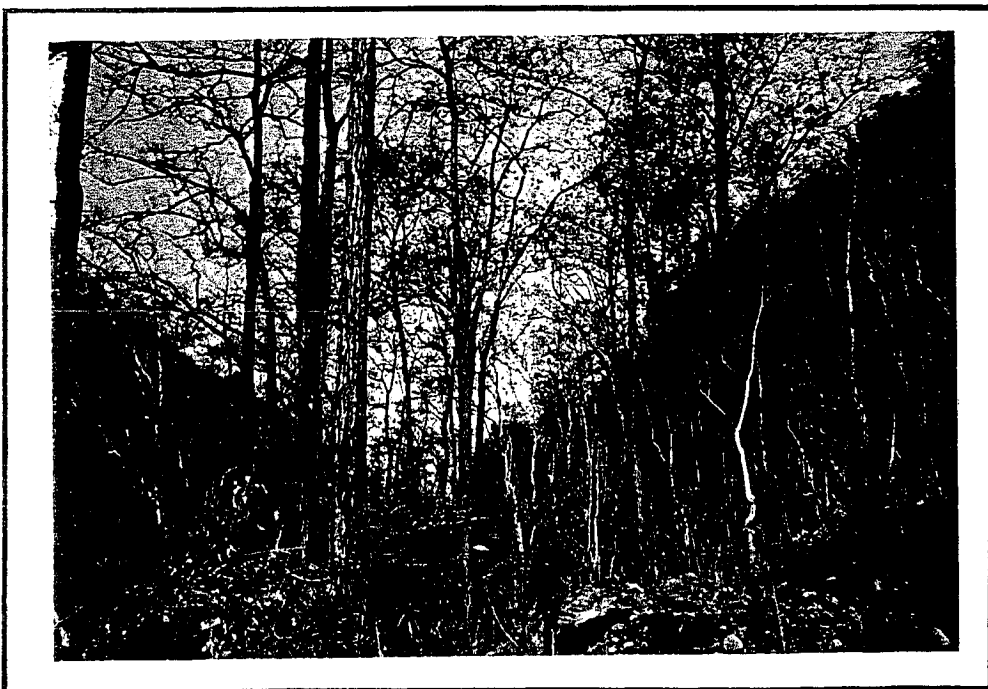


Agriculture land at the right bank near Saune

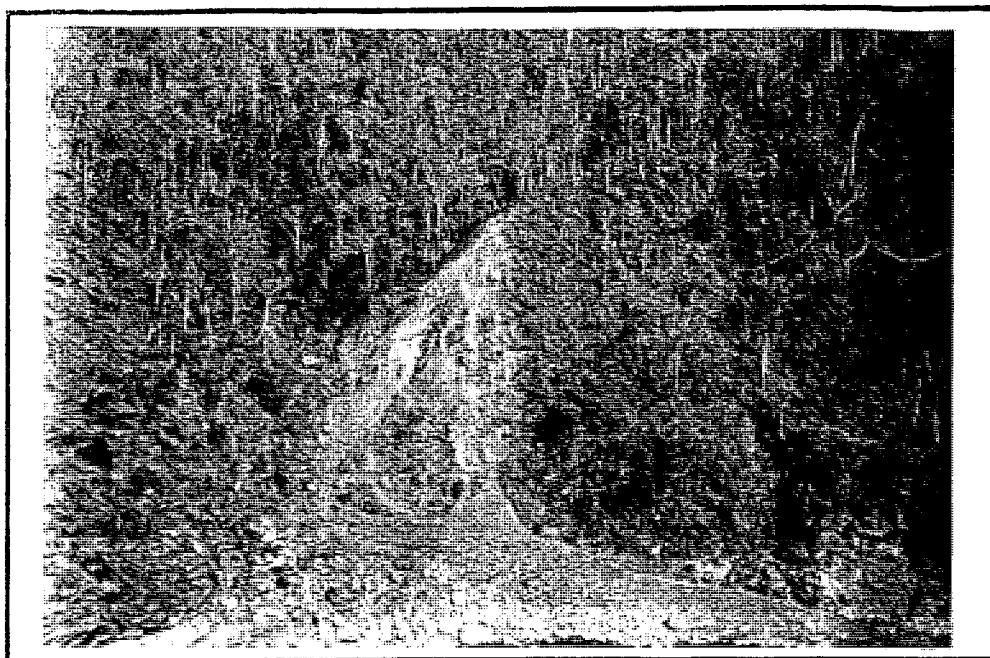




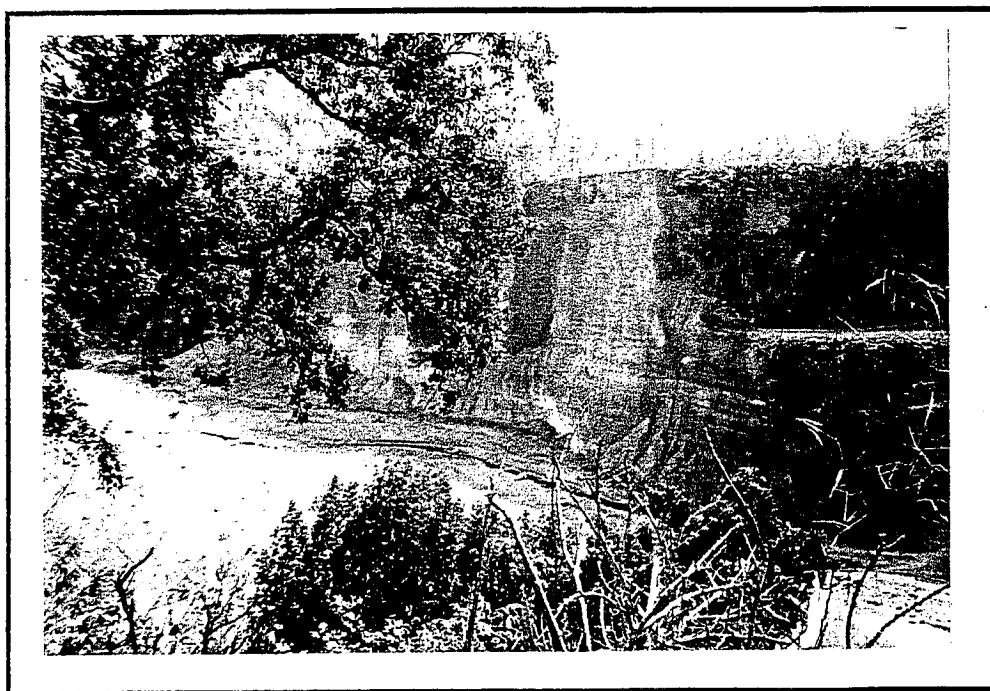
Acacia Catechu forest at both the banks of seti river affected
by the reservoir



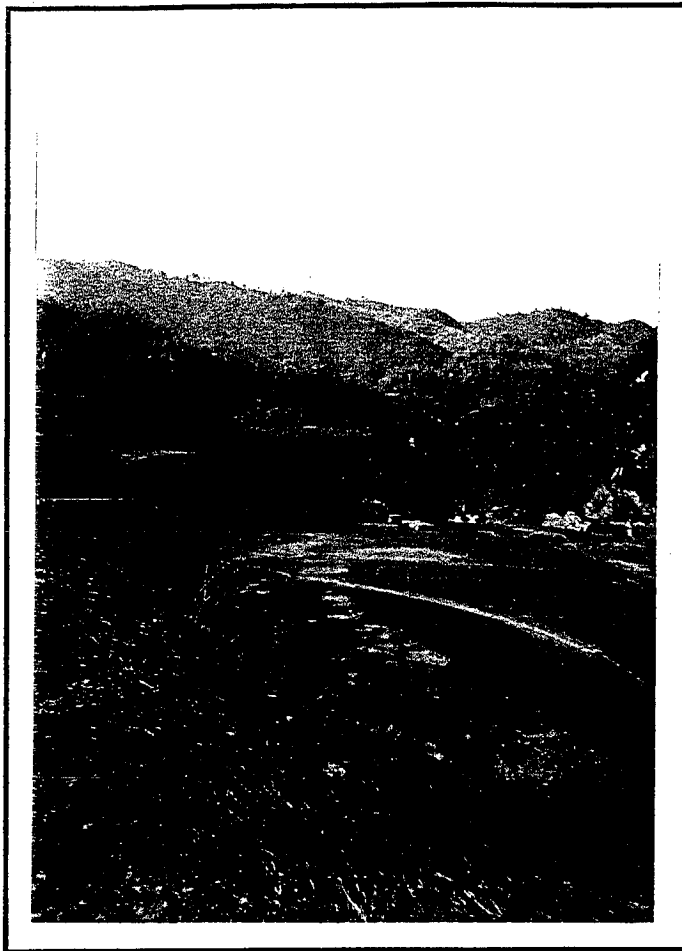
Terminilia forest at the left bank of Seti river



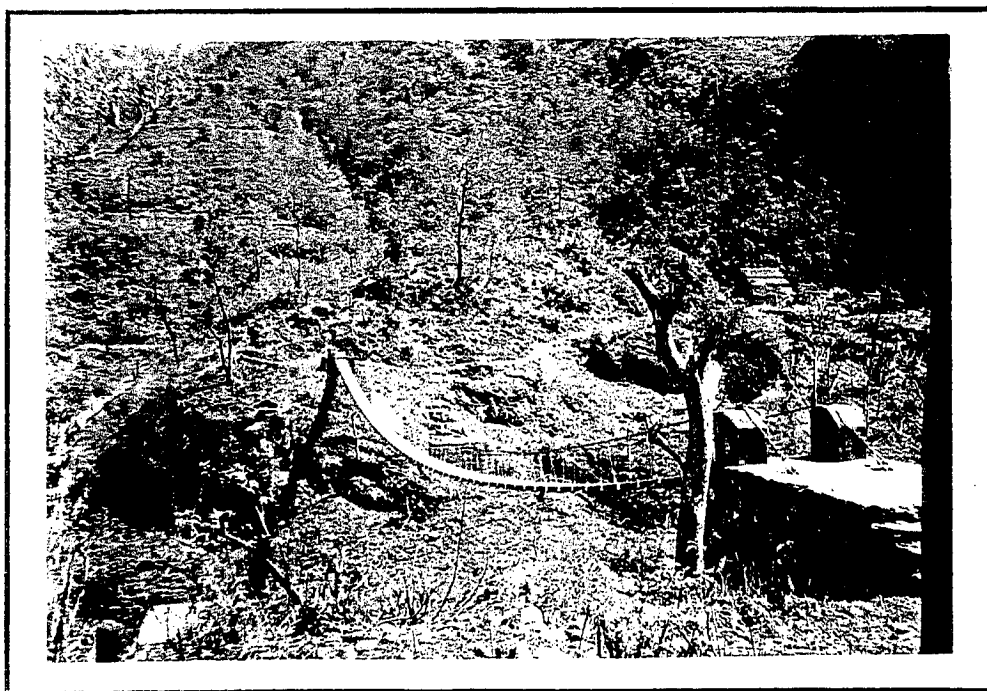
Landslides seen at the right bank (upstream) of the damsite near intake



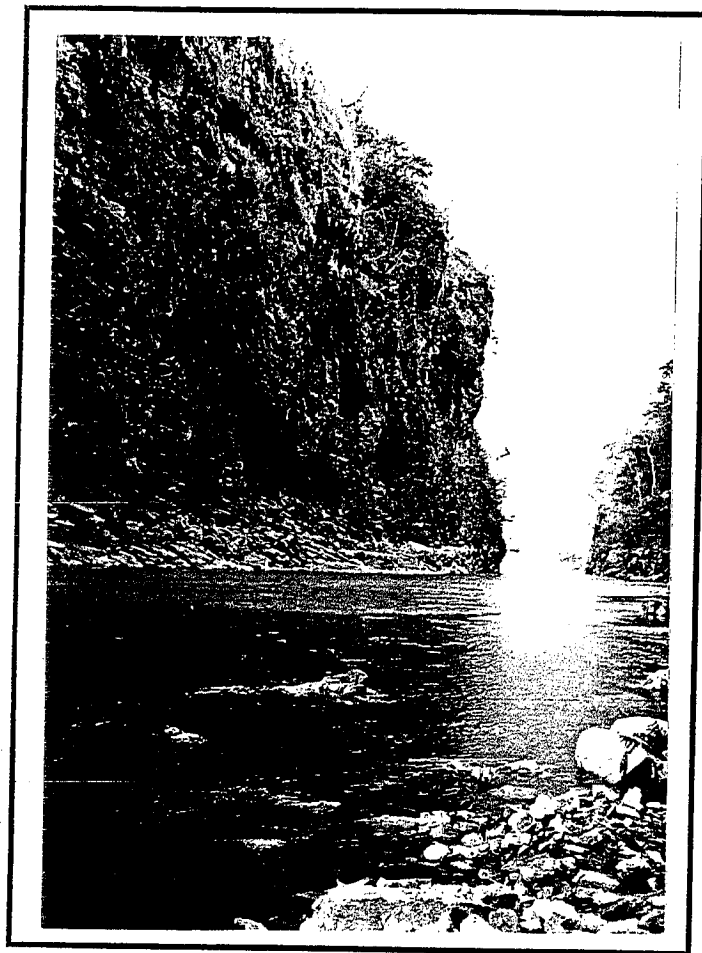
Unstable areas which will contribute to reservoir sedimentation
(along Wanten khola)



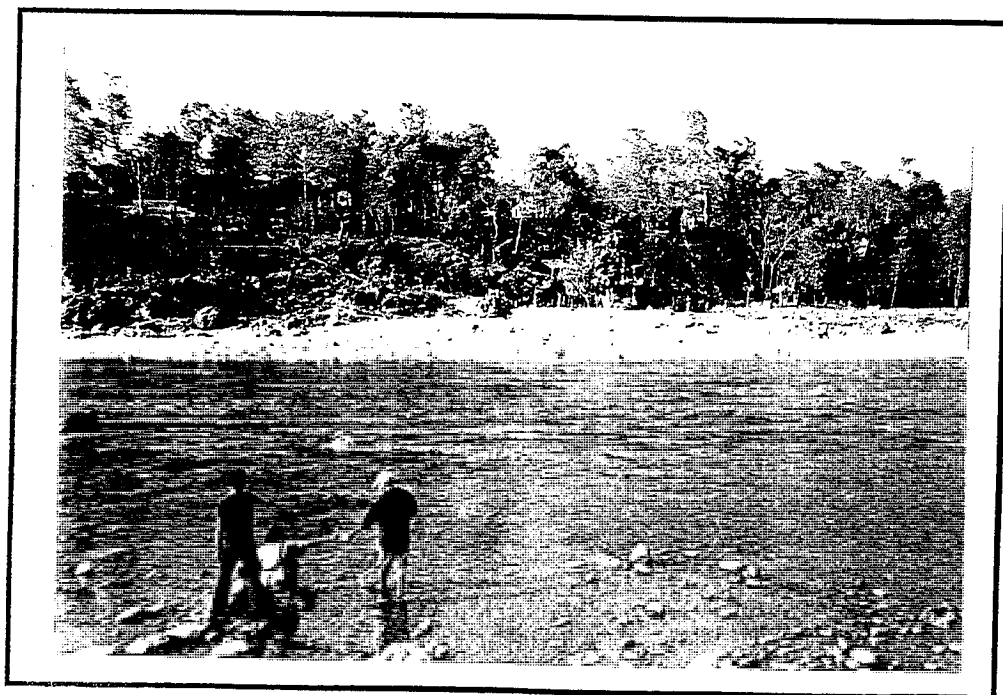
A temple at the bank of Seti river near Bhimad Bazar to be inundated



One of the suspension bridges to be inundated

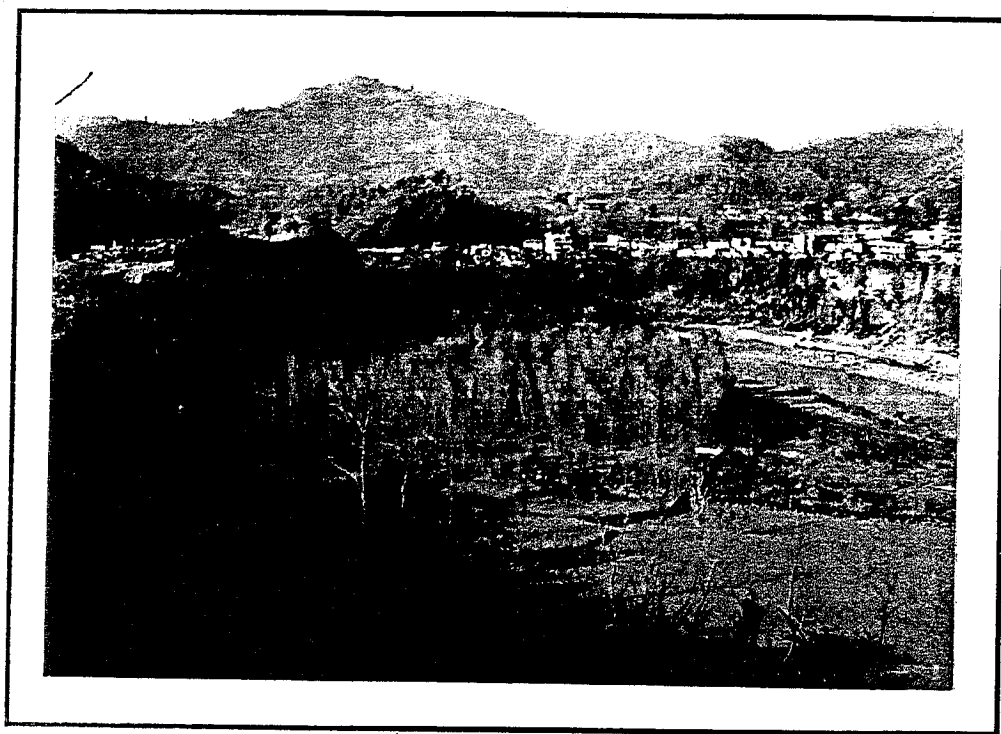


Location of the dam

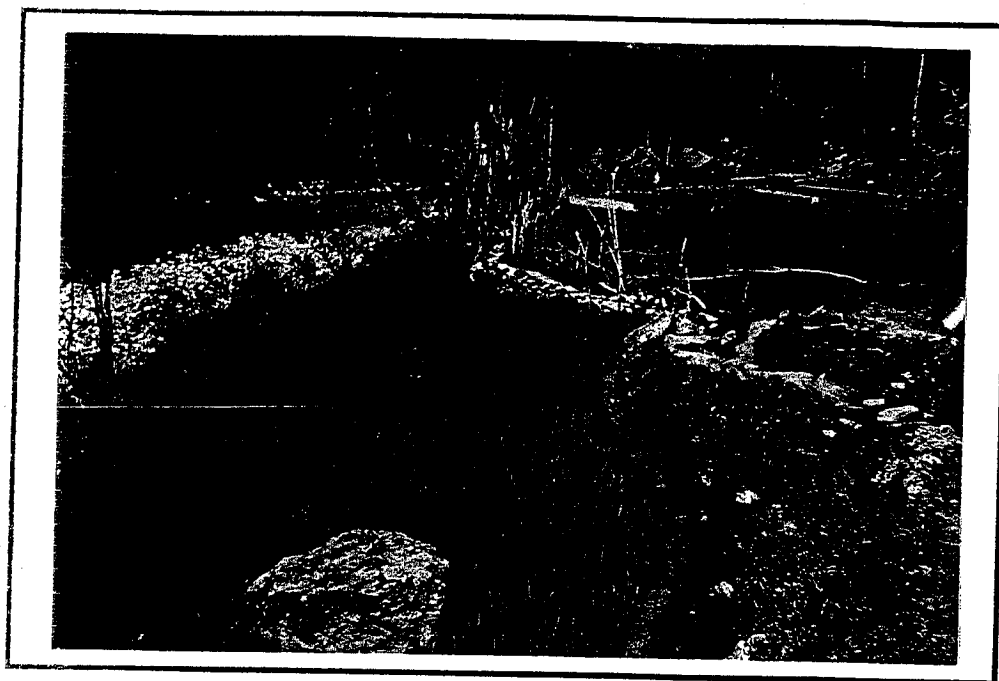


Water sampling in Madi river

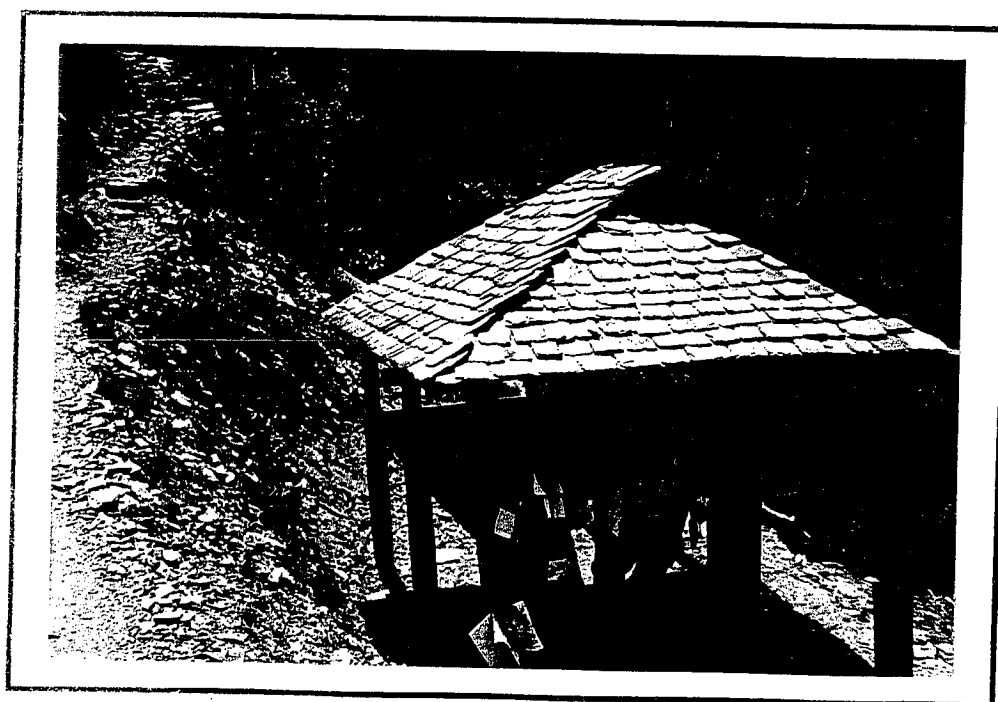




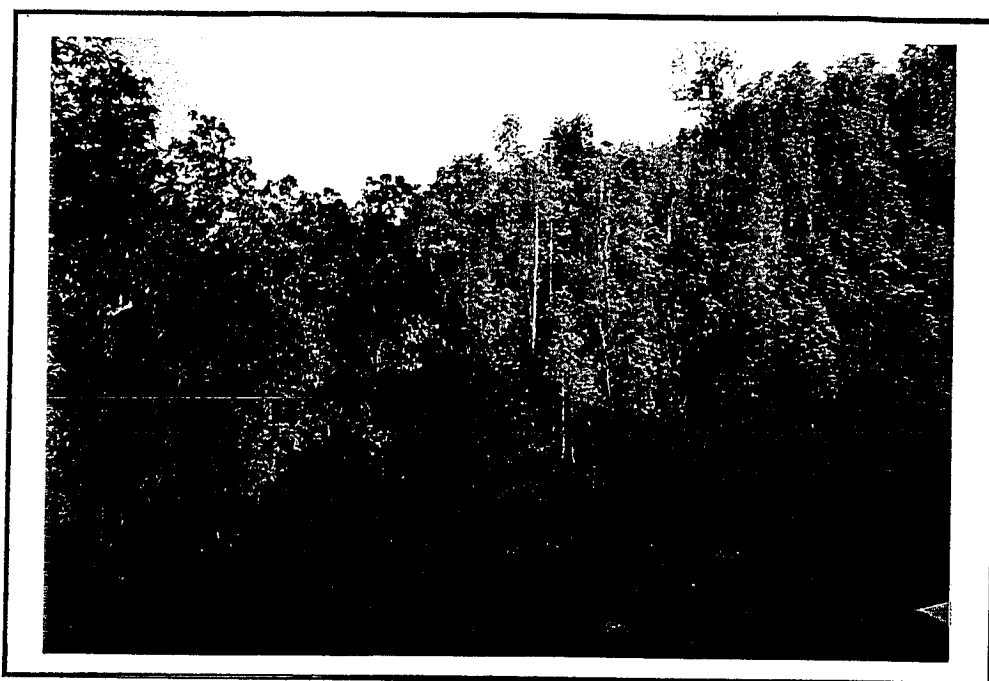
Settlement under risk of slope failure along the bank of Seti river
near Bhimad Bazar



Houses to be inundated in the mid section of reservoir



A shed constructed by the Aama Samuha affected by the reservoir



Shorea Roburta forest on the upper slopes of the Seti river



Bamboo plantation at the upstream of Damsite to be inundated

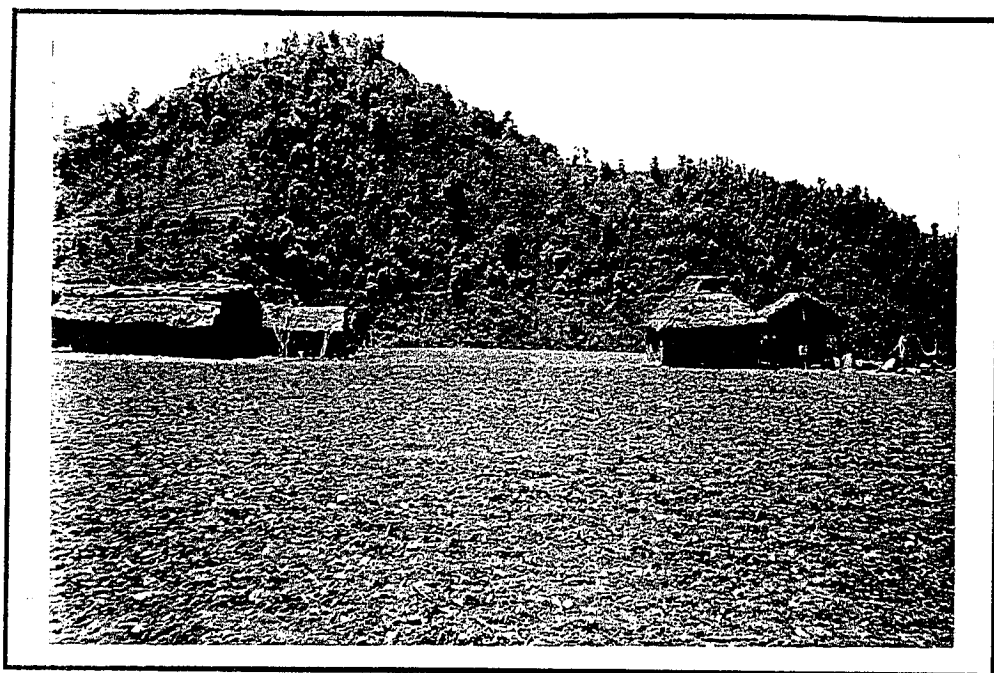


The environmental team interviewing the relocates

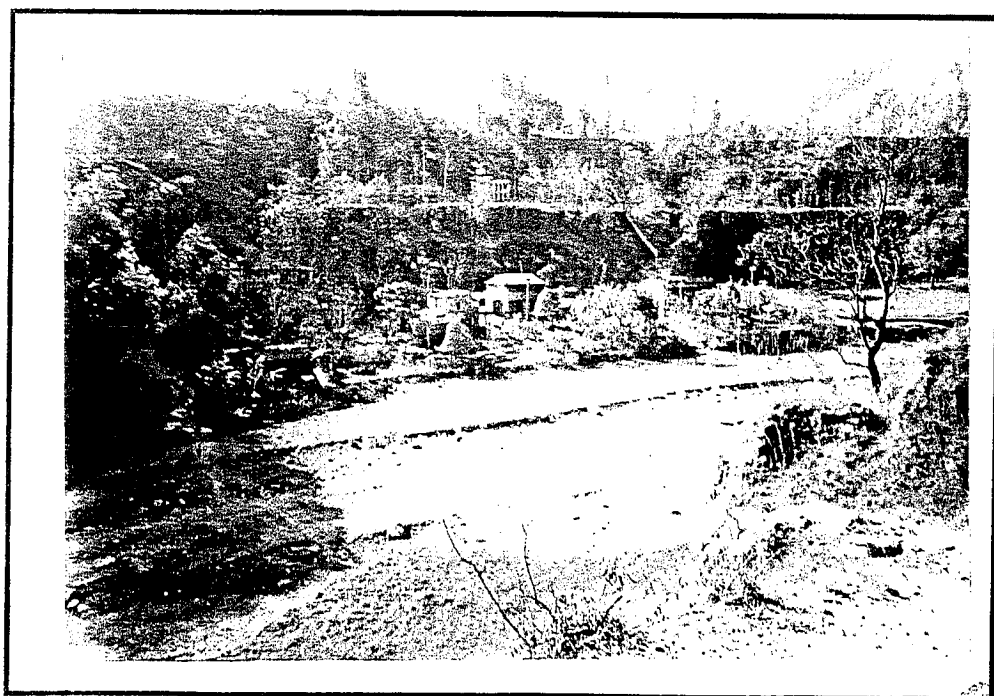


The environmental team conducting household survey of the affected area





A settttlement of Bandarkuna to be compltely resettled



A settttlement along Waten khola to be compltely resettled



Appendix L

Relocates List and Land Owners List



Appendix L Relocatees list (Total-86 households)

D) Relocatees List – Reservoir area.

Chhang VDC

No. of Relocatees	Number of structures	House Identification	Name of owner	Total Members	Address
1	4	RJC - 5	Hem Bdr. Gurung	4	Jhakas
1	2	RJC - 6	Hem Bdr. Gurung	4	Jhakas
2	3	RJC - 1	Gobardhan Gurung***	5	Jhakas
3	6	RJC - 2	Uttar Kumar Gurung***	6	Jhakas
4	2	RJC - 3	Khadka Bdr. Gurung***	3	Jhakas
5	7	RJC - 4	Khiri Bdr. Gurung***	9	Jhakas
6	1	RK - 2	Kum Bahadur Thapa***	10	Kundaletar
7	5	RK - 1	Jhul Bahadur Thapa (House)	13	Kundaletar

Source: Field Survey 2006, * Cowshed only, ** Community property *** Owners without legal holdings

Jamune VDC

No. of Relocatees	Number of structures	House Identification	Name of owner	Total Members	Address
1	1	RBe - 1	Harsha Bahadur Thakuri***	9	Belbot
2	1	RBe - 2	Budhi Lal Gurung ***	8	Belbot
3	2	RBe - 3	Dil Bahadur Gurung ***	16	Belbot
4		RBe - 4	Santosh Bahadur Gurung***	3	Belbot
5	2	RBe - 5	Wan Singh Thapa***	7	Belbot
6	4	RBe - 6	Uttar Singh Ale***	4	Belbot
7	2	RBe - 7	Chum Bahadur Thapa ***	2	Belbot
8	3	RBak - 8	Bom Bahadur Thapa (House)***	8	Bhakhar
9	4	RBhak - 9	Khem Bahadur Thapa ***	15	Bhakhar

Source: Field Survey 2006, * House abandoned, *** Owners without legal holdings

Rising Ranipokhari

No. of Relocatees	Number of structures	House Identification	Name of owner	Total Members	Address
1	6	RW - 2	Kul Bdr. Rana Magar***	9	Wantang Khola
2	2	RW - 3	Til Bdr. Ale ***	7	Wantang Khola
3	3	RW- 4	Krishna Pd. Gaire ***	7	Wantang Khola
4	5	RW- 5	Prem Bdr. Baniya Chhetri ***	6	Wantang Khola
5	2	RW- 6	Yam Maya Shrestha ***	8	Wantang Khola
6	7	RW- 7	Rok Bahadur Gurung***	8	Wantang Khola
7	5	RW- 8	Narayan Gaire ***	3	Wantang Khola
8	3	RW- 10	Lal Bdr. Pariyar ***	8	Wantang Khola
9	3	RW- 11	Chin Bahadur Pariyar ***	8	Wantang Khola
10	3	RW- 12	Ram Bahadur Pariyar ***	7	Wantang Khola
11	2	RW- 13	Aita Ram Pariyar ***	5	Wantang Khola
12	4	RW - 14	Chandra bahadur Pariyar***	8	Wantang Khola
13	4	RBa- 6	Poorna Singh B.K.	10	Bandarkuna
14	5	RBa- 4	Som bahadur B.K.***	6	Bandarkuna
15	6	RBa - 5	Jul bahadur B.K.***	7	Bandarkuna
16	1	RR - 15	Rana Prasad Shrestha	8	Jaruwapani
17	2	RR- 16	Netra lal Shrestha	9	Jaruwapani
18	1	RR - 17	Krishna/Ramu Gaire	7	Jaruwapani



19	2	RBa- 1	Dal Bahadur Thapa	11	Bandarkuna
20	1	RBa - 2	Tek Bahadur Thapa	7	Bandarkuna
21	2	RG - 1	Dev Bahadur Magar***	0	Geruwatar
22	4	RG- 2	Sham Sher B.K***	6	Geruwatar
23	2	RG - 1	Dev Bahadur Magar***	0	Geruwatar
24	4	RG- 2	Sham Sher B.K***	6	Geruwatar

Source: Field Survey 2006, * Cowshed only, ** Community property, *** Owners without legal holdings

II) Affected residential structure owners of the Spoil disposal, Base Camp and Access Road area.

2. Spoil Dump Beltar (Kahun Shivapur VDC)

No. of Relocatees	Structure	HH identification	Name of Owners	Total members
1	5	SD-1	Bhim Bahadur Garja(House A)	12
2	2	SD-2	Shri Jung Thapa(House A)	25
3	3	SD-3	Dil Bahadur Thapa(House)	26
4	4	SD-4	Pramila Shrestha (House)	0
5	4	SD-5	Mahadev Thapa (House)	3
6	1	SD-6	Yam Bdr. (House)	3
7	2	SD-7	Sri Man Thapa (House)	4
8	7	SD-8	Gangadhar Thapa(House)	15
9	3	SD-9	Purna Bdr. Thapa(House)	3
10	2	SD-10	Kamal Bdr. Ale (House)	9
11	1	SD-11	Rikhi Ram B.C (House)	7
12	1	SD-12	Dil Kumar Bishwokarma (House)	5
13	2	SD-13	Chet Bahadur Garja Magar(House)	6
14	2	SD-14	Hasta Bdr. Bote (House)	3
15	2	SD-15	Dharma Raj B.K(House)	6
16	2	SD-16	Hira Singh Baral(House)	9
17	2	SD-17	Sher Bdr. Makim (House)	13
18	3	SD-18	Jun Maya Darji (House)	9

Source: Field Survey 2006

3. Base Camp Huksetar (Kahun Shivapur VDC)

No. of Relocatees	Structure	HH identification	Name of Owners	Total members
1	6	BC-1	Rina Maya Garja Magar	13
2	4	BC-2	Ram Bahadur Thapa	6
3	5	BC-3	Nar Bdr. Saru Magar	6
4	7	BC-4	Bam Bahadur Sani Magar	7
5	3	BC-5	Jit Bdr. Rana	6
6	7	BC-6	Rima Maya Shakya	2
7	5	BC-7	Hasta Bahadur Bache Magar	4

Source: Field Survey 2006

4. Access road

No. of Relocates	Structure	HH identification	Name of Owners	Total members
1	7	RAR -1	Parasu Ram Giri (HouseA)	6
2	2	RAR -2	Hem Prasad Poudel	0
3	4	RAR -3	Kalpana Thapa (House A)	7
4	3	RAR -4	Ratna Bdr. Nepali (House)	3
5	1	RAR -5	Yogendra Nepali (House)	2
6	2	RAR -6	Dhan Bdr. Nepali (House)	6
7	5	RAR -7	Tej Bdr. Nepali (House)	4
8	3	RAR -8	Sal Bdr. Thapa (House)	6
9	3	RAR -9	Shree Maya Neplai (House)	8
10	1	R-ARD-1	Parth Ram Thapa*	0
11	1	R-ARD-2	PrajaPati Subedi (House)	6
12	2	R-ARD-3	Dol Murti Panta (House)	6
13	5	R-ARD-4	Toi Bahadur Ale (House)	6
14	3	R-ARD-5	Bhim Bahadur Ale (House)	4
15	3	R-ARD-6	Leela Bdr. Thapa(House)	5
16	5	R-ARD-7	Chhabilal Thapa (House)	8
17	5	R-ARD-8	Man Bdr. Thapa(House)	6
18	4	R-ARD-9	Buddha Bdr. Thapa (Hosue)	14
19	3	R-ARD-10	Keshar Bdr. Thapa (House)	4
20	3	R-ARD-11	Jagat Bdr. Thapa(Hosue)	4
21	3	R-ARD-12	Bom Bahadur Saru	2

Source: Field Survey 2006, * = House abandoned

Appendix L

List of the Name of the Owners of the Affected Plots at Designed FSL 425 m Reservoir

1. VDC. Bhimad

SN	Owner's Name	Plots Nos.	Cadastral, VDC
1	Badri Nath Khanal, Bhimad-7	119	Bhimad 1 Nga
2	Bikash Ale, Bhimad 1	121	Bhimad 1 Nga
3	Bishnu	372, 375	Bhimad 1 Nga
4	Bodh Raj Khanal	123, 99	Bhimad 1 Nga
5	Chakra Pani	371, 373	Bhimad 1 Nga
6	Hari Bhakta	374	Bhimad 1 Nga
7	Kiran Khanal, Bhimad	125	Bhimad 1 Nga
8	Padam pani Subedi	100, 101	Bhimad 1 Nga
9	Padam raj Subedi, Bhimad1	120, 118	Bhimad 1 Nga
10	Santa Bahadur Kumal	564	Bhimad 1 Nga
11	Unidentified owner	NA	Bhimad 1 Nga

Note:

Total Number of identified owners = 10

Total Number of Unidentified plots = 1

2. VDC. Chhang

SN	Owner's Name	Plots Nos.	Cadastral, VDC
1	Aman Singh Gurung 7	56	Chhang Bajar 7 Nga
2	Bal Bahadur Gurung, 7	55, 40, 42, 62, 20	Chhang Bajar 7 Nga, 7 nga, 7 nga, 7 nga, 7 gha
3	Bhagkta Bahadur Gurung,7	61, 5, 10, 15, 19	Chhang Bajar 7 Nga, 7 gha, 7 gha, 7 gha, 7 gha
4	Bhoj Man Ale Magar,4	2, 4, 28, 21	Chhang Bajar 4 Ka
5	Bindra Singh Ale 6Magar,4	5, 3, 25, 29	Chhang Bajar 4 Ka
6	Daan Bahadur Gurung, 7	54, 12, 20, 36	Chhang Bajar 7 Nga, 7 gha
7	Dhan bol Gurung 7	58, 63, 36, 20	Chhang Bajar 7 Nga
8	Dharma Raj Khanal,8	32	Chhang Bajar 8 ka
9	Gadha Bir Ale	12	Chhang Bajar 4 Ka
10	Gagan Singh Ale Magar,4	8, 11, 17, 19	Chhang Bajar 4 Ka
11	Gajha Bir Ale Magar,4	9, 7, 20	Chhang Bajar 4 Ka
12	Gobinda Thapa Magar,4	22	Chhang Bajar 4 Ka
13	Guman Singh Gurung,7	47	Chhang Bajar 7 Nga
14	Hira Sinha	117	Chhang Bajar 7 Nga
15	Human Singh	124, 120	Chhang Bajar 7 Nga
16	Jaman Singh Gurung,7	64	Chhang Bajar 7 Nga
17	Khil Bahadur Gurung	57, 65	Chhang Bajar 7 Nga
18	Kul Bahadur Thapa,4	1, 34	Chhang Bajar 4 Ka
19	Lil Bahadur Gurung,7	9, 41	Chhang Bajar 7 Nga
20	Lilamber Thapa Magar,4	27	Chhang Bajar 4 Ka
21	Lok Bahadur Gurung,7	22	Chhang Bajar 7 gha
22	Man Bahadur Gurung, 7	28	Chhang Bajar 7 Nga
23	Mohan Raj	204	Chhang Bajar 9 gha
24	Mu. Kesh Bahadur Gurung 7	53, 66, 3, 7	Chhang Bajar 7 Nga, 7 Nga, 7 Gha, 7 gha
25	Padam bahadur Gurung	132	Chhang Bajar 7 Nga
26	Pream Gurung	123, 119	Chhang bajar 7 Nga
27	Puttra Man Shrestha,4	33	Chhang bajar 4 Ka
28	Rekh Man Shrestha 7	52, 49	Chhang bajar 7 Nga
29	Resham Lal Newar, 7	29, 51, 26, 48	Chhang bajar 7 Nga
30	Ruk Bahadur	114	Chhang bajar 7 Nga
31	Sere Gurung,7	21	Chhang bajar 7 gha
32	Sher Bahadur Gurung, 7	60, 4	Chhang bajar 7 Nga, 7 gha



SN	Owner's Name	Plots Nos.	Cadastral, VDC
33	Som Bahadur	118	Chhang Bajar 7 Nga
34	Som Prasad Shrestha,9	164	Chhang Bajar 9 gha
35	Su. Bal Bahadur Gurung,7	14, 23	Chhang Bajar 7 gha
36	Suman Sinha	113	Chhang Bajar 7 Nga
37	Surbir	122	Chhang Bajar 7 Nga
38	Tek Bahadur Ale Magar,4	31, 23	Chhang Bajar 4 Ka
39	Tek Gurung	130	Chhang Bajar 7 Nga
40	Tilak bahadur Thapa,4	26	Chhang Bajar 4 Ka
41	Tul Maya Gurungseni,7	11, 17	Chhang Bajar 7 gha
42	Tulsi Narayan Shrestha,4	24	Chhang Bajar 4 Ka
43	Unidentified owner	67	Chhang Bajar 7 Nga
44	Unidentified owner	68	Chhang Bajar 7 Nga
45	Unidentified owner	69	Chhang Bajar 7 Nga
46	Unidentified owner	121	Chhang Bajar 7 Nga
47	Unidentified owner	37	Chhang Bajar 4 Ka
48	Unidentified owner	51	Chhang Bajar 4 Ka
49	Unidentified owner	52	Chhang Bajar 4 Ka
50	Unidentified owner	25	Chhang Bajar 7 gha
51	Unidentified owner	26	Chhang Bajar 7 gha
52	Unidentified owner	27	Chhang Bajar 7 gha
53	Unidentified owner	28	Chhang Bajar 7 gha
54	Unidentified owner	29	Chhang Bajar 7 gha
55	Unidentified owner	33	Chhang Bajar 7 gha
56	Unidentified owner	34	Chhang Bajar 7 gha
57	Unidentified owner	35	Chhang Bajar 7 gha
58	Unidentified owner	205	Chhang Bajar 9 gha
59	Unidentified owner	264	Chhang Bajar 9 gha
60	Unidentified owner	289	Chhang Bajar 9 gha
61	Yek Bahadur Gurung	131, 129	Chhang Bajar 7 Nga
62	Yem Bahadur Gurung,7	27	Chhang Bajar 7 Nga
63	Yem Maya Shrestha,9	165	Chhang Bajar 9 gha

Note:

Total Number of identified owners = 45

Total Number of Unidentified plots = 18

3. VDC. Kanhu Shivapur

SN	Owner's Name	Plots Nos.	Cadastral, VDC
1	Aaita Singh Mathim Magar,4	44, 42	Kahun Shivapur 3 ga
2	Aeku	130	Kahun Shivapur 3 ga
3	Amar Singh Sanu magar , Kanhu 3	106	Kahun Shivapur 3 ga
4	Bal Bahadur	114	Kahun Shivapur 3 ga
5	Bal Bahadur Mathim Magar,3	14, 8, 11	Kahun Shivapur 3 ga
6	Bhom Bahadur Thapa	120, 122, 119	Kahun Shivapur 3 ga
7	Bhunte Saru Magar,3	39	Kahun Shivapur 3 ga
8	Daku	128	Kahun Shivapur 3 ga
9	Dal Bahadur Mathim Magar,3	7	Kahun Shivapur 3 ga
10	Debilal	111	Kahun Shivapur 3 ga
11	Deu Maya	110	Kahun Shivapur 3 ga
12	Devilal Rilami Magar,2	53	Kahun Shivapur 3 ga
13	Dhan Bahadur Rilami Magar	13, 31	
14	Dil Bahadur Thapa	123, 121, 118,	Kahun Shivapur 3 ga
15	Ganga Bahadur Rilami Magar,3	10	Kahun Shivapur 3 ga
16	Ghale Thapa Magar,4	43, 46	Kahun Shivapur 3 ga
17	Gobardan Thapa	115, 132, 136	Kahun Shivapur 3 ga

SN	Owner's Name	Plots Nos.	Cadastral, VDC
18	Hastibir Ambar Singh	107	Kahun Shivapur 3 ga
19	Horn Bahadur Ale Magar, Kotdurbar 2	50, 48	Kahun Shivapur 3 ga
20	Ishwori Baral, 2	54	Kahun Shivapur 3 ga
21	Jhul Bahadur Ale Magar, Kotdurbar 2	47, 38	Kahun Shivapur 3 ga
22	Jhul Bahadur Ale Magar, 2	52, 17	Kahun Shivapur 3 ga, kotdurbar 1 kha
23	Man Bahadur Lungoli Magar, 3	29, 30	Kahun Shivapur 3 ga
24	Man Bahadur	137	Kahun Shivapur 3 ga
25	Masudhan Saru Magar, 3	41	Kahun Shivapur 3 ga
26	Mohan Singh Thapa Magar, 4	45	Kahun Shivapur 3 ga
27	Om Bahadur Saru, Kanhu 3	27,	Kahun Shivapur 3 ga
28	Purna Bahadur Saru Magar, 3	40	Kahun Shivapur 3 ga
29	Raman Singh Lungoli Magar, 3	29	Kahun Shivapur 3 ga
30	Shree Maya Ale	138, 139	Kahun Shivapur 3 ga
31	Tika Maya Thapa, Kanhu 3	35,	Kahun Shivapur 3 ga
32	Tul Bahadur Rilami, Kanhu 3	36	Kahun Shivapur 3 ga
33	Unidentified owner	104	Kahun Shivapur 3 ga
34	Unidentified owner	105	Kahun Shivapur 3 ga
35	Unidentified owner	224	Kahun Shivapur 3 ga
36	Unidentified owner	225	Kahun Shivapur 3 ga

Note:

Total Number of identified owners = 32

Total Number of Unidentified plots = 4

4. VDC. Kotdurbar

SN	Owner's Name	Plots Nos.	Cadastral, VDC
1	Bal Bahadur Thapa Magar, 1	10, 1	Kotdurbar 1 Tha (7), 1 ga
2	Bandra Singh Thapa Magar, 7	19	Kotdurbar 1 Tha (7)
3	Bhabilal Thapa Magar, 1	19	Kotdurbar 1 kha
4	Bhakta Bahadur Garga Magar, 3	9, 15, 18, 22	Kotdurbar - 1 Thha (Yf), 1 Thha, 1 Tha, 1 Thha
5	Bhaktabir Thapa Magar, 1	30, 31, 34, 41, 43, 38	Kotdurbar 1 kha
6	Bhim Bahadur Thapa Magar, 1	4	Kotdurbar 1 Tha (7)
7	Dhaku	91	Kotdurbar 1 kha
8	Dharma Bahadur Thapa Magar, 1	13	Kotdurbar 1 Tha (7)
9	Horn Bahadur Ale Magar, 2	18, 37	Kotdurbar 1 kha, Kahun Shivapur 3 ga
10	Karma Singh Thapa Magar, 7	11	Kotdurbar 1 Tha (7)
11	Karna Bahadur Thapa Magar, 7	12	Kotdurbar 1 Tha (7)
12	Khadka Singh Garga Magar,	26, 6, 8, 12, 14, 16, 10	Kotdurbar 1 Tha (7), 1 Thha, 1 Thha, 1 Thha, 1 Thha, 1 Thha, 1 Thha, 1 Thha, 1 Thha, 1 Thha
13	Khum Bahadur	6, 8	Kotdurbar 1 ga
14	Lal Bahadur, Kanu 3 Rindanda	7, 9	Kotdurbar 1 ga
15	Limang River	5	Kotdurbar 1 ga
16	Man Bahadur Thapa Magar, 1	28, 33, 35, 37, 40	Kotdurbar 1 kha
17	Mu. Purna bahadur Ale Magar, 1	3, 4	Kotdurbar 1 ga
18	Santa Bahadur Thapa Magar, 1	7	Kotdurbar 1 Tha (7)
19	Sarbajit Ale Magar, 3	2, 3, 1, 2	Kotdurbar 1 Tha (7), 1 Tha, 1 Ta, 1 Ta
20	Sher Bahadur Thapa Magar, 1	9	Kotdurbar 1 Tha (7)
21	Tile Thapa magar, 1	29, 32, 36, 42, 44	Kotdurbar 1 kha
22	Yagya Thapa Magar, 3	25, 5, 7, 11, 13	Kotdurbar 1 Tha (7), 1 Thha, 1 Thha, 1 Thha, 1 Thha



SN	Owner's Name	Plots Nos.	Cadastral, VDC
23	Yek bahadur	89	Kotdurbar 1 kha
24	Unidentified owner	Na	Kotdurbar - 1 Thha (Yf)
25	Unidentified owner	na	Kotdurbar - 1 Thha (Yf)
26	Unidentified owner	na	Kotdurbar - 1 Thha (Yf)
28	Unidentified owner	31	Kotdurbar 1 ga
29	Unidentified owner	118	Kotdurbar 1 ga
30	Unidentified owner	119	Kotdurbar 1 ga
31	Unidentified owner	72	Kotdurbar 1 kha
32	Unidentified owner	4	Kotdurbar 1 Ta (Tf)

Note:

Total Number of identified owners = 23

Total Number of Unidentified plots = 9

5. VDC. Rising Ranipokhari (Some plots from Sabhung Bhagwatipur)

SN	Owner's Name	Plots Nos.	Cadastral, VDC
1	Aash bahadur Thapa	61	Rising Ranipokhari 9 Jha
2	Apusara Magarni, 9	19	Rising Ranipokhari 9 Jha
3	Babu Kaji	31, 506	Rising Ranipokhari 8 ga (u), Sabhung Bhagwatipur 1 kha
4	Babu Lal Sarki, 8	27	Rising Ranipokhari 9 Jha
5	Babu lal Shrestha, 8	5	Rising Ranipokhari 7 Kha (Vf)
6	Baburam	505	Sabhung Bhagwatipur 1 Kha, Ranipokhari
7	Bal Bahadur Sunari, 9	21	Rising Ranipokhari 9 Jha
8	Bal Bahadur Thapa, 9	20	Rising Ranipokhari 9 Jha
9	Balkrishna Gaire, 1	114	sabhung Bhagwatipur 1 Ka Ranipokhari
10	Bam Nath Ghaire, 1	12	sabhung Bhagwatipur 1 Ka Ranipokhari
11	Ban Singh Thapa	20	Rising Ranipokhari 9 ga
12	Bashudev Gaire, 1	8	sabhung Bhagwatipur 1 Ka Ranipokhari
13	Basudev	34	Rising Ranipokhari 8 ga (u)
14	Bel Bahadur Shrestha, 8	95, 1	Rising Ranipokhari 7 ga (u), Sabhung Bhagwatipur 1 Nya
15	Bhabishowr Ghaire, 1	14	sabhung Bhagwatipur 1 Ka Ranipokhari
16	Bhobilal Karki, 2	411	Sabhung Bhagwatipur 1 Kha, Ranipokhari
17	Bhuban Singh Khadka, 7	46, 30, 2	Rising Ranipokhari 9 Jha, 9 jha, 7 kha
18	Bin Bahadur Rana, 7	5	Rising Ranipokhari 9 Jha
19	Bir Bahadur Lamakam, 7	10, 27	Rising Ranipokhari 7 Kha (Vf)
20	Bir Bahadur Shrestha, 1	10	Sabhung Bhagwatipur 1 chha, Ranipokhari
21	Birkha Bahadur Khamba Magar, 9	4	Rising Ranipokhari 9 ga
22	Bishne Damai, 1	20	Sabhung Bhagwatipur 1 ja, Ranipokhari
23	Bodh Raj Gaire, 1	3, 145	sabhung Bhagwatipur 1 Ka Ranipokhari, 1 Ana Majkot
24	Chabi Lal Thenga, 7	40	Rising Ranipokhari 9 Jha
25	Chandra Bahadur Daami, 1	21	Sabhung Bhagwatipur 1 ja, Ranipokhari
26	Chandra Sarki, 8	26	Rising Ranipokhari 9 Jha
27	Dal Bahadur Thapa, 7	9, 13, 18, 21	Sabhung Bhagwatipur 1 Nya, Ranipokhari
28	Dallu Thenga, 7	14	Rising Ranipokhari 9 Jha
29	Deu Raj Ale, 9	6, 17	Sabhung Bhagwatipur 1 Nya, Ranipokhari
30	Deuchan Lamakam, 7	38, 9	Rising Ranipokhari 9 Jha, 7 kha

SN	Owner's Name	Plots Nos.	Cadastral, VDC
31	Devi Lal Sunari,7	4, 17	Rising Ranipokhari 7 Kha (Vf)
32	Dhal Bahadur Thenga,7	19, 18	Rising Ranipokhari 7 Kha (Vf), 8 ga
33	Dhan Singh Rana,7	1, 44, 23, 51, 42	Rising Ranipokhari 7 Kha (Vf), 7 kha, 9 jha, 9 jha, 9 jha
34	Dhole Thenga,7	2	Rising Ranipokhari 9 Jha
35	Dil Bahadur Ale,9	4, 16	Sabhung Bhagwatipur 1 Nya, Ranipokhari
36	Dil Bahadur Gurung,5	12	Sabhung Bhagwatipur 1 Nya, Ranipokhari
37	Ganesh Kumar Shrestha,1	6, 8, 2	Sabhung Bhagwatipur 1 Kha, 1kha Ranipokhari, 8 ga Rising ranipokhari
38	Ganesh Man Shrestha,7	43	Rising Ranipokhari 7 Kha (Vf)
39	Gau Bahadur Thenga7	16	Rising Ranipokhari 8 ga (u)
40	Gobilal Thenga,7	3	Rising Ranipokhari 9 Jha
41	Gobinda	504	Sabhung Bhagwatipur 1 Kha, Ranipokhari
42	Hasta Bahadur Saru,9	8, 22	Rising Ranipokhari 7 Kha (Vf)
43	Hiranya Lal Ghaire,1	11	sabhung Bhagwatipur 1 Ka Ranipokhari
44	Indra Bahadur Shrestha,8	46	Rising Ranipokhari 7 Kha (Vf)
45	Jagat Bahadur Sunari,7	1, 6	Rising Ranipokhari 9 Jha
46	Jas Bahadur	57, 59	Rising Ranipokhari 9 Jha
47	Jhakbir Thapa,7	47	Rising Ranipokhari 7 Kha (Vf)
48	Jhul Bahadur ,	34	Rising Ranipokhari 9 Jha
49	Jhul Bahadur,	37, 90	Rising Ranipokhari 9 Jha, kotdurbar 1 kha
50	Juddha Bir Rana Magar,7	24	Rising Ranipokhari 8 ga (u)
51	Junga Bahadur Khadka,7	17, 29, 41, 43	Rising Ranipokhari 9 Jha
52	Kahar Singh Thenga,7	20	Rising Ranipokhari 8 ga (u)
53	Kala Lanka Thapa , 9	56	Rising Ranipokhari 9 Jha
54	Khadga Bahadur Thenga	13, 16	Rising Ranipokhari 9 Jha
55	Khem Bahadur Sunari,7	7, 16, 35	Rising Ranipokhari 7 Kha (Vf), 7 kha, 9 jha
56	Khum Lal Bhawa Dham, 7	22, 50, 55, 53	Rising Ranipokhari 9 Jha
57	Krishna Bahadur Rana, 7	9	Rising Ranipokhari 9 Jha
58	Kunaram Thenga,7	20	Rising Ranipokhari 7 Kha (Vf)
59	Lal Bahadur Thapa,9	2, 8	Sabhung Bhagwatipur 1 Nya, Ranipokhari
60	Lal Kumari	447	Sabhung Bhagwatipur 1 Kha, Ranipokhari
61	Lal Sinha	64	Rising Ranipokhari 9 Jha
62	Lali Thapa	35	Rising Ranipokhari 8 ga (u)
63	Lekh Bahadur Thenga,7	21	Rising Ranipokhari 7 Kha (Vf)
64	Loknath Ghaire,1	15	sabhung Bhagwatipur 1 Ka Ranipokhari
65	Maite Damai	20	Sabhung Bhagwatipur 1 chha, Ranipokhari
66	Man Bahadur Ale,9	5, 15, 20	Sabhung Bhagwatipur 1 Nya, Ranipokhari
67	Man Kumari Magarni,7	44, 45	Rising Ranipokhari 9 Jha
68	Mane Sunari	62	Rising Ranipokhari 9 Jha
69	Mani Ratna Ghaire,1	10	sabhung Bhagwatipur 1 Ka Ranipokhari
70	Mayer Singh Rana,7	8, 10	Rising Ranipokhari 9 Jha
71	Mitra Lal Gaire,1	7	sabhung Bhagwatipur 1 Ka Ranipokhari
72	Netra Bahadur Ale, 9	1	Rising Ranipokhari 9 ga
73	Ohm Raj Ghaire,1	17,11	sabhung Bhagwatipur 1 Ka 1 chha Ranipokhari,

SN	Owner's Name	Plots Nos.	Cadastral, VDC
74	Padam Pani Ghaire,1	10, 17	Sabhung Bhagwatipur 1 ja, Ranipokhari, 1 chha
75	Padma Kanta Ghaire,1	1,2	sabhung Bhagwatipur 1 ja, 1 Ka, Ranipokhari
76	Pahalman Shrestha,8	50	Rising Ranipokhari 7 Kha (Vf)
77	Parwasi Kami,7	45	Rising Ranipokhari 7 Kha (Vf)
78	Prithivi Narayan Rana,7	7	Rising Ranipokhari 9 Jha
79	Purna Bahadur Thenga	96, 19, 21	Rising Ranipokhari 7 ga (u), 8ga, 8 ga
80	Rabi Lal Damai,1	12	Sabhung Bhagwatipur 1 chha, Ranipokhari
81	Rana Singh Thenga,7	14	Rising Ranipokhari 7 Kha (Vf)
82	Rekh Bahadur Thapa,7	3, 7, 14, 19, 22	Sabhung Bhagwatipur 1 Nya, Ranipokhari
83	Rikhiram Tiwari,1	13, 18 19	Sabhung Bhagwatipur 1 chha, 1 chha Ranipokhari, S.B 1 ja
84	Rishiram Gaire,1	5	sabhung Bhagwatipur 1 Ka Ranipokhari
85	Rupdhar Sinar,1	2	Sabhung Bhagwatipur 1 Kha, Ranipokhari
86	Samajit Thapa Magar,7	11	Rising Ranipokhari 7 Kha (Vf)
87	Santa Bahadur	32	Rising Ranipokhari 8 ga (u)
88	Santa Bir Thapa Magar, 9	49, 54	Rising Ranipokhari 9 Jha
89	Shree Prasad Para, 9	28, 58, 60	Rising Ranipokhari 9 Jha
90	Shyam lal Gaire,1	9	sabhung Bhagwatipur 1 Ka Ranipokhari
91	Sole Thanga,7	13	Rising Ranipokhari 7 Kha (Vf)
92	Tek Bahadur Sunari,9	12,24, 39, 52	Rising Ranipokhari 9 Jha
93	Tek Bahadur Thenga,7	3	Rising Ranipokhari 7 Kha (Vf)
94	Thaman Prasad Ghaire,1	1	sabhung Bhagwatipur 1 Ka Ranipokhari
95	Tija Maya Gaireni	14	Sabhung Bhagwatipur 1 chha, Ranipokhari
96	Tole Sunari Thapa,9	33, 36, 18	Rising Ranipokhari 9 Jha, 9 jha, 7 kha
97	Trilochan Gaire,1	12,13, 16	Sabhung Bhagwatipur 1 ja, Ranipokhari, 1 ja, 1 ka
98	Tulsi Jargha,7	11	Rising Ranipokhari 9 Jha
99	Uddei Damai,8	1, 15, 18	Sabhung Bhagwatipur 1 chha, Ranipokhari, 1 ja, 1 ja
100	Uttam Kumar B.K	69, 76	Rising Ranipokhari 7 Kha (Vf)
101	Unidentified owner	63	Rising Ranipokhari 7 Kha (Vf)
102	Unidentified owner	64	Rising Ranipokhari 7 Kha (Vf)
103	Unidentified owner	65	Rising Ranipokhari 7 Kha (Vf)
104	Unidentified owner	66	Rising Ranipokhari 7 Kha (Vf)
105	Unidentified owner	67	Rising Ranipokhari 7 Kha (Vf)
106	Unidentified owner	68	Rising Ranipokhari 7 Kha (Vf)
107	Unidentified owner	69	Rising Ranipokhari 7 Kha (Vf)
108	Unidentified owner	70	Rising Ranipokhari 7 Kha (Vf)
109	Unidentified owner	71	Rising Ranipokhari 7 Kha (Vf)
110	Unidentified owner	72	Rising Ranipokhari 7 Kha (Vf)
111	Unidentified owner	74	Rising Ranipokhari 7 Kha (Vf)
112	Unidentified owner	75	Rising Ranipokhari 7 Kha (Vf)
113	Unidentified owner	76	Rising Ranipokhari 7 Kha (Vf)
114	Unidentified owner	77	Rising Ranipokhari 7 Kha (Vf)
115	Unidentified owner	78	Rising Ranipokhari 7 Kha (Vf)
116	Unidentified owner	79	Rising Ranipokhari 7 K .a (Vf)
117	Unidentified owner	80	Rising Ranipokhari 7 Kha (Vf)

SN	Owner's Name	Plots Nos.	Cadastral, VDC
118	Unidentified owner	82	Rising Ranipokhari 7 Kha (Vf)
119	Unidentified owner	83	Rising Ranipokhari 7 Kha (Vf)
120	Unidentified owner	84	Rising Ranipokhari 7 Kha (Vf)
121	Unidentified owner	86	Rising Ranipokhari 7 Kha (Vf)
122	Unidentified owner	87	Rising Ranipokhari 7 Kha (Vf)
123	Unidentified owner	88	Rising Ranipokhari 7 Kha (Vf)
124	Unidentified owner	89	Rising Ranipokhari 7 Kha (Vf)
125	Unidentified owner	90	Rising Ranipokhari 7 Kha (Vf)
126	Unidentified owner	91	Rising Ranipokhari 7 Kha (Vf)
127	Unidentified owner	92	Rising Ranipokhari 7 Kha (Vf)
128	Unidentified owner	99	Rising Ranipokhari 7 Kha (Vf)
129	Unidentified owner	100	Rising Ranipokhari 7 Kha (Vf)
130	Unidentified owner	101	Rising Ranipokhari 7 Kha (Vf)
131	Unidentified owner	102	Rising Ranipokhari 7 Kha (Vf)
132	Unidentified owner	103	Rising Ranipokhari 7 Kha (Vf)
133	Unidentified owner	104	Rising Ranipokhari 7 Kha (Vf)
134	Unidentified owner	105	Rising Ranipokhari 7 Kha (Vf)
135	Unidentified owner	106	Rising Ranipokhari 7 Kha (Vf)
136	Unidentified owner	81	Rising Ranipokhari 7 Kha (Vf)
137	Unidentified owner	339	Rising Ranipokhari 8 ga (u)
138	Unidentified owner	388	Rising Ranipokhari 8 ga (u)
139	Unidentified owner	389	Rising Ranipokhari 8 ga (u)
140	Unidentified owner	392	Rising Ranipokhari 8 ga (u)
141	Unidentified owner	393	Rising Ranipokhari 8 ga (u)
142	Unidentified owner	490	Rising Ranipokhari 8 ga (u)
143	Unidentified owner	491	Rising Ranipokhari 8 ga (u)
144	Unidentified owner	498	Rising Ranipokhari 8 ga (u)
145	Unidentified owner	499	Rising Ranipokhari 8 ga (u)
146	Unidentified owner	500	Rising Ranipokhari 8 ga (u)
147	Unidentified owner	502	Rising Ranipokhari 8 ga (u)
148	Unidentified owner	503	Rising Ranipokhari 8 ga (u)
149	Unidentified owner	562	Rising Ranipokhari 8 ga (u)
150	Unidentified owner	564	Rising Ranipokhari 8 ga (u)
151	Unidentified owner	Na	Rising Ranipokhari 8 ga (u)
152	Unidentified owner	Na	Rising Ranipokhari 8 ga (u)
153	Unidentified owner	9	Rising Rani Pokhari 9 Kha (Vf)
154	Unidentified owner	50	Rising Rani Pokhari 9 Kha (Vf)
155	Unidentified owner	1	Sabhung Bhagwatipur 2 ka, Ranipokhari
156	Unidentified owner	494	sabhung Bhagwatipur 1 Ka Ranipokhari
157	Unidentified owner	495	sabhung Bhagwatipur 1 Ka Ranipokhari
158	Unidentified owner	557	sabhung Bhagwatipur 1 Ka Ranipokhari
159	Unidentified owner	558	sabhung Bhagwatipur 1 Ka Ranipokhari
160	Unidentified owner	29	Sabhung Bhagwatipur 1 Nya, Ranipokhari
161	Unidentified owner	30	Sabhung Bhagwatipur 1 Nya, Ranipokhari
162	Unidentified owner	415	Sabhung Bhagwatipur 1 chha, Ranipokhari
163	Unidentified owner	412	Sabhung Bhagwatipur 1 Kha, Ranipokhari
164	Unidentified owner	414	Sabhung Bhagwatipur 1 Kha, Ranipokhari

SN	Owner's Name	Plots Nos.	Cadastral, VDC
165	Unidentified owner	415	Sabhung Bhagwatipur 1 Kha, Ranipokhari
166	Unidentified owner	435	Sabhung Bhagwatipur 1 Kha, Ranipokhari
167	Unidentified owner	436	Sabhung Bhagwatipur 1 Kha, Ranipokhari
168	Unidentified owner	446	Sabhung Bhagwatipur 1 Kha, Ranipokhari
169	Unidentified owner	63	Rising Ranipokhari 9 Jha
170	Unidentified owner	415	Sabhung Bhagwatipur 1 ja, Ranipokhari

Note:

Total Number of identified owners = 99

Total Number of Unidentified plots = 71

6. Majkot (Sabhung Bhagwatipur 1 Dha and 1 Ana)

SN	Owner's Name	Plots Nos.	Cadastral, VDC
1	Babame Gaire	292	Sabhung Bhagabatipur 1 Dha , Majkot
2	Badri Nath Gaire	40, 44, 263, 420	Sabhung Bhagabatipur 1 Dha , Majkot
3	Bal Krishna Gaire	54, 58	Sabhung Bhagabatipur 1 Dha , Majkot
4	Balaram Gaire Jaisi,1	38, 46, 57	Sabhung Bhagabatipur 1 Dha , Majkot
5	Bam Dev Aryal,2	247	Sabhung Bhagabatipur 1 Dha , Majkot
6	Bhakta Bahadur Thapa,2	248, 249	Sabhung Bhagabatipur 1 Dha , Majkot
7	Bhakti Prasad Gaire jaisi,1	34, 49, 147, 42	Sabhung Bhagabatipur 1 Dha , Majkot
8	Bhim Lal Lamsal, Majkot 9	176	Sabhung Bhagwatipur 1 Ana Majkot
9	Bhima Lal	345, 354	Sabhung Bhagabatipur 1 Dha , Majkot
10	Bhod Raj	404, 594	Sabhung Bhagwatipur 1 Ana Majkot
11	Biddhu Nath Ghair,1	173	Sabhung Bhagwatipur 1 Ana Majkot
12	Bishnu Hari Gaire jaisi,1	213, 231(1Dha), 141, 143(1 Ana)	Sabhung Bhagabatipur 1 Dha , Majkot
13	Bisnu Devi Gaire	162	Sabhung Bhagabatipur 1 Dha , Majkot
14	Bodhraj Gaire Jaisi,1	219, 224	Sabhung Bhagabatipur 1 Dha , Majkot
15	Chakrapani Devkota	239	Sabhung Bhagabatipur 1 Dha , Majkot
16	Chandra Kala Gaire	294	Sabhung Bhagabatipur 1 Dha , Majkot
17	Chandra Kanta Gaire Jaisi,1	228,	Sabhung Bhagabatipur 1 Dha , Majkot
18	Chhaturbhuj Gaire Jaisi,1	208, 210	Sabhung Bhagabatipur 1 Dha , Majkot
19	Danda Pani Subedi,4	246, 362	Sabhung Bhagabatipur 1 Dha , Majkot
20	Dasi Narayan	287	Sabhung Bhagabatipur 1 Dha , Majkot
21	Deudatta Bhandari	387	Sabhung Bhagabatipur 1 Dha , Majkot
22	Dharmoni Gaireni Jaisini,1	35, 47, 37, 41	Sabhung Bhagabatipur 1 Dha , Majkot
23	Dil Maya Gaire, Majkot 9	330	Sabhung Bhagwatipur 1 Ana Majkot
24	Dil Maya	593	Sabhung Bhagwatipur 1 Ana Majkot
25	Dilli Maya Gaire	337	Sabhung Bhagabatipur 1 Dha , Majkot
26	Diwakar Gaire Jaisi,1	236	Sabhung Bhagabatipur 1 Dha , Majkot
27	Gunakhar Ghair,1	166, 13, 18	Sabhung Bhagwatipur 1 Ana Majkot, 1 ka Risin, 1 ka Risin
28	Hari Chandra Bhandari	388	Sabhung Bhagabatipur 1 Dha , Majkot
29	Hari Maya	338	Sabhung Bhagabatipur 1 Dha , Majkot
30	Hiranna Lal Gaire Jaisi,1	229	Sabhung Bhagabatipur 1 Dha , Majkot
31	Hom Nath Ghair,1	137, 142	Sabhung Bhagwatipur 1 Ana Majkot
32	Ishwor	592	Sabhung Bhagwatipur 1 Ana Majkot
33	Kalika Gaire	313	Sabhung Bhagabatipur 1 Dha , Majkot
34	Kashiram Gaire jaisi,1	235	Sabhung Bhagabatipur 1 Dha , Majkot
35	Khim Lal Poudel	26	Sabhung Bhagabatipur 1 Dha , Majkot

SN	Owner's Name	Plots Nos.	Cadastral, VDC
36	Krishna	356	Sabhung Bhagabatipur 1 Dha , Majkot
37	Krishna Lal Gaire Jaisi,1	160, 163	Sabhung Bhagabatipur 1 Dha , Majkot
38	Kul Bahadur Rana Magar,1	217, 216	Sabhung Bhagabatipur 1 Dha , Majkot
39	Laxmi	415	Sabhung Bhagwatipur 1 Ana Majkot
40	Laxmi Kanta	280	Sabhung Bhagabatipur 1 Dha , Majkot
41	Lilamaya Gaireni,1	252	Sabhung Bhagwatipur 1 Ana Majkot
42	Lok Man Gaire,1	16	Sabhung Bhagwatipur 1 Ana Majkot
43	Megha Nath Upadhyaya	288, 289	Sabhung Bhagabatipur 1 Dha , Majkot
44	Mu. Narayandutta Gaire,1	23	Sabhung Bhagabatipur 1 Dha , Majkot
45	Nanda Lal Gaire,1	264	Sabhung Bhagwatipur 1 Ana Majkot
46	Narayan Dutta Gaire	262	Sabhung Bhagabatipur 1 Dha , Majkot
47	Ohm Raj	405	Sabhung Bhagwatipur 1 Ana Majkot
48	Parbati Gaire	335	Sabhung Bhagabatipur 1 Dha , Majkot
49	Puspa Raj Gaire	293, 36, 33,	Sabhung Bhagabatipur 1 Dha , Majkot
50	Radhika Gaire, Ranipokhari 9	373	Sabhung Bhagabatipur 1 Dha , Majkot
51	Raju Prasad	355	Sabhung Bhagabatipur 1 Dha , Majkot
53	Ram Prasad Gaire	327, 242, 241, 230, 328, 240	Sabhung Bhagabatipur 1 Dha , Majkot
54	Ramdutta Gaire Jaisi,1	372, 25	Sabhung Bhagabatipur 1 Dha , Majkot
55	Ramnath Gaire Jaisi,1	232, 226	Sabhung Bhagabatipur 1 Dha , Majkot
56	Salikram Gaire Jaisi,1	148	Sabhung Bhagabatipur 1 Dha , Majkot
57	Sher Bahadur Shrestha,9	68	Sabhung Bhagabatipur 1 Dha , Majkot
58	Shiva Dutta Gaire,1	17,	Sabhung Bhagwatipur 1 Ana Majkot, 1 dha, 1 dha
59	Surbir Ale,1	165	Sabhung Bhagwatipur 1 Ana Majkot
60	Surya Ratna Shrestha,5	59, 60, 61	Sabhung Bhagabatipur 1 Dha , Majkot
61	Tek Nath Gaire Jaisi,1	225	Sabhung Bhagabatipur 1 Dha , Majkot
62	Thir Lal Gaire Jaisi,1	45, 43, 263, 39	Sabhung Bhagabatipur 1 Dha , 1 Dha, 1 Ana Majkot
63	Til Maya Gaire	161	
64	Tirtha Raj Gaire	291	Sabhung Bhagabatipur 1 Dha , Majkot
65	Udaya Raj	329	Sabhung Bhagabatipur 1 Dha , Majkot
66	Ujeli Maya Gaire,1	53	Sabhung Bhagabatipur 1 Dha , Majkot
67	Unidentified owner	251	Sabhung Bhagabatipur 1 Dha , Majkot
68	Unidentified owner	260	Sabhung Bhagabatipur 1 Dha , Majkot
69	Unidentified owner	261	Sabhung Bhagabatipur 1 Dha , Majkot
70	Unidentified owner	264	Sabhung Bhagabatipur 1 Dha , Majkot
71	Unidentified owner	265	Sabhung Bhagabatipur 1 Dha , Majkot
72	Unidentified owner	336	Sabhung Bhagabatipur 1 Dha , Majkot
73	Unidentified owner	419	Sabhung Bhagabatipur 1 Dha , Majkot
74	Unidentified owner	Na	Sabhung Bhagabatipur 1 Dha , Majkot
75	Unidentified owner	Na	Sabhung Bhagabatipur 1 Dha , Majkot
76	Yem Nath Ghaire,1	136	Sabhung Bhagwatipur 1 Ana Majkot

Note:

Total Number of identified owners = 66

Total Number of Unidentified plots = 10

Total private owners identified at designed FSL of 425m were found to be 275.

113 private plots' owners could not be identified at the moment. Government Land, Parti land, bushes area, Forest plots and River plots are not included in the above mentioned plots.



List of name of the Owners of the Affected Plots at Project Facility Sites

7. Beni Patan (Vyas Municipality)

SN	Owners Name and Address	Plot Nos.	VDC, Cadestral
1	Aek Bahadur	524	Gunadi 1Kha
2	Ajaya Kumar	1004	Gunadi 1Kha
3	Ambar Bahadur	340	Gunadi 1Ga
4	Amrit Lal Shrestha	220,218(1Ga),1043	Gunadi 1Kha
5	Apasara Thapa	727	Gunadi 1Kha
6	Babula Shrestha	483(1Kha)219,217	Gunadi 1Ga
7	Baburam	500	Gunadi 1Kha
8	Bahadur Ale Magar,1	285	Gunadi 1Kha
9	Bal bahadur Thapa	435,431	Gunadi 1Kha
10	Bal BahadurBote,1	165,163,353	Gunadi 1Kha
11	Bale sarki,1	188	Gunadi 1Kha
12	Baliram Thapa Magar,1	46(1Ga),279	Gunadi 1Kha
13	Bam Bahadur Saru Magar	12,334,332	Gunadi 1Ga
14	Bamdev	482	Gunadi 1Kha
15	Bhagawan Giri	146	Gunadi 1Ga
16	Bhairab	132,131	Gunadi 1Ga
17	Bhim Bahadur Garga Magar,1	1076,1068,1014,205,15,1059	Gunadi 1Kha
18	Bhimlal Giri,1	276	Gunadi 1Kha
19	Bhoj kumar	638	Gunadi 1Kha
20	Bhojraj Khanal,2	841,157	Gunadi 1Kha
21	Bijaya Raj	541	Gunadi 1Kha
22	Bimala	590	Gunadi 1Kha
23	Bir Bahadur	100,449	Gunadi 1Kha
24	Bishnu	205,82(1Ga)1193	Gunadi 1Kha
25	Bishnu Lal	1047	Gunadi 1Kha
26	Bishnu maya Malla	744	Gunadi 1Kha
27	Bisnu Bahadur Ale	361	Gunadi 1Ga
28	Biwaha Maya	704	Gunadi 1Kha
29	Buddha Bahadur Thapa,1	58,54	Gunadi 1Ga
30	Buddhi	640,122	Gunadi 1Ga
31	Chandra Kala Malla	359	Gunadi 1Ga
32	Chandra Singh Thapa	69,754, 717	Gunadi 1Ga
33	Chet Bahadur Thapa	681,679	Gunadi 1Ga
34	Chij Kumari	234,349	Gunadi 1Ga
35	Chija Kumari Joshi	7,011,208	Gunadi 1Ga
36	Chija Maya	531	Gunadi 1Kha
37	Chin Kumari	464	Gunadi 1Kha
38	Chini Maya Magar	676,678	Gunadi 1Kha
39	Chitra Singh	265	Gunadi 1Kha
40	Dal Bahadur Garga Magar,1	20	Gunadi 1Kha

SN	Owners Name and Address	Plot Nos.	VDC, Cadestral
41	Dambar Bahadur	6,951,078	Gunadi 1Kha
42	Dambar Kumari	81	Gunadi 1Kha
43	Dambar Singh Thapa	891,895,879, 877	Gunadi 1Ga
44	Dan Bahdur Magar	963	Gunadi 1Ga
45	Debendra Dhakal	646	Gunadi 1Kha
46	Dev Bahadur Malla	781	Gunadi 1Kha
47	Dewan Singh Rana	643	Gunadi 1Ga
48	Dhan Bahadur Gurung	924,614	Gunadi 1Ga
49	Dil bahadur	896,892	Gunadi 1Kha
50	Dil Bahadur Derai,2	194	Gunadi 1Ga
51	Dil Bahadur Sunawar	862	Gunadi 1Kha
52	Dil maya Ale	767,765	Gunadi 1Kha
53	Dilap Singh Thapa Magar,1	383,282	Gunadi 1Kha
54	Dilli Raj Thapa	852	Gunadi 1Kha
55	Dilu Maya Thapa	599	Gunadi 1Kha
56	Dori Maya Ale	714	Gunadi 1Kha
57	Ganesh Bahadur Magar	585,624	Gunadi 1Kha
58	Ghangadhar Thapa Magar,1	108,107	Gunadi 1Ga
59	Gore bahadur B.k	860	Gunadi 1Kha
60	Gyan Bahadur Thapa	609	Gunadi 1Ga
61	Haribal Saru Magar,1	331,333,56	Gunadi 1Ga
62	Hasta Bahadur Darai,2	135	Gunadi 1Ga
63	Heera Singh Thapa	925	Gunadi 1Kha
64	Hom Raj	652	Gunadi 1Ga
65	Iman Singh	733	Gunadi 1Ga
66	Iman Singh	864,748	Gunadi 1Kha
67	Indu Prasad Wagle	358	Gunadi 1Kha
68	Ishwor Thapa	675	Gunadi 1Ga
69	Ishwor, Madhu Thapa	622	Gunadi 1Kha
70	Jana	644,643	Gunadi 1Kha
71	Jeet Bahadur Bote	645,694	Gunadi 1Kha
72	Jeet Bahadur Thapa Magar,1	56,125,134	Gunadi 1Kha
73	Jeevan Thapa	180	Gunadi 1Ga
74	Jog Bahadur THapa	780	Gunadi 1Kha
75	Jomaya Thapa	630	Gunadi 1Ga
76	Juti Maya	1080	Gunadi 1Kha
77	Kagiman	1027	Gunadi 1Kha
78	Kali Thapa	854,602	Gunadi 1Kha
79	Kalu Bahadur Ale,1	52	Gunadi 1Kha
80	Kaluram Thapa Magar,1	57(1Ga),100	Gunadi 1Kha
81	Karam Singh	746	Gunadi 1Ga
82	Karma Bahadur Ale	645	Gunadi 1Kha
83	Karma Singh Thapa	904,656,732	Gunadi 1Kha
84	Keshab Bahadur	505,507	Gunadi 1Ga

SN	Owners Name and Address	Plot Nos.	VDC, Cadestral
85	Keshab Raj	540	Gunadi 1Ga
86	Keshar, nar bahadur	693	Gunadi 1Kha
87	Khadka Bahadur Bote	230	Gunadi 1Kha
88	Khadka Bahadur darai	1021	Gunadi 1Kha
89	Khagisara Ale	760,719	Gunadi 1Ga
90	Khagisara Thapa	692	Gunadi 1Kha
91	Khem Lal Giri	177,121	Gunadi 1Ga
92	Krishna Giri	642	Gunadi 1Ga
93	Krishna Prasad	501	Gunadi 1Kha
94	Kusumaya	774	Gunadi 1Kha
95	Lal Ale	363	Gunadi 1Kha
96	Lal Bahadur	375,373,281	Gunadi 1Ga
97	Lal Bahadur Roka	346	Gunadi 1Ga
98	Laxmi Devi	10,981,209	Gunadi 1Ga
99	Laxmi Giri	184	Gunadi 1Kha
100	Lila Bahadur Bote,1	166,164	Gunadi 1Kha
101	Lila Kumari	707	Gunadi 1Ga
102	Lilamber Thapa	777	Gunadi 1Kha
103	Lile Ale Magar,1	53	Gunadi 1Kha
104	Madhu Giri	178,176	Gunadi 1Ga
105	Madhu maya Malla	182	Gunadi 1Ga
106	Madhu Singh Thapa	725,919,587	Gunadi 1Ga
107	Mahadev	1052	Gunadi 1Ga
108	Man bahadur	1,075,257	Gunadi 1Kha
109	Man Bahadur Rana	987	Gunadi 1Kha
110	Man Bahadur Saru Magar,1	133,57	Gunadi 1Ga
111	Man Maya	370,342	Gunadi 1Kha
112	Man Maya Bakhe	762,710	Gunadi 1Ga
113	Man Maya Sarki	687	Gunadi 1Kha
114	Mathu Singh Pulami	638	Gunadi 1Kha
115	Mina Radha	489	Gunadi 1Ga
116	Mitthu Maya devi	1067	Gunadi 1Kha
117	Motilal Magar	619	Gunadi 1Ga
118	Narsingh Baral Magar,2	139	Gunadi 1Kha
119	Nash Singh	391	Gunadi 1Kha
120	Nirmala Maya Thapa	909	Gunadi 1Kha
121	Niru Maya Bote	164,168	Gunadi 1Kha
122	Pabikala Thapa	629	Gunadi 1Ga
123	Padam Bahadur Garga Magar,1	6	Gunadi 1Kha
124	Parbati Rana	1058	Gunadi 1Ga
125	Parbati Ranabhat	885	Gunadi 1Kha
126	Prajapati	199,111	Gunadi 1Kha
127	Puni Maya	206	Gunadi 1Kha
128	Purni Maya Joshi	194	Gunadi 1Ga

SN	Owners Name and Address	Plot Nos.	VDC, Cadestral
129	Rai Maya Sarki	673,671	Gunadi 1Ga
130	Rajeshwor Paudel	148	Gunadi 1Ga
131	Ram Bhakta Rana	690	Gunadi 1Kha
132	Ram Bhakta Ranabhat	770	Gunadi 1Ga
133	Ram Kumari Sarki	457,229	Gunadi 1Ga
134	Rana Bal Thapa	280	Gunadi 1Kha
135	Rana Singh Thapa	573	Gunadi 1Ga
136	Ranajit Bharati,1	259	Gunadi 1Kha
137	Resham Bahadur Ale	749	Gunadi 1Kha
138	Rikhe B.K	771	Gunadi 1Kha
139	Rima Thapa	682,680	Gunadi 1Ga
140	Rishi Ram Thapa	964	Gunadi 1Kha
141	Sahabir Pulami Magar,2	140	Gunadi 1Kha
142	Santa Bahadur	1011, 1010, 1008	Gunadi 1Ga
143	Sanu Kumari Shrestha	341	Gunadi 1Ga
144	Shamsher	842	Gunadi 1Kha
145	Sher Bahadur Ale	672	Gunadi 1Kha
146	Sher Bahadur Makim,2	141,143,138	Gunadi 1Kha
147	Sher Bahadur Thapa Magar,1	43,283,44	Gunadi 1Kha
148	Sher, Disu Magar	998	Gunadi 1Ga
149	Shivashankar karki	421	Gunadi 1Ga
150	Shova Gurung	588	Gunadi 1Kha
151	Shreejung Thapa Magar,2	1008, 103	Gunadi 1Kha
152	Shuma Thapa	647	Gunadi 1Ga
153	Sukumaya Gurung	905,637	Gunadi 1Kha
154	Sunita Budathoki	641	Gunadi 1Kha
155	Suresh Raj Panth	610	Gunadi 1Ga
156	Surya Bahadur	752	Gunadi 1Kha
157	Tanka Bahadur Thapa	607	Gunadi 1Kha
158	Tara Khanal	665	Gunadi 1Kha
159	Tek Kumari	1042	Gunadi 1Ga
160	Til Bahadur B.K	764,688	Gunadi 1Kha
161	Tul Bahadur	88	Gunadi 1Ga
162	Uttam Bahadur Ale,1	61	Gunadi 1Ga
163	Yek Bahadur Ale	493,494,613	Gunadi 1Kha
164	Yem Bahadur Thapa Magar,2	26,24,25	Gunadi 1Ga
165	Yem Kumari Chand	689	Gunadi 1Ga
166	Yem, Disu bahadur Magar	1000	Gunadi 1Kha
167	Unidentified Owner	65	Gunadi 1Ga
168	Unidentified Owner	66	Gunadi 1Ga
169	Unidentified Owner	69	Gunadi 1Ga
170	Unidentified Owner	70	Gunadi 1Ga
171	Unidentified Owner	147	Gunadi 1Ga
172	Unidentified Owner	198	Gunadi 1Ga



SN	Owners Name and Address	Plot Nos.	VDC, Cadestral
173	Unidentified Owner	222	Gunadi 1Ga
174	Unidentified Owner	239	Gunadi 1Ga
175	Unidentified Owner	240	Gunadi 1Ga
176	Unidentified Owner	241	Gunadi 1Ga
177	Unidentified Owner	354	Gunadi 1Ga
178	Unidentified Owner	354	Gunadi 1Ga
179	Unidentified Owner	365	Gunadi 1Ga
180	Unidentified Owner	366	Gunadi 1Ga
181	Unidentified Owner	Na	Gunadi 1Ga
182	Unidentified Owner	Na	Gunadi 1Ga
183	Unidentified Owner	Na	Gunadi 1Ga
184	Unidentified Owner	Na	Gunadi 1Ga
185	Unidentified Owner	Na	Gunadi 1Ga
186	Unidentified Owner	Na	Gunadi 1Ga
187	Unidentified Owner	Na	Gunadi 1Ga
188	Unidentified Owner	Na	Gunadi 1Ga
189	Unidentified Owner	Na	Gunadi 1Ga
190	Unidentified Owner	Na	Gunadi 1Ga
191	Unidentified Owner	Na	Gunadi 1Ga
192	Unidentified Owner	83	Gunadi 1Kha
193	Unidentified Owner	83	Gunadi 1Kha
194	Unidentified Owner	84	Gunadi 1Kha
195	Unidentified Owner	85	Gunadi 1Kha
196	Unidentified Owner	177	Gunadi 1Kha
197	Unidentified Owner	229	Gunadi 1Kha
198	Unidentified Owner	255	Gunadi 1Kha
199	Unidentified Owner	295	Gunadi 1Kha
200	Unidentified Owner	296	Gunadi 1Kha
201	Unidentified Owner	311	Gunadi 1Kha
202	Unidentified Owner	312	Gunadi 1Kha
203	Unidentified Owner	315	Gunadi 1Kha
204	Unidentified Owner	316	Gunadi 1Kha
205	Unidentified Owner	468	Gunadi 1Kha
206	Unidentified Owner	485	Gunadi 1Kha
207	Unidentified Owner	487	Gunadi 1Kha
208	Unidentified Owner	526	Gunadi 1Kha
209	Unidentified Owner	873	Gunadi 1Kha
210	Unidentified Owner	988	Gunadi 1Kha
211	Unidentified Owner	1162	Gunadi 1Kha
212	Unidentified Owner	1174	Gunadi 1Kha
213	Unidentified Owner	1175	Gunadi 1Kha
214	Unidentified Owner	Na	Gunadi 1Kha
215	Unidentified Owner	Na	Gunadi 1Kha
216	Unidentified Owner	Na	Gunadi 1Kha

SN	Owners Name and Address	Plot Nos.	VDC, Cadestral
36	Chola Man	1077, 510,508,504	Kahun Shivapur 1Gha
37	Dal Bahadur	1079	Kahun Shivapur 1Gha
38	Dal Kumari Thapa	631	Kahun Shivapur 1Gha
39	Dama Maya Thapa	1013	Kahun Shivapur 1Gha
40	Daman Singh Thapa	798	Kahun Shivapur 1Gha
41	Damanti Bhandari	461	Kahun Shivapur 1Gha
42	Dan Bahadur Bote	232	Kahun Shivapur 1Gha
43	Danu maya	753	Kahun Shivapur 1Gha
44	Deepak Kumar	919	Kahun Shivapur 1Gha
45	Dev Bahadur Thapa	699	Kahun Shivapur 1Gha
46	Devbra B.K	694	Kahun Shivapur 1Gha
47	Devi Maya	129	Kahun Shivapur 1Gha
48	Dhan Bahadur Ale	456,810,978,625, 809,	Kahun Shivapur 1Gha
49	Dhan Bahadur Bote	204	Kahun Shivapur 1Gha
50	Dhan Bahadur Thapa	567,584	Kahun Shivapur 1Gha
51	Dhan Maya Gurung	993,917	Kahun Shivapur 1Gha
52	Dhanu paudel	666	Kahun Shivapur 1Gha
53	Dharma Raj Kami	853	Kahun Shivapur 1Gha
54	Dhruba Dev	772	Kahun Shivapur 1Gha
55	Dhut Bahadur Thapa	866	Kahun Shivapur 1Gha
56	Dil	646,641	Kahun Shivapur 1Gha
57	Dil Bahadur Bote	130,167,348	Kahun Shivapur 1Gha
58	Dil Bahadur Thapa	878,876	Kahun Shivapur 1Gha
59	Dil Kumari	918(Gunadi 1Kha),769	Kahun Shivapur 1Gha
60	Dil Maya	980	Kahun Shivapur 1Gha
61	Dil Maya Bote	1081	Kahun Shivapur 1Gha
62	Dilu Shrestha	387,386	Kahun Shivapur 1Gha
63	Durga Bahadur	814,811,807	Kahun Shivapur 1Gha
64	Durga Bahadur Ale	709,703,661	Kahun Shivapur 1Gha
65	Durga bahadur Gurung	980,936	Kahun Shivapur 1Gha
66	Durga Bahadur Thapa	755	Kahun Shivapur 1Gha
67	Durga Narayan	693,649	Kahun Shivapur 1Gha
68	Ganga Ma Bi	572	Kahun Shivapur 1Gha
69	Ganga Ma Bi. (Shahid)	572,570,564,574, 576,	Kahun Shivapur 1Gha
70	Gangadhar Thapa	145	Kahun Shivapur 1Gha
71	Gopal Prasad	424	Kahun Shivapur 1Gha
72	Govinda Bista	221	Kahun Shivapur 1Gha
73	Hari Bahadur Saru Magar,1	4,21	Kahun Shivapur 1Gha
74	Hari kala	120	Kahun Shivapur 1Gha
75	Hari Singh Thapa	506,416	Kahun Shivapur 1Gha
76	Harighna Giri	642	Kahun Shivapur 1Gha
77	Harka Bahadur Bote,1	21,19	Kahun Shivapur 1Gha
78	Harka Thapa	747	Kahun Shivapur 1Gha
79	Hasta Bahadur Wache Magar,1	53,19	Kahun Shivapur 1Gha

SN	Owners Name and Address	Plot Nos.	VDC, Cadestral
80	Hasta Bahadur Whache	806,808,812,815, 992,	Kahun Shivapur 1 Gha
81	Hem bahadur Thapa	988	Kahun Shivapur 1 Gha
82	Hir Bahadur	96	Kahun Shivapur 1 Gha
83	Hira Man Bote	133,352,226	Kahun Shivapur 1 Gha
84	Indra Bahadur Ale	258,459,463,256, 715,	Kahun Shivapur 1 Gha
85	Indra Maya Thapa	1075	Kahun Shivapur 1 Gha
86	Indra Thapa	660,658	Kahun Shivapur 1 Gha
87	Ishwor Narayan	804	Kahun Shivapur 1 Gha
88	Jamuna Giri	882,658,657	Kahun Shivapur 1 Gha
89	Jamuna Thapa	632	Kahun Shivapur 1 Gha
90	Jau Maya	914	Kahun Shivapur 1 Gha
91	Jun Narayan	805,530,521,520	Kahun Shivapur 1 Gha
92	Junraj Shrestha,2	183	Kahun Shivapur 1 Gha
93	Kabir Thapa	779	Kahun Shivapur 1 Gha
94	Kalpana Devi	738	Kahun Shivapur 1 Gha
95	Kankaje Ma. Bi.	506	Kahun Shivapur 1 Gha
96	Karmasingsh Mathim Magar,1	105	Kahun Shivapur 1 Gha
97	Karna Bahadur Ale	644	Kahun Shivapur 1 Gha
98	Karna Bahadur Magar	341	Kahun Shivapur 1 Gha
99	Kesh Bahadur	351	Kahun Shivapur 1 Gha
100	Kesh Bahadur Thapa	634	Kahun Shivapur 1 Gha
101	Keshar Bahadur Thapa	505, 1051, 509, 929,700	Kahun Shivapur 1 Gha
102	Keshar Maya	1048	Kahun Shivapur 1 Gha
103	Keshari B.K	1065	Kahun Shivapur 1 Gha
104	Keshari Devi, Mitthu B.K	1066	Kahun Shivapur 1 Gha
105	Keshu Raj Thapa	697	Kahun Shivapur 1 Gha
106	Khadga Bahadur	1028	Kahun Shivapur 1 Gha
107	Khadka Bahadur Ale	633	Kahun Shivapur 1 Gha
108	Khadka Bahadur Thapa	611	Kahun Shivapur 1 Gha
109	Khagisera	107	Kahun Shivapur 1 Gha
110	Khem bahadur Ale	941,617	Kahun Shivapur 1 Gha
111	Khem Bahadur Rana	652,654,639	Kahun Shivapur 1 Gha
112	Kiman Singh Ale Magar,1	189	Kahun Shivapur 1 Gha
113	Krishna Bahadur Ale	742,458,457,264, 461,	Kahun Shivapur 1 Gha
114	Kul Bahadur Bote	381,436	Kahun Shivapur 1 Gha
115	Kuman Bahadur	208	Kahun Shivapur 1 Gha
116	Lal Bahadur	350,141	Kahun Shivapur 1 Gha
117	Lal Bahadur Garga Magar,1	260,575,66	Kahun Shivapur 1 Gha
118	Lal Bahadur Garga Magar,2	204,135	Kahun Shivapur 1 Gha
119	Lalmati Giri	411	Kahun Shivapur 1 Gha
120	Lalu Ale	353,348,350	Kahun Shivapur 1 Gha
121	Lekh Narayan	423	Kahun Shivapur 1 Gha
122	Ludhre Singh Thapa Magar,1	663,106	Kahun Shivapur 1 Gha
123	Madhu and Ishwor Thapa	622	Kahun Shivapur 1 Gha

SN	Owners Name and Address	Plot Nos.	VDC, Cadestral
124	Madhu Maya B.K	698	Kahun Shivapur 1Gha
125	Madhu maya Bote	190	Kahun Shivapur 1Gha
126	Madhu Singh pulami	618,616	Kahun Shivapur 1Gha
127	Mahadev	1049	Kahun Shivapur 1Gha
128	Mahendra Kumar Shrestha,9	195	Kahun Shivapur 1Gha
129	Mamata Ale	757,718	Kahun Shivapur 1Gha
130	Man Bahadur	1,058,473	Kahun Shivapur 1Gha
131	Man Bahadur Ale	344,372,106,104,203	Kahun Shivapur 1Gha
132	Man Devi Dhrestha	736,751	Kahun Shivapur 1Gha
133	Man Kaji	463	Kahun Shivapur 1Gha
134	Man Kumari	110	Kahun Shivapur 1Gha
135	Manda Bahadur Thapa	608	Kahun Shivapur 1Gha
136	Mangale Bote	507	Kahun Shivapur 1Gha
137	Masingh Gurung	773	Kahun Shivapur 1Gha
138	Maya Ale	685,683	Kahun Shivapur 1Gha
139	Maya Devi Soti	735,750	Kahun Shivapur 1Gha
140	Maya Kumari	745	Kahun Shivapur 1Gha
141	Megh Raj Kafle	753	Kahun Shivapur 1Gha
142	Meher	392	Kahun Shivapur 1Gha
143	Mekh bahadur	207	Kahun Shivapur 1Gha
144	Min bahdur Thapa	384(Gunadi 1Kha),903	Kahun Shivapur 1Gha
145	Minika Rana	655,653	Kahun Shivapur 1Gha
146	Mod Raj Khanal	716	Kahun Shivapur 1Gha
147	Mohan Singh Gurung	651,649,908	Kahun Shivapur 1Gha
148	Moi Sara Rana	776	Kahun Shivapur 1Gha
149	Moti Sara Magarni,1	42	Kahun Shivapur 1Gha
150	Moti Sara Thapa	935	Kahun Shivapur 1Gha
151	Namita Rana Thapa	696	Kahun Shivapur 1Gha
152	Nar Bahadur Ganga Magar,2	940,134,136,259, 577,	Kahun Shivapur 1Gha
153	Nar Bahadur Garga Magar,1	100,97,68,67,64,55	Kahun Shivapur 1Gha
154	Nar Bahadur Kami	778	Kahun Shivapur 1Gha
155	Nar Bahadur Magar	636	Kahun Shivapur 1Gha
156	Nar Bahadur Pulame,1	145	Kahun Shivapur 1Gha
157	Nar Singh Baral Magar,2	139	Kahun Shivapur 1Gha
158	Nara Bahadur Thapa,1	258	Kahun Shivapur 1Gha
159	Narayan	708	Kahun Shivapur 1Gha
160	Narayan Giri	716	Kahun Shivapur 1Gha
161	Narsingh Thapa Magar,1	129,126	Kahun Shivapur 1Gha
162	Netra	1159	Kahun Shivapur 1Gha
163	Netra Bahadur	580,749,754	Kahun Shivapur 1Gha
164	Netra Bahadur B.K	720,761	Kahun Shivapur 1Gha
165	Nrayan Singh Thapa	706	Kahun Shivapur 1Gha
166	Om bahadur	870	Kahun Shivapur 1Gha
167	Padam Bahadur	394,893,897,586	Kahun Shivapur 1Gha

SN	Owners Name and Address	Plot Nos.	VDC, Cadestral
168	Padam Bahadur	1077	Kahun Shivapur 1Gha
169	Padam Bahadur Ale	623	Kahun Shivapur 1Gha
170	Padam Bahadur Damai	1040	Kahun Shivapur 1Gha
171	Parashuram	356	Kahun Shivapur 1Gha
172	Parbati Khanal	517,519,692	Kahun Shivapur 1Gha
173	Parbati Malla	727	Kahun Shivapur 1Gha
174	Pasam Bahadur	407	Kahun Shivapur 1Gha
175	Pashuram Ale	418	Kahun Shivapur 1Gha
176	Prem Bahadur Thapa	1,078,578	Kahun Shivapur 1Gha
177	Prem Kumar Sarki	704	Kahun Shivapur 1Gha
178	Puransingh Thapa Magar	110	Kahun Shivapur 1Gha
179	Purni Maya Thapa	734	Kahun Shivapur 1Gha
180	Rabilal Thapa	670,668	Kahun Shivapur 1Gha
181	Rajendra	542	Kahun Shivapur 1Gha
182	Ram B.K	1005	Kahun Shivapur 1Gha
183	Ram bahadur	1061,446(1Kha)97,93	Kahun Shivapur 1Gha
184	Ram Bahadur Thapa	583,626	Kahun Shivapur 1Gha
185	Ram Chandra	656	Kahun Shivapur 1Gha
186	Raman Singh Pulami	393,702,700	Kahun Shivapur 1Gha
187	Rameshwr Ale	967	Kahun Shivapur 1Gha
188	Ramji Dorga	834	Kahun Shivapur 1Gha
189	Ranabhat Sewa Samati	812	Kahun Shivapur 1Gha
190	Ranjeet Giri	191,142,139,119	Kahun Shivapur 1Gha
191	Rasha Singh	1032	Kahun Shivapur 1Gha
192	Ratna Bahadur	330,322	Kahun Shivapur 1Gha
193	Rishi Bahadur Rabat	525	Kahun Shivapur 1Gha
194	Ruwale Bote	502,853(1Kha),87,163	Kahun Shivapur 1Gha
195	Sabina Bhattarai	657	Kahun Shivapur 1Gha
196	Sabitri Joshi	357	Kahun Shivapur 1Gha
197	Sahadev	1053	Kahun Shivapur 1Gha
198	Santa Maya	406	Kahun Shivapur 1Gha
199	Sanu Maya	597,589	Kahun Shivapur 1Gha
200	Sarbajit Thapa Magar,1	123,104	Kahun Shivapur 1Gha
201	Shanta Giri	233	Kahun Shivapur 1Gha
202	Sher Bahadur Thapa Magar,1	565,92	Kahun Shivapur 1Gha
203	Shiribini	635	Kahun Shivapur 1Gha
204	Shiva Bahadur	751	Kahun Shivapur 1Gha
205	Shiva Prasad Wagle	615	Kahun Shivapur 1Gha
206	Shom Bahadur	124	Kahun Shivapur 1Gha
207	Shom, Bhom Thapa	667	Kahun Shivapur 1Gha
208	Shree Bahadur Ale	758,756	Kahun Shivapur 1Gha
209	Shyam Bahadur Thapa	997	Kahun Shivapur 1Gha
210	Shyam Nirmala	1073	Kahun Shivapur 1Gha
211	Shyanu Maua Ranabhat	1009	Kahun Shivapur 1Gha

SN	Owners Name and Address	Plot Nos.	VDC, Cadestral
212	Som Bahadur	639,490	Kahun Shivapur 1Gha
213	Suk Bahadur Bote	173	Kahun Shivapur 1Gha
214	Suku Bahadur Dargi	382,366	Kahun Shivapur 1Gha
215	Sundari	777	Kahun Shivapur 1Gha
216	Tal Bahadur Thapa Magar	385,907	Kahun Shivapur 1Gha
217	Tara Debi Ale	713	Kahun Shivapur 1Gha
218	Tara Debi Thapa	711	Kahun Shivapur 1Gha
219	Taran Bahadur Ale	906	Kahun Shivapur 1Gha
220	Tek Bahadur	664,674,662	Kahun Shivapur 1Gha
221	Tek Bahadur	480,472(1Kha),209,103,	Kahun Shivapur 1Gha
222	Tek bahadur Ale	684,686	Kahun Shivapur 1Gha
223	Tek Bahadur Garga magar	579	Kahun Shivapur 1Gha
224	Tek Bahadur Sarki	695	Kahun Shivapur 1Gha
225	Tek Kagi Thapa	979	Kahun Shivapur 1Gha
226	Tham bahadur	416	Kahun Shivapur 1Gha
227	Thaman Singh Thapa	721	Kahun Shivapur 1Gha
228	Tika Maya	355	Kahun Shivapur 1Gha
229	Tika Ram	775	Kahun Shivapur 1Gha
230	Tikaram	724	Kahun Shivapur 1Gha
231	Tila Kumari	705	Kahun Shivapur 1Gha
232	Tul Bahadur Ale	766	Kahun Shivapur 1Gha
233	Udaya Raj Adhikari	589	Kahun Shivapur 1Gha
234	Urmila Chaudhari	903	Kahun Shivapur 1Gha
235	Usaya raj Adhikari	620	Kahun Shivapur 1Gha
236	Yaman Kanta Giri	140	Kahun Shivapur 1Gha
237	Yashu Maya	380	Kahun Shivapur 1Gha
238	Yem Bahadur Ale	943,944,985,691, 640	Kahun Shivapur 1Gha
239	Yuba Raj Bote	375,376,185	Kahun Shivapur 1Gha
240	Unidentified Owner	251	Kahun Shivapur 1Gha

Na = Not available